SCIENTIFIC WRITING

www.garyburkhart.fr

Important Questions To Plan a Paper

1. What message do I want to convey?
2. What is the right format for my message?
3. What is the real audience for my message?

So what? "What effect will the message in this paper have on concepts or practices?" Will it lead to widespread changes in the way we view the world?

Who cares? "Who will be the most interested in this information?" To whom will it be important? Will it be the specialists in a small field? Or most practitioners? Or the scientific world in general?

4. What is the right journal for my paper?

Steps in Revising First and Later Drafts

FIRST DRAFT

Is all of the text needed?
Is the content of each section appropriate to that section?
Is the sequence of paragraphs proper?
Should any paragraphs be divided?
Are headings and subheadings appropriate to their sections and is their hierarchy clear?
Is the title informative, specific and concise?
Does the abstract represent all elements of the article, within the length allowed by the journal?
Should any tables or figures be eliminated?
Is each table and figure cited in the text?
Are footnotes, table headings, and figure legends precise and concise? Are they redundant with the text?
Have you acknowledged assistance received up to this point?
Have you checked quotations and references against original sources?
Is each reference cited in the text?

Correct: Make necessary changes and have the manuscript retyped (second draft).

SECOND DRAFT

Review: Ask appropriate colleagues to read this draft and criticize its content and style.

Rewrite: Consider criticisms of colleagues and rewrite sections as necessary. Add to acknowledgments, as appropriate, names of colleagues who made substantive criticisms.

THIRD DRAFT

Review: Is the text clear and concise?

Correct: Make corrections in prose style. Prepare additional drafts to refine further the content and style.

FINAL DRAFT

WRITING A GOOD JOURNAL ARTICLE

Step 1: Ask yourself whether the time is right

Step 2: Clarify your conclusions by preparing tables and figures complete with title and Footnotes

Step 3: Decide who will be co-authors

Step 4: Consider the ethics of scientific publication

Step 5: Relate your conclusions to the existing body of knowledge

Step 6: Write a working title and abstract

Step 7: Choose the target journal and make notes on its Instructions to Authors

Step 8: Name the main sections

Step 9: Fill section files with relevant brief notes in any order to form "ragbags"

Step 10: Arrange the contents of the ragbags logically

Step 11: Finalize the design and content of tables and figures

Step 12: Make a topic outline and consider writing a sentence outline

Step 13: Write the first draft continuously, collecting references as you go

Step 14: See if the first draft needs major alterations

Step 15: Have the illustrations prepared in final form for the target journal

Step 16: Polish the prose

Step 17: Rewrite the title, and structure the abstract

Step 18: Request private review by three independent critics and your co-authors

Step 19: Re-read the Instructions to Authors and make any necessary adjustments

Step 20: Revise as many times as necessary

Step 21: Submit the article to the journal

Step 22: Analyse the editor's decision and respond appropriately

Submitting the Manuscript

Before submitting a manuscript to a journal for review, check each item in the following list to make certain that the manuscript is complete.

1) Text pages of final draft are numbered consecutively, beginning with the title page.
2) Figures and tables, in separate series, are numbered consecutively according to order of citation in the text, and each text citation is to the appropriate figure or table.
3) Marginal notes are added to indicate the point where each table or figure is first cited in the text.
4) The figure number and the author's name(s) are written lightly in pencil on the reverse side of each figure.
5) There is one suitable copy of each figure for each copy of the manuscript.
6) Each reference cited in the text, tables and legends is also listed in the bibliographic section.
7) All references listed in the bibliographic section are cited at least once in the text, tables or legends.
8) Accuracy of all references in the bibliographic section, as retyped in the final draft, is confirmed by comparison with the *original* article or book or with a previous draft that has been carefully checked against the *original* source.
9) Each footnote symbol or number in text or tables has a corresponding footnote.
10) The final draft has been carefully read at least twice, once against the pages from which it was typed.
11) Letters granting permission to publish material borrowed from other sources and permissions from persons to use their photographs are ready to be sent with the manuscript.
12) The address to which letters and proof should be sent is on the title page of the manuscript.

Checklist for Journal Styles

- ❑ US or UK?
- ❑ Guidelines for authors?
- ❑ Member of CSE, ASM, ACS, APA?
- ❑ Scope
- ❑ Level of speculation
- ❑ Number of references
- ❑ Length of papers
- ❑ Various sections / subsections?
- ❑ Reference style: Smith (2008) reported, ou A increases B (12)?
- ❑ Units?
- ❑ Length of Title / Abstracts?
- ❑ Questions, results in Titles?
- ❑ Informative or descriptive subtitles and titles for Tables and Figures?
- ❑ Depersonalized Abstract?
- ❑ Tables, references in Abstract?
- ❑ Results, conclusions at the end of Introduction?
- ❑ Synopsis of Materials and Methods (if too long), with detailed appendix?
- ❑ Unpublished results; personal communication, gray literature?
- ❑ Position des limitations dans la Discussion
- ❑ Capitalization of title and headers of sections and subsections?
- ❑ Abbreviations in various sections?
- ❑ Typing and presentation format?

Good Practice for Reviewers

Read, evaluate, and return each manuscript to the editor promptly. Inform the editor if you cannot meet the deadline. Follow closely instructions from the editor on how to prepare your critique. Some journals provide special forms for manuscript evaluations.

Be careful in your reading; authors frequently complain that reviewers' critiques give evidence of careless reading. Be objective in evaluating a manuscript and in writing comments. Avoid acrimony. Test the critique for fairness and objectivity by asking yourself if you would be willing to sign it and send it to the author.

Do not consider prevailing opinion infallible; you could reject an important manuscript because its conclusions are not in accord with current scientific orthodoxies. On the other hand, do not be misled by persuasive writing when an article lacks adequate data and proper statistical controls.

Consider not only an article's scientific merit, but also in its suitability for readers of the journal and the quality of presentation. The editor may ask, however, that comments on suitability be kept separate from those intended for the author.

Be specific in your suggestions. The author of an excessively long manuscript will not be helped by a comment such as « This manuscript is too long. Condense it to half. » Give specific directions for eliminating unimportant parts or for condensing the others. Indicate errors in grammar or rhetoric. Call attention to verbose or unclear writing.

The contents of a manuscript are the property of the author. Treat the manuscript as a confidential communication. Do not discuss it with anyone except the editor unless you have been given the option of seeking opinions from your colleagues. Do not make photostatic copies of the manuscript.

Do not make corrections and comments directly on the manuscript pages unless instructed to do so by the editor. The editor will stipulate the number of copies of your critique that will be needed and whether you should sign them. If the critique is not to be signed, be sure that it is identified as yours in an accompanying letter. Keep a copy of the critique for later reference or to replace copies lost in the mail.

Checklist for Reviewers

1) Is the purpose of the article made clear in the introduction?
2) Is the objective of the experiment or of the observations important for the field?
3) Are the experimental methods described adequately?
4) Are the study design and methods appropriate for the purposes of the study? Have the procedures been presented in enough detail to enable a reader to duplicate them?
5) Do you find errors of fact or interpretation? Scan and spot-check calculations. Are the statistical methods appropriate?
6) Is all of the discussion relevant?
7) Has the author cited the pertinent, and only the pertinent literature? If the author has omitted important references, cite them; if he or she has included inconsequential or not pertinent references, suggest deleting them.
8) Have any ideas been overemphasized or underemphasized? Suggest specific revisions.
9) Should some sections of the manuscript be expanded, condensed, or omitted?
10) Do you find any content repeated or duplicated? A common fault is repetition in the text of data in tables or figures. Suggest that tabular data be interpreted or summarized, not merely repeated, in the text.
11) Are the author's statements clear? Challenge ambiguous statements. Suggest by examples how clarity can be achieved, but do not merely substitute your style for the author's.
12) Is the title of the article appropriate and clear?
13) Is the abstract specific, representative of the article, and in the correct form?
14) Have key words been provided by the author? If so, do they represent the paper adequately?
15) Are the form and arrangement of illustrations and tables satisfactory? Call attention to graphs and tables that are hard to read because they are crowded with too much information or to those that could save space if they were combined with other illustrations.
16) Can the illustrations be improved? Note whether letters, numerals, or symbols may be illegible if they are reduced and whether photographs have superfluous areas that might be cropped. Are there captions or symbols that may be better included in the legend? Do illustrations show what they purport to show?
17) Should all parts of the manuscript be published? Extensive supplementary tables or long reference lists may merit publication but are costly to print and interest only a few readers. You may suggest to the editor that material of this kind be deposited with the National Auxiliary Publications Service or other repository.
18) Has material in the manuscript been published previously? If you know that any of the material in the manuscript has already been published, inform the editor of the fact and give details.
19) What are your recommendations to the editor on revision and publication of the article? Of course, it can be assumed that, if asked by the editor, you will be willing to review the revised manuscript. What priority for publication do you suggest?
20) Is the manuscript more suitable for some other journal? If you believe it is, explain the reasons and suggest to the editor, but not to the author, a more suitable journal.

RULES OF SCIENTIFIC WRITING

Rule 1: Be Simple and Concise

This phenomenon is associated, in a causative or accompanying way, with…
(This phenomenon causes or accompanies)

At the termination of the experiment…
(At the end of the experiment)

… has the capability of…
(can, is able to)

… at a high speed level…
(quickly, rapidly)

This result would seem to indicate the possible presence of…
(This result indicates that… may be present.)

Effectiveness of the oral inoculum in producing caries varies widely with the strain of rat; in some cases, rats may become highly caries active, whereas in other strains, the oral inoculum has much less adverse influence.
(delete everything after the semicolon)

X produced an inhibitory effect on the formation of Y.
(X inhibited the formation of Y.)

It was possible to obtain semipreparative (100 μg) quantities of substance X.
(About 100 μg of X could be made.)

X formed Y at least an order of magnitude faster when…
(X formed Y at least ten times faster when…)

Computations were conducted…
(Calculations were made; or, X was calculated)

… in a state of protrusion…
(protruding)

… subsequent to their entry into the cell…
(after they have entered the cell)

… occupies a juxta-nuclear position…
(is next to the nucleus)

Solvents were pre-cooled at 0 °C prior to use.
(What does "pre-cooled" have over "cooled", or "prior to" over "before"?)

One lot contained particles greater than 74 μ, and this material was shaken on a sieve prior to use to remove particles in excess of this size.
(One lot contained particles *larger* than 74 μ; these were removed by sieving.)

Figs. 1-3 are photographs of thin-layer chromatograms developed in the solvent system described and are typical of the separation achieved with this chromatographic method.
(Figs. 1-3 show typical chromatograms.)

Rule 2: Make Sure of the Meaning of Every Word

Ferric chloride was *deleted* from the color reagent.

(Simple malapropism of *"deleted"* for *"eliminated"* or *"omitted".)*

Glyceryl ethers of varying degrees of *unsaturation*…

(The continuous *"varying"* is inappropriately used instead of *"various"*.)

A method is described for use on unfractionated human plasma that is *superior to* that now in use.

(Is the plasma *superior to* that now in use?)

The composition of the lymph of the fasted rat is also *unlike depot fat*.

(Is the composition *unlike fat*? This is a very common type of fault, eliminated by inserting *"that of"* before *"depot fat"*.)

The addition of hexokinase decreased palmitate oxidation *and was therefore not included* in the incubation medium.

(The addition was not included ?)

The optimal conditions for transesterification *approximate* those for phospholipase activity.

(Not *"approximate"*, which means *"approach"*, but *"are about the same as"*.)

The two major components *analyzed* very close to *that* expected for the mono- and diacetate *structures*.

(1- Did the components analyze, OR were they analyzed?
2- What is antecedent of *"that"*?
3- What is the use of the word *"structures"*?)

The problem of diffusion constants of almost insoluble substances…

(Are the diffusion constants a problem?)

Due to the low resistance of the plate, a 100-ohm resistance was placed in series with it.

(*"Due to"* is often advantageously replaced by *"because of"*. Try inverting the sentence: it makes sense with *"because of"* but not with *"due to"*.)

Following the incubation, the remaining fluid was poured off and the slices washed.

(1- Was the fluid *following* the incubation? Use *"after"*.
2- The auxiliary verb *"were"* is omitted.)

The tubes were shaken, *followed by* centrifugation, and the upper phase withdrawn.

(Were the tubes *followed by* centrifugation? *Were* the upper phase withdrawn?)

Fasting blood was drawn.

(Can blood *fast*?)

In view of the *colored nature* of retinol…

(What is a *colored nature*? Can it come into *view*, as a color can?)

Based on electrophoretic patterns, hyperlipoproteinemias have been classified.

(Were hyperlipoproteinemias *based on* electrophoretic patterns?)

Other investigators have reported large populations of lactobacilli in fecal contents. Reference 7 presents a recent review dealing with *this problem.*

(Are large populations - at least in this context - a problem?)

In the steady state, the daily fecal excretion of neutral plus acidic steroids of endogenous origin *should approximate* the daily synthesis of cholesterol.

(…*should approximately equal*…)

Contrast this correct usage:

When radioactive cholesterol is given to patients with every meal, the specific activity of biliary bile acids approximates that of plasma cholesterol after some days.

"Warning Words"

These are to be regarded not as invariably undesirable words, but as warning signals that something may be amiss, or susceptible of improvement. One soon gets into the habit of noticing them at a glance, on any page.

Colorless verbs (usually to be eliminated; they often occur as the past participle, as shown)

accomplished	experienced	obtained
achieved	facilitated	occurred
attained	given	performed
carried out	implemented	proceeded
conducted	indicated	produced
done	involved	required
effected	made	

Woolly words (sometimes these have a precise meaning; more often, they are an indication that the thought has to be sharpened)

area	problem
character	process
conditions	situation
field	structure
level	system
nature	

Dangling words All words that end in "ing" or "ed"

Danger words
- this (obscure antecedent)
- it (obscure antecedent)
- their, its, and all
- other pronouns

Vague qualifiers (can usually be omitted, since they add nothing)

fairly quite rather several very much

Words incorrectly used as synonyms

amount	alternate	minimal	varying
concentration	alternative	negligible	various
content		slight	varied
level			different

Rule 3: Use Verbs Instead of Abstract Nouns

Protein determinations were performed as described above.
(Proteins were determined as described above.)

Hydriodic acid attack on unsaturated ethers proceeds at olefinic bonds.
(Hydriodic acid attack**s** unsaturated ethers at olefinic bonds.)

Conversion of acetates to iodides was effected.
(Acetates were converted to iodides.)

Primary and secondary particle separation was obtained by performing electrophoresis.
(Primary and secondary particles were separated by electrophoresis. "Performing" is both dangling and redundant.)

Injection of the protein was more difficult of achievement in older animals due to the frequency of occurrence of thrombosis.
(It was more difficult to inject the protein into older animals because thrombi often formed.)

Preferential release of monoenoic acids would also appear to be the case in man.
(Monoenoic acids seem to be preferentially released in man also.)

The separations were checked frequently to ensure that quantitative recovery of cholesteryl esters, uncontaminated by triglycerides, was being achieved in the second fraction.
(Frequent checks established that cholesteryl esters, uncontaminated by triglycerides, were recovered quantitatively in the second fraction.)

The paper lost its integrity.
(The paper disintegrated.)

There was predominantly protein formation…
(Mostly proteins were formed…)

Rule 4: Break up Noun Clusters and Stacked Modifiers

The monoamine oxidase inhibitor insensitive agent
(The agent that is insensitive to the inhibitor of monoamine oxidase)

Radioactive glycerol-labeled triglyceride metabolism
(Metabolism of triglycerides labeled with radioactive glycerol)

Anomalous stability constant order
(Anomalous order of stability constants)

… in order to obtain high purity, high yield aldehyde
(… in order to obtain aldehyde in high purity and high yield)

Highly purified heavy beef heart mitochondria protein
(Protein from the highly purified heavy fraction of bovine heart mitochondria)

Proteolipid protein-free lower phase lipids
(Lipids contained in the lower phase, free from proteolipid protein)

STYLE

Remember:

- Follow a grammatical subject as soon as possible with its verb.
- Place in the stress position the "new information" you want the reader to emphasize.
- Place the person or thing whose "story" a sentence is telling at the beginning of the sentence, in the topic position.
- Place appropriate "old information" (material already stated in the discourse) in the topic position for linkage backward and contextualization forward.
- Articulate the action of every clause or sentence in its verb.
- In general, provide context for your reader before asking that reader to consider anything new.
- In general, try to ensure that the relative emphases of the substance coincide with the relative expectations for emphasis raised by the structure.

EXERCICES

1. Enable, allow, make, etc + Infinitive

Note: Enable really means to *make possible*, but it is often used in the same sense as *allow* and *permit*. *Let* is spoken, but not often written in this sense. With *let* and *make*, the word 'to' is not used before the infinitive.

---

1. The microscope	} enables {	scientists	} to { examine very small objects.
2. A thermometer		the doctor	measure body temperature.
3. Helicopters	} enable {	passengers }	to { land in the city center.
4. Good production methods		the factory	manufacture more cars.
5. Expansion joints		the pipes	expand or contract.
6. Safety valves	} permit {	the steam }	to { escape from the boiler.
7. We	allow	the metal	cool slowly.
8. The heat	} caused {	the metal }	to { melt.
9. Weakness in the metal		it	fracture under tension.
10. The heat	} made {	the metal melt.	
11. Weakness in the metal		it fracture under tension.	

EXERCISE

Complete these statements using the verbs shown above:

1. The rise in temperature ..... the mercury ..... rise up to the tube.
2. The motorway ..... motorists ..... travel from London to Birmingham much more quickly than before.
3. Tractors ..... more food ..... be produced more cheaply.
4. The presence of oxygen ..... the mixture ..... burn rapidly.
5. The failure of both engines ..... the aircraft ..... crash.
6. The increase in exports ..... the country ..... import more raw materials.
7. The risk of an explosion ..... the workers ..... leave the factory.
8. The speed of the train ..... it ..... leave the rails on the curve.
9. The fluidity of cast-iron ..... it ..... be cast into intricate shapes.
10. Pressure gauge ..... the engineer ..... read the boiler pressure.
11. The sharp rise in temperature ..... the engine ..... overheat.
12. The presence of non-metallic constituents in iron ..... it ..... behave in various ways.
13. The growth of industrial towns ..... many people ..... leave the countryside.
14. The differential gear ..... the two rear wheels ..... turn at different speeds.

2. Comparative

Here are some of the most useful patterns for comparing two things.

Steel	is	stronger much / far stronger slightly stronger more expensive much more expensive a much more expensive material a much more expensive material to produce a material that is much more expensive to produce	than	cast-iron
Cast-iron	is	weaker less expensive far/much less expensive a much less expensive material a much less expensive material to produce a material that is less expensive to produce	than	steel
Cast-iron	is	not as/so expensive not such an expensive material not such an expensive material to produce a material that is not as expensive to produce	as	steel
Cast-iron	is	as useful almost as useful almost as useful a material a material that is almost as useful	as	steel

EXERCICE

Join the two statements in each line, by comparing one with the other. Turn the comparison round both ways:

A is larger than B

e.g.

B is not as large as A, etc.

1. The carbon content of mild steel is 0.2%; the carbon content of cast steel is 1.2%.
2. Wrought-iron contains 0.02% of carbon; it contains 0.02% of manganese.
3. The British engine weighs 3 tons; the French engine weighs 3 ½ tons.
4. Cast-iron contains up to 3.0% of silicon; it contains up to 1.5% of phosphorus.
5. The temperature in this room is 28°C; the temperature outside the room is 22°C.
6. My radio works very well; my brother's radio works very badly.

3. Sequence

When steam enters the turbine, it has very high *initial* velocity.
When it leaves the turbine, it has a much lower *final* velocity.
As it passes through the turbine, its velocity is *progressively* reduced.

The rows of blades in the turbine are made *progressively* larger.
Each row is a little larger than the *previous* or *preceding* row.
From January to August, the weather gets *progressively* warmer.
Each month is slightly warmer than the *previous* or the *preceding* one.

The first steam engine was built during the nineteenth century.
During the *following* or *succeeding* hundred years, it became the main source of power.
The *initial* attempt to solve the problem ended in failure. So did the three *succeeding* attempts.
The *final* attempt succeeded.

Subsequent or *later* attempts to repeat the experiment failed.
The condensate is stored in a cooling tower, for *subsequent* use in the condenser.

In a turbine, the steam passes through a *series* or *succession* of wheels holding blades.
It passes through them one after the other. Each *successive* row reduces kinetic energy of the steam. The energy of the steam is *progressively* reduced as it passes through the *successive* rows.

Not every row of blades rotates. There is a rotating ring, *followed by* a stationary ring, and this is *succeeded by* another rotation ring.
Every second ring is a rotating ring.
Every other ring is a rotating ring.
Each alternate ring rotates.
The rotating rings *alternate with* the stationary rings.
Each *alternate* stroke on a two-stroke engine is a working stroke.
Only *one* stroke *in four* of a four-stroke engine is a working stroke.
The strokes occur in *a sequence.*

4. Ratio and proportion

---

1. *a.* There is one professor to every ten students. They are *in a ratio of* 1 *to* 10.
   b. There are 15 parts of air to every part of fuel. They are *in a ratio of* 15 *to* 1.
   c. The professor/student *ratio* is 1:10.
   d. The air/fuel *ratio* is 15:1.
   e. The *ratio of* the clearance volume *to* the swept volume in a cylinder differs in different types of engine.
   f. A compression *ratio* of about 4:1 can be obtained with a turbo-compressor.
   g. The efficiency of a cyclic process is the *ratio of* the work done *to* the heat received.

---

2. *a.* The *proportion* of students to professors is 10 to 1.
   b. The proportion of air to fuel in the combustion chamber is 15 to 1.
   c. The air and fuel are mixed *in a proportion of* 15 to 1.
   d. Manganese and magnesium are present *in equal proportions* in duralumin.

   e. The linear speed of rotation of a pulley is } *proportional to* { its diameter.
   f. The electromotive force induced in a circuit is } *proportional to* { the rate of change of flux.

   g. The volume of a mass of gas at constant pressure is directly } *proportional to* { its absolute temperature.
   h. The power of an engine is *directly* } *proportional to* { the area of cross-section of the cylinder.

   i. The insulation resistance of a cable is *inversely proportional to* its length.
   j. As the demand for power increases, the supply is *proportionately* increased.

   k. The machine is simple but much too heavy. It is } *disproportionately* { heavy.
   l. The new machine is slightly better but twice as expensive. It is } *disproportionately* { expensive.

---

3. *a.* This bridge will be very costly } *relative to* / *in relation to* / *for* / *with reference to* { its limited usefulness.
   b. The evaporative capacity is large } *relative to* / *in relation to* / *for* / *with reference to* { the size of the boiler.
   c. The machine is very heavy } *relative to* / *in relation to* / *for* / *with reference to* { its small size.

5. Variables

1. a. *T*he *higher* the velocity of steam, *the greater* (is) the turbine speed.
   b. *The further* the flame-front travels, *the greater* (is) the detonation risk.
   c. *The thinner* the layer of solder, *the higher* (must be) the soldering temperature.

2. a. the velocity of the steam increases, the turbine speed increases.
   b. *As* { the flame-front advances, } the risk of detonation increases.
   c. the temperature of a solid rises, the molecular agitation increases.

3. *a*. The specific heat of ice *decreases* } *with* { a reduction in temperature.
   the temperature.

   b. The magnetic field *increases* } *with* { an increase in current.
   the current.

   c. The saturation pressure of a vapor *varies* *with* the temperature.
   d. The number of blades in each wheel *varies* } *according to* { the size of the turbine.
   its composition.
   e. The melting point of brass *varies*

   f. Friction losses in the pipe *vary as* the square of the velocity of flow.

   g. During expansion the procedure *varies inversely as* the volume.

EXERCISE

Use the patterns of (1) and (2) to link these statements.

1. The population of the world goes up. The demand for food goes up.
2. The cost of living rises. Wages must rise.
3. Industrial towns attract more people. Few people are available for farming.
4. The steel is hard. It is difficult to work.
5. The rivets get cool. The plates are drawn tighter together.
6. The shaft rotates faster. More friction is developed.
7. Expansion proceeds. The intrinsic energy of the steam decreases.
8. The steam pressure falls in nozzles. Its velocity increases.
9. The fuel/air mixture is richer. The temperature in the engine is higher.
10. The turbine blades rotate faster. The stresses imposed on the steam increase.
11. The rate of evaporation is high. More steam will be generated.
12. The mass flow of air decreases. The compressor delivery pressure falls.

6. Exceptions

It is important not to confuse the following three items:

---

1. *a.* Everyone in the room comes from Egypt, } *except* (for) { the teacher. (=she does not)
   b. None of the planets are inhabited, } *except* (for) { the earth.
   c. All solids expand when they liquefy, } *except* (for) { ice and a few others

Except for / *With the exception of* { the teacher, everyone in the room comes from Egypt. / the earth, none of the planets are inhabited. / ice and few others, all solids expand when they liquefy.

---

2. *a.* An engine cannot run } *without* { fuel. (=in the absence of fuel).
   b. Toughened steel machines easily } *without* { tearing.
   c. The engine would quickly overheat } *without* { an efficient cooling system.
   d. Gases cannot be quickly compressed } *without* { generating heat.

---

3. *Apart from* / *Besides* / *In addition to* { the lecturer, there are twenty people here. (= not counting him). / coal, the most important natural fuels are gas and oil. / its lightness, aluminum has several other advantages. / the earth, how many planets revolve around the sun?

7. Patterns (to avoid?)

It	is was seems appears proves becomes	easy possible necessary essential advisable preferable useful instructive desirable advantageous practicable common usual	(difficult) (impossible) (unnecessary) (inadvisable) (useless) (undesirable) (disadvantageous) (impracticable) (uncommon) (unusual)	to	do something

It is	*likely* *possible*	that	eddy currents will be produced in the core of the magnet.
It is	*evident* *obvious* *clear*	that	these currents will generate heat in the core.
It is	*desirable* *essential*	that	these currents should be eliminated as far as possible.
It should be	*noted* *realized*	that	This energy cannot be destroyed, only changed into other forms
It will be	*noticed* *seen* *appreciated*		
It can be	*shown* *proved* *demonstrated*		
It is	*known*		
It is	*assumed*	that	the gas temperature in the cylinder is constant.
It has been	*decided* *arranged* *planned*	that	production should begin in a few months.

8. Similarities

This machine is	*exactly the same as* *identical with / to*		
	about the same as *exactly the same as* *similar to* *like*	the other one	in design
	exactly the same		
	about the same		
The two machines are	*alike* *identical* *similar* *the same*		in every respect. in most respects.
Sweden, *like* Finland, has very large *resources* of timber. Argon, *like* neon, is an inert gas.			
An a.c. motor does not need a commutator, *as* the d.c. motor does. Regenerative feed-water heating is used, *as* (it is) in ordinary steam power plants.			

9. Differences

This machine	*differs* *is different* --- *can be distinguished*	from	the other one	in --- by	its shape. several respects. the fact that it is more powerful. that it is more powerful. --- its shape.
It is useful to	*differentiate* *distinguish* *make a distinction*	*between*		a blower and a liquid pump.	
This engine,	*unlike* *as distinct from* *as opposed to*	the earlier one, has six cylinders.			
This engine has six cylinders		*as against* *as compared with* *as opposed to*		the four cylinders of the earlier one.	

Humor: A Guide to Effective Scientific Communication

Phrase	Translation
It has long been known	I haven't bothered to look up the reference
It is believed	I think
It is generally believed	A couple of other guys think so too
It is not unreasonable to assume	If you believe this, you'll believe anything
In my experience	Once
In case after case	Twice
In a series of cases	Three times.
According to statistical analysis	Rumour has it
Of great theoretical importance	I find it kind of interesting
Of great practical importance	I can get some mileage out of it
Typical results are shown	The best results are shown
Three samples were chosen for further study	The others didn't make sense, so we ignored them
The 4-hour sample was not studied	I dropped it on the floor
The 4-hour determination may not be significant	I dropped it on the floor, but I scooped most of it up
The significance of these results is unclear	Look at the pretty artifact
It has not been possible to provide definitive answers	The experiment was negative, but at least I can publish the data somewhere
Correct within an order of magnitude	Wrong
It might be argued that	I have such a good answer for this objection that I shall now raise it
Much additional work will be required	This paper is not very good, but neither are all the others in this miserable field
These investigations proved highly rewarding	My grant is going to be renewed
I thank X for assistance with the experiments and Y for useful discussions of the data	X did the experiment; Y explained it to me
A careful analysis of obtainable data…	Three pages of notes were obliterated when I knocked over a glass of beer
The most reliable results are those of Jones	He was my graduate assistant