Organizing Scientific Thought: The 5 Big Questions

1. What do you want to do?
2. Why do you want to do it?
3. How will you do it?
4. What did you find?
5. What does it mean?

These five basic points must be addressed in any scientific discussion. They pertain to research proposals, abstracts for meetings, poster presentations, seminars, journal clubs, manuscripts, qualifying exams, dissertations, and so on. If you cover these points, the audience will understand your work. If these points are mixed up or skipped, the audience will be confused and cranky. Memorize these points and make sure you cover them when you communicate your ideas.

What do you want to do?

Describe the major goal of the study. This can be stated as the Aim, Purpose, Goal, or Question. State the hypothesis here. This point can also be given second.

Why do you want to do it?

Explain the importance to health and science. Try to give the study relevance and a human dimension. Put your study in context -- where does the field currently stand? This point can also be given first.

How will you do it?

Mention the main experimental approach that you will take to address the major goals. State the technique but not the method. For example, "microarray analysis will be used to measure mRNA levels" is appropriate, whereas "mRNA from different samples will be labeled with fluorescent dyes" is too detailed.

What did you find?

This is the results section. Describe your findings and interpret the data. Be conservative here and save the speculations for the discussion section.

Alternatively, this may be the Research Design section of a proposal. Describe the parameters of the experiment, including all controls, and the expected results.

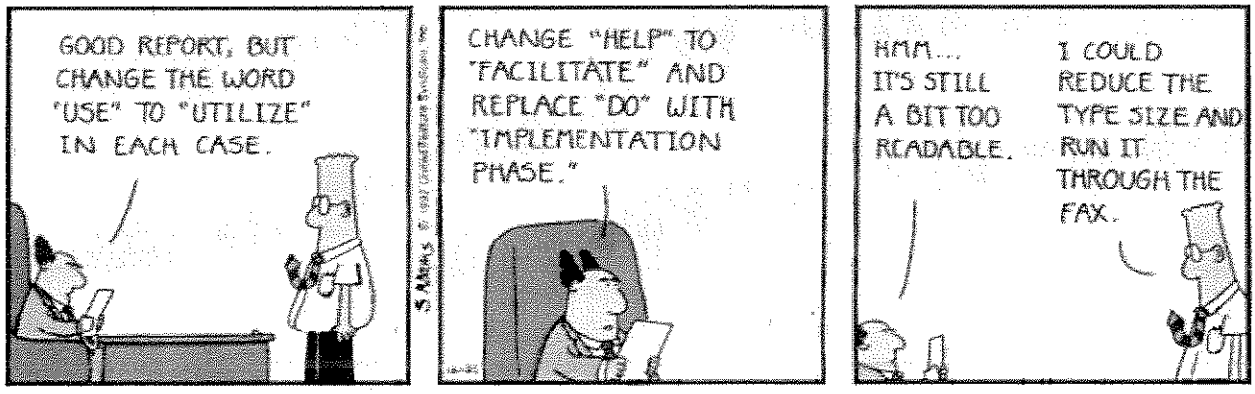
What does it mean?

This is the discussion section. Can also be called "Conclusions", but avoid this term since science is never really finished. Determine whether the results were successful in answering the main questions. State the significance of the findings and their impact on science or health. Explain why this study is important. It is OK to speculate here on possibilities. Propose new directions for research or the next major question to be studied.

Clean writing

Too many words can get in the way of your ideas. When ideas are complicated, it is best to write simple sentences. Clean writing is clear and graceful because it prioritizes the readers' need to understand. It also gives the reader the impression that you have mastered the subject. Look for these phrases in your writing and pare down to the essentials.

Too long = wordy	Concise = Better choice
Accounted for by the fact that	Because
An order of magnitude	10 times or 10-fold
As to whether	Whether
At this point in time	Now
Caused damage to	Damaged
Conducted inoculation experiments on	Inoculated
Decreased number of	Fewer, less
Definitely proved	Proved
Due to the fact that	Because
Has been shown to be	Is
Has the capability of	Can
In a considerable number of cases	Often
Indicative of	shows
In order to	To
In the present communication	Here
Is able to	Can
Large numbers of	Many
On a regular basis	Often
On the basis of	By or from
Similar in every detail	Same
Subsequent to	After
Utilize	Use
When and if	If
Whether or not	Whether
With regard to	about



Readability

Sentence length: Ideal is 15-20 words, 12 words is too short, 40 words is too long. However, varying sentence length can make prose more interesting. Strive for a mix of long and short sentences.

Paragraph length: Ideal is 150 words, 50 is too short. Each paragraph should include one idea.

Word order: Ideal is the expected subject-verb-object. SVO presents words in the order those events happen, which takes less effort to understand.

Multiple nouns and adjectives: 2-word combos are good, strings of 3 or more modifiers are confusing.

Hedging: using one qualifying phrase in a sentence is OK, but too many of them weaken your writing. Hedging words: probably, possibly, seemingly, appear, suggest, seem, and speculate.

Conciseness: Remove unnecessary words.

Tenses

Choosing the correct tense (past, present or future) is important for scientific writing because it reflects the status of the work being described. Knowing what tense to use for scientific writing is not commonly taught, and so many people make avoidable errors in their manuscripts.

Present tense: Use when a fact has been published. When results are published in a journal, they become established knowledge that is described in the present tense. This shows respect for the scientists who made the discovery, and they should be cited. Therefore, the Introduction of a research article and the Background section of a research proposal use the present tense to explain published work. Refer to tables and figures in the present tense because you are pointing the readers' attention to the data.

Past tense: Use for unpublished results. Describe the results of your own experiments in the past tense if they are not yet published. Therefore, the Methods and Results sections of a research article are written in the past tense to describe what you did.

Future tense: Use for proposed experiments. If you are writing a grant proposal, then use the future tense for the Research Design section.

Research Article
Abstract: present and past
Introduction: present
Methods: past for new methods, present for published methods
Results: past
Discussion: past for this study, present for others' work

Research Proposal
Abstract: present and future
Specific Aims: future
Background & Significance: present
Experimental Design: future

Presenting your rotation project worksheet

1. Describe the main research topic of the lab. Is there a disease or basic science subject that everyone in the lab works on? (Why do you want to do it?)

2. Describe the goal of your rotation project. How does it fit into the main research topic? (What do you want to do?)

3. What approach(es) did you use to address your goal? Did you use a particular method? Can you diagram the experiments or show a model? (How will you do it?)

4. Describe or show your most important results. Can you make high-quality figures from your data? (What did you find?)

5. Did you make progress toward your original goal? Did your results provide useful information to the lab? (What does it mean?)