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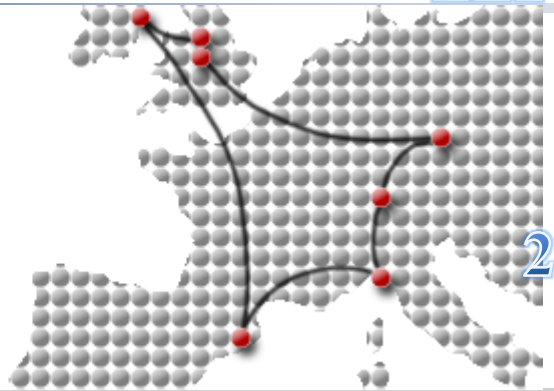

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An Introduction to Research Writing Skills

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Why is good scientific writing so important?

- The goal of writing is communication

  → If the intent of the writer is communicated, the writing was effective

A well written scientific research paper will:

- Present a coherent account of the research
- Convey the context and impact of the research
- Introduce new ideas and concepts in a way that is easy for the reader to understand
- Avoid ambiguities
- Avoid excess length and extraneous detail
- Provide sufficient detail for replication or expansion of the experiments

When writing an article you must consider who your audience is…

- Specialist academic journals
- Multidisciplinary academic journals
- Popular science literature
- Newspaper reports, research brochures, public documents

Can you explain your work to an intelligent individual with no knowledge of your research area?

How can you write coherently?

- Consider the order in which you introduce information to the reader

  → new ideas are easier to understand if the context is clear

- Identify information which is familiar to the reader (‘old’ information), and information which is new to the reader

  → put new information last

Consider the following example…

Farmers try to provide optimal growing conditions for crops by using soil additives to adjust soil pH.

Garden lime, or agricultural limestone, is made from pulverized chalk, and can be used to raise the pH of the soil.

Clay soil, which is naturally acidic, often requires addition of agricultural lime.

What are the new and old pieces of information here?

Consider the following example…

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Clay soil, which is naturally acidic, often requires addition of agricultural lime.

Blue – old information Red – new information

A possible revision could be…

Farmers try to provide optimal growing conditions for crops by using soil additives to adjust soil pH.

One way to raise the pH of the soil is an additive made from pulverized chalk called garden lime or agricultural limestone.

Agricultural limestone is often added to naturally acidic soils, such as clay soil.

Some brief notes on grammar:

1. Use of *passive* vs *active* voice

2. Correct use of tenses

Active and Passive Voice

A sentence is said to be in *active voice* when the subject of the sentence is the doer of the action indicated by the verb.

Example: "The dog chased the ball."

In *passive voice*, the subject is the receiver of the action indicated by the verb.

Example: "The ball was chased by the dog."

or simply *"The ball was chased."*

Why is this important in scientific writing?

Active and Passive Voice

Use the ***active voice*** when it is less wordy and more direct than the passive…

Passive voice:

"The fact that such processes are under strict stereoelectronic control is demonstrated by our work in this area."

(note how passive voice in this case puts new information first!)

Active voice:

"Our work in this area demonstrates that such processes are under strict stereoelectronic control."

Active and Passive Voice

Use the ***passive voice*** when the doer of the action is unknown or not important or when you would prefer not to specify the doer of the action.

Examples:

“The solution is shaken until the precipitate forms.”

“Melting points and boiling points have been approximated.”

Active and Passive Voice

- A consequence of ***passive voice*** is that the doer of the action can be omitted → common in scientific writing.

- It is okay to omit the doer of the action if it is self explanatory, understood, or unimportant.

- It is <u>not</u> okay to omit the doer of the action if there are multiple possibilities, leaving your reader to guess.

Example:

"The DNA was sequenced using the n-terminus method (Smith et al. 2004)."

Why is Smith et al cited here?

- they developed the n-terminus method?
- they did the sequencing?

Active and Passive Voice

- Scientific journals are not keen on overuse of the *passive voice*.

  "Nature journals like authors to write in the active voice..."

  -Nature, Instructions for Authors

  "Choose the active voice more often than you choose the passive..."

  -Science, Instructions for Authors

Correct use of tenses

- Using the appropriate verb tense helps to orient the reader as to the nature of the information.

Simple past tense is correct for stating what was done, either by others or by you.

Examples:

“The structures were determined by neutron diffraction methods.”

“Solutions were incubated for 10 hours.”

Correct use of tenses

- Using the appropriate verb tense helps to orient the reader as to the nature of the information.

Present tense is correct for statements of fact.

Examples:

"Hyperbranched compounds are macromolecular compounds that contain a branching point in each structural repeat unit."

"Absolute rate constants for a wide variety of reactions are available."

Correct use of tenses

- Using the appropriate verb tense helps to orient the reader as to the nature of the information.

Present and simple past tenses may both be correct for results, discussion, and conclusions.

Examples:

"The absence of substitution was confirmed by preparative-scale electrolysis."

"IR spectroscopy shows that nitrates are adsorbed and are not removed by washing with distilled water."

Clarity and Concision

Some general rules:

- Omit unnecessary words and phrases
- Use positive rather than double negative sentence constructions
- Avoid overcomplex sentence constructions
- Use adverbs and adjectives frugally

Omit unnecessary words and phrases

- Be brief → excess words obscure your message and annoy your readers.
- Avoid using empty phrases that do not add clarity

Examples:

As already stated
It has been found that
It has long been known that
It is interesting to note that
It is worth mentioning at this point
It may be said that
It was demonstrated that

Omit unnecessary words and phrases

- Consider using one simple word rather than a multi-word phrase that means the same thing

Instead of:	*Consider:*
the question as to whether	**whether**
there is no doubt but that	**doubtless**
used for fuel purposes	**used for fuel**
in a careful manner	**carefully**
this is a subject that	**this subject**
has the capacity to	**can**
whether or not	**whether**
are in agreement	**agree**

Omit unnecessary words and phrases

- Omit excess words.

Instead of:	*Consider:*
It is a procedure that is often used.	**This procedure is often used.**
This is a problem that is ….	**This problem is ….**
These results are preliminary in nature	**These results are preliminary.**

Omit unnecessary words and phrases

*An example of what **not** to do…*

"As discussed, the second reaction is really the end result of a very large number of reactions. It is also worth emphasizing that the reactions do not represent a closed system, as r appears to be produced out of thin air. In reality, it is created from other chemical species within the cell, but we have chosen here not to model at such a fine level of detail. One detail not included here that may be worth considering is the reversible nature of the binding of RNAP to the promoter region. It is also worth noting that these two reactions form a simple linear chain, whereby the product of the first reaction is the reactant for the second."

Omit unnecessary words and phrases

*An example of what **not** to do…*

"As discussed, the second reaction is really the end result of a very large number of reactions. It is also worth emphasizing that the reactions do not represent a closed system, as r appears to be produced out of thin air. In reality, it is created from other chemical species within the cell, but we have chosen here not to model at such a fine level of detail. One detail not included here that may be worth considering is the reversible nature of the binding of RNAP to the promoter region. It is also worth noting that these two reactions form a simple linear chain, whereby the product of the first reaction is the reactant for the second."

Ineffectual words highlighted

Use positive rather than double negative sentence constructions

Instead of	*consider using*
This reaction is not uncommon.	**This reaction is common.**
This transition was not unexpected.	**This transition was expected.** **We knew that such transitions were possible.**
This strategy is not infrequently used.	**This strategy is frequently used.** **This strategy is occasionally used.**
This result is not unlikely to occur.	**This result is likely to occur.** **This result is possible.**

Avoid overcomplex sentence constructions

- Don't try to accomplish too much in a single sentence
  → i.e. define a complex abstract entity (the subject), and then describe something that it does.

- It is usually more clear to split these tasks into multiple sentences
  → some to define the subject
  → others to describe what it does.

Example:
"The sequences that had passed our filtering, trimming, and alignment with ClustalX, were scanned for conserved elements across mammals."

Could be revised to:
"The sequences were trimmed, filered, and aligned with ClustalX. The resulting alignments were scanned for conserved elements across mammals."

Use adverbs and adjectives frugally

- One of the most over-used adverbs is “very”:

“The methods demonstrated here are very innovative”

“These conclusions are thus very important…”

- What about when “very” just isn’t enough?

→ there’s always “extremely”!

- Adjectives are particularly prone to the **repetition** problem → using two or more words where one suffices:

completely and utterly alone → completely alone → alone

new invention → invention

Summary

- Consider your audience
- Structure your sentences to improve coherence
- Pay attention to grammar – e.g. tenses, active and passive voice
- Take care with sentence construction
- **Be concise** – “Brevity is the soul of [scientific writing]”

How can you improve your research writing skills?

- Critically read as much scientific literature as possible

- When planning a paper consider:
  - What are the key points for your paper?
  - What is the narrative?
  - Can you summarise everything in a paragraph?

- Be ruthless when revising your work
  - cut unnecessary words and phrases

Further reading and useful resources

- Duke University: Graduate School Writing Resources https://cgi.duke.edu/web/sciwriting/index.php
- 'Writing a clear and engaging paper for all astronomers' , Leslie Sage, Astronomy Communication, 290 221 (2003)
- “The Science of Scientific Writing”, George D. Gopen and Judith A. Swan, American Scientist 78, 550-558 (1990)
- “What is the Scientific Literature?”, John Maddox, Nature 322, 681 (1986)
- ACS Style Guide: http://pubs.acs.org/isbn/9780841239999