Communication II: Report Writing

- Context

(Supplementary Materials)

- Writing Scientific Prose
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(Session Material)

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- Who is the report for?
- How can I structure my report and what information does it need to contain?
- How can I make the text clear and accessible to my audience?

Context

One of the most important things you need to learn as a scientist is how to convey your research and results to other people in a clear and understandable manner. In the sections below we have provided you with supplementary material covering the following topics:

- Writing Scientific Prose
- Referencing Sources
- Other general guidelines

However, there is much more to reporting writing than this and as such the discussions in this session will touch on this material and expand upon it to cover the entire report writing process.

Writing Scientific Prose

The aim of scientific writing isn't to merely put words around the data you have collected; it is about conveying this information in a clear and effective manner to the reader. Remember that the purpose is to accurately report the required information, not to impress the reader with elegant, flowery prose. The message is important, not the sheer number of words. Always strive to use the precise words or expressions in any given circumstance; avoid ambiguous, vague or needlessly complex sentences.

Even though you have received feedback on written assignments and deliverables throughout your academic career it is very easy to develop 'bad habits'. The aim of this session is to help you overcome some of these habits and to develop a clearer style of writing.

The modern scientific style is to write **concise, direct prose**.

- Keep it short.

Conveying meaning in fewer words is difficult and takes practice. Revise, revise, revise – eliminate inessential words, phrases and sentences.

- Use the active and passive voices where appropriate.

There is nothing inherently wrong with the passive voice, but if you can say the same thing in the active voice then you are encouraged to do so as this style is more engaging to the reader. The passive voice has its place, for example in the methods section of a scientific write-up, but it is not appropriate throughout.

Active versus passive voice

Active:

Sentences using an active voice tells the reader "who is doing what"; the grammatical subject of the sentence is the doer of the action.

When to use: In general the majority of your writing should be composed in the active voice, as it conveys a sense of immediacy that makes the reader feel more 'involved'. Sentences are often more concise when the subject of the sentence carries out the action.

Passive:

The passive voice tells the reader what is done to the subject of the sentence; the grammatical subject of the sentence is acted upon by some other agent or by something unnamed. The person or thing doing the action may or may not be mentioned but is always implied.

When to use: The passive voice is recommended in two/three situations:

1) When it is more important to draw the readers' attention to the person or thing acted upon than the person or thing carrying out the action.
   "The unidentified victim was apparently struck during the early morning hours."
2) When the actor in the situation is not important.
   "The aurora borealis can be observed in the early morning hours."
   This is especially true in scientific or technical writing or laboratory reports where the passive voice is preferred to indicate objective procedures. The individual performing the experiment is not important but the physical process or principle being described is. Instead of writing "I poured 20 cc of acid into the beaker" it is better to write "Twenty cc of acid is/was poured into the beaker".

The active voice enhances the authority of the writer, whilst the passive voice can obscure it. Remember, do not mix active and passive constructions in the same sentence.

For further information and exercises see:
Marc E. Tischler, University of Arizona ("Scientific Writing Booklet";
http://www.biochem.arizona.edu/marc/Sci-Writing.pdf)

Reader interpretation and expectations

Readers do not simply read; they interpret. Any piece of text, no matter how short, may be interpreted in ten different ways by ten different readers. The methodology of reader expectations,

as explained by Open and Judith (1990), is based on the principle that readers make many of their most important interpretive decisions about the content of the text based on the clues they receive from its structure.

Information is interpreted easily and in a uniform manner if it is placed where most readers expect to find it. Readers have relatively fixed expectations about where in the text they will encounter particular items of its contents. If you are aware of these locations you can improve the degree of recognition and emphasis your readers will give to various pieces of information you are presenting.

The Topic Position:

The information that begins a sentence (or paragraph), establishes the perspective for viewing the sentence (paragraph) as a whole. This is referred to as the "topic position". You should therefore arrange contextual material at the start of the sentence (paragraph) to provide the reader with the perspective on the following text that they need and expect in this position.

In reading, as in most experiences, we appreciate the opportunity to become familiar with a new concept before we have to apply it. Writing that continually begins sentences with new information and ends with old information disorientates the reader.

The Stress Position:

Linguistic studies have shown that readers naturally emphasise the material that arrives at the end of a sentence. This is referred to as the "stress position". You should therefore arrange for important information to appear at the end of the sentence where the reader naturally places the greatest emphasis.

The stress position can change in size from sentence to sentence. The definitive factor is this: A reader has reached the beginning of the stress position when they know that there is nothing left in the clause or sentence but the material presently being read.

Within a sentence, secondary stress positions can be formed by the appearance of a properly used colon or semicolon; by grammatical convention, the material preceding these punctuation marks must be able to stand by itself as a complete sentence. By using a colon, or semicolon, you create a second stress position that accommodates a second piece of information that is worthy of emphasis.

Subject-verb separation:

Readers expect a grammatical subject to be followed immediately by the verb. Without the verb the reader does not know what the subject is doing or what the sentence is about. As a result the reader focuses attention on the arrival of the verb and resists recognizing anything of length that intervenes between subject and verb; this material is read as an interruption and therefore as something of lesser importance.

None of these reader-expectation principles should be considered as concrete "rules". There can be no fixed algorithm for good writing for two reasons:

1) Too many reader expectations are functioning at any one time for structural decisions to remain clear; sometimes you will be unable to fulfil all of the criteria and still produce sentences with concise and unambiguous content.

2) Any reader expectation can be violated to good effect in certain circumstances. The best writers turn out to be the most skilful "rule breakers"; but in order to carry this off they must fulfil expectations most of the time, causing the violations to be perceived as exceptional moments, worthy of note.

For further information see:
George D. Open and Judith A. Swan ("The Science of Scientific Writing": http://www.amstat.org/publications/jcgs/sci.pdf)

Tips for clear and concise writing

The importance of a clear, concise writing style cannot be over emphasised. Unnecessarily complex sentences can lead to confusing texts that frustrate the reader. Conversely, ideas stated simply have a far better chance of being understood, especially in interdisciplinary fields.

Other weak writing practices that often occur are the overuse of;

- Prepositional phrases. Using too many prepositional phrases causes information overload that can confuse your readers.
- The verb "to be". Overuse of the weak linking verb "to be" creates unnecessarily long and imprecise sentences.
- Nominalizations (noun forms of verbs). Sentences with many nominalizations result in texts that are difficult to understand.
- Noun strings (nouns modifying nouns); these often result in too much compressed information that is confusing to your readers.

Below are some examples of sentences published in The Journal of Neuroscience and their suggested revisions (Gary Westbrook and Linda Cooper "Say it Simply: Tips for Clear Writing"):

Original: It is generally agreed that the ability to discriminate between different auditory signals is supported by neurons of the auditory cortex and surrounding cortical areas, yet some ability to perform auditory discriminations is retained after loss of regions of the cortex.

Revised: While neurons of the auditory cortex and surrounding cortical areas discriminate among different auditory signals, some ability to perform auditory discriminations remains after these cortical regions are damaged.

This revision limits the verb 'to be,' reduces prepositional phrases, and eliminates redundancy by removing the obvious.

Original: The diffuse plaques are composed of nonfibrillar amorphous Aß aggregates that are not associated with degenerative changes, whereas the cored plaques contain abundant Aß fibrils that are associated with pathological changes in the surrounding brain parenchyma.

Revised: Cored plaques, composed of abundant Aß fibrils, cause pathological changes whereas diffuse plaques, composed of nonfibrillar amorphous Aß aggregates, do not.

This revision eliminates the verb 'to be' and reinforces parallelism.

Original: The goal of the present study was to evaluate directly a role of the cAMP pathway in opiate withdrawal behaviours by studying, in vivo, whether withdrawal is influenced by intra-LC infusion of compounds known to activate or inhibit protein kinase A (PKA).

Revised: Here we evaluate a role of the cAMP pathway in opiate withdrawal behaviours by monitoring withdrawal after infusing the LC with protein kinase A (PKA) activators or inhibitors.

This revision replaces nouns with verbs, eliminates the verb 'to be,' and reorganizes information into an appropriate stress position.

The following are some examples and tips presented by Westbrook and Cooper (2001) in their letter to The Journal of Neuroscience newsletter ("Techniques for Clear Scientific Writing and Editing"):

1. Use direct, active-voice sentences.

Original: Only at synaptic sites the co-localization of GLu1 and NR1 with the PSD-95 complex was observed.

Revised: We observed that GLu1 and NR1 co-localize with the PSD-95 complex only at synaptic sites.

2. Limit prepositional phrases.

Original: This growth factor is important to the survival of the motoneurons in the spinal cord but not in the cranial nucleus in the brainstem.

Revised: This growth factor helps motoneurons survive in the spinal cord but not in the cranial nucleus.

3. Limit use of the verb "to be."

Original: This mechanism is an important factor in our understanding of cytomegaloviral infections in the brain.

Revised: This mechanism will help us understand how cytomegaloviruses infect the brain.

4. Avoid noun forms of verbs (nominalizations).

Original: Significant ipsilateral cortical activation was seen with stimulation in previous PET studies.

Revised: Previous PET studies show that stimuli activate the ipsilateral cortex.

5. Limit noun strings (nouns modifying nouns).

Original: Community information feedback mechanisms are important if governments want scientists to explain how they spend taxpayers' money.

Revised: Governments should create effective mechanisms for scientists to explain how they spend taxpayers' money.

6. Put new and important information toward the end of sentences.

Original: Whereas mutating four CREs in the promoter did not block up-regulation, sitedirected mutagenesis of all five CREs in the promoter blocked this up-regulation almost completely.

Revised: Site-directed mutagenesis of all five CREs in the promoter blocked this upregulation almost completely, whereas mutating four of them had no effect.

For further information and examples see:

Gary Westbrook, Senior Editor, The Journal of Neuroscience

Linda Cooper, McGill University
("Say it Simply: Tips for Clear Writing";
http://web.sfn.org/index.cfm?pagename=neuroscienceQuarterly_02julyaugust_sayitsimply)

Gary Westbrook, Senior Editor, The Journal of Neuroscience
Linda Cooper, McGill University
("Techniques for Clear Scientific Writing and Editing" - The Journal of Neuroscience Newsletter, July-August 2001 - no longer available online)

Referencing sources

Obviously 'wholesale' direct copying of material from textbooks etc in your CLEs and deliverables will be considered as plagiarism and will be severely penalised when detected. However, sometimes the most succinct way to answer a question or illustrate your point is to quote directly from the source. This is perfectly acceptable as long as it is clear that you are quoting from a source and provide a full reference (you will be provided with more details of this in subsequent skill sessions).

References within the text

There are several different ways in which you can include references in the prose sections of your report.

Footnote referencing.

Example: It is possible to reconstruct the geological history of a region from its stratigraphic record[1].

[1]Grotzinger et al (2007) *Understanding Earth, 5th Edition*. New York. W.H. Freeman and Company

Comments: This is far from the best way from referencing sources and it should not really be used at University level. Footnotes should be reserved for additional information not references.

Numerical referencing.

Example: It is possible to reconstruct the geological history of a region from its stratigraphic record [1].

Comments: This is slightly better than 'footnote referencing' but it is also not an ideal method to use at University level. The reason is that you will also be referencing figures, tables and equations numerically and it is very easy for your reader to confuse [1] with figure 1, table 1, equation 1 and reference 1.
If you do use this method then the full references should be collated in a reference section and listed in numerical order.

Direct referencing (Harvard Method).

Example: It is possible to reconstruct the geological history of a region from its stratigraphic record (Grotzinger et al. 2007).

Or

Grotzinger et al (2007) state that it is possible to reconstruct the geological history of a region from its stratigraphic record.

Comments: This is the preferred and most professional method of referencing used at University level. You will often see this method in academic papers.
If you use this method then the full references should be collated in a reference section and listed in alphabetic order. If an author has published more than one paper then sort them by date. If the same author has published more than one paper in a year it is normal to cite them as Bloggs (2010a) and Bloggs (2010b).

Long format references

The following are the conventional formats that you will use in the References section of any report:

- **Book references.**
  - Example: Knapper, C.K. and Cropley, A. 1991. *Lifelong Learning and Higher Education*. London, Croom Helm.
  - Breakdown: <Surname followed by the initials of all authors>, <Year of publication>. <Book title – either in italics, bold, underlined or quotation marks to distinguish it from other details>, <Place of publication>, <Name of publisher>.

- **Papers or articles within an edited book.**
  - Example: Lyon, E.S. 1992. Humanities graduates in the labour market. In H. Eggins (ed.), *Arts Graduates, their Skills and their Employment*. London, The Falmer Press, pp. 123-143.
  - Breakdown: <Surname followed by the initials of all authors>, <Year of publication>. <Article title>. In <Editor> (ed.), <Title of overall publication – either in italics, bold, underlined or quotation marks to distinguish it from other details >, <Place of publication>, <Name of publisher>, <Page reference>.

- **Journal articles.**
  - Example: Pask, G. 1979. Styles and strategies of learning. *British Journal of Educational Psychology*, 46, pp. 128-148.
  - Breakdown: <Surname followed by the initials of all authors>, <Year of publication>. <Article title>, <Journal – in italics>, <Volume number>, <Page reference>.

Note that in the last two references above, it is the book title and the journal name that are italicised, **not** the title of the paper or article. The name highlighted should always be the name under which the work will have been filed on the library shelves or referenced in any indexing system. It is often the name which is written on the spine of the volume, and if you remember this it may be easier for you to remember which is the appropriate title to highlight.

These are the most common publication types; the same general principles apply to any source you may reference.

- **Web pages.**
  - Example: University of Leicester Standing Committee of Deans (6/8/2002) Internet code of practice and guide to legislation. Accessed 8/8/02. *http://www.le.ac.uk/committees/deans/codecode.html*
  - Breakdown: <Author of the page / information>, <Date the page was created>, <The title>, <The date you accessed the page>, <Web address>.

- **Lectures.**
  - Examples: Barker, G. 1996 (7 October): The Archaeology of Europe, Lecture 1. University of Leicester.
  - Breakdown: <Lecturer>, <Date>, <Lecture title>, <Location of lecture>.

For further information see:
"Referencing & bibliographies"
Student Learning Centre, University of Leicester
https://swww2.le.ac.uk/offices/ssds/slc/resources/writing/ref-bib/ref-bib

Other general guidelines

- Use consistent tenses throughout your document.
- Remember that the goal of good writing is to interest, inform and possibly persuade the reader.
- Write for your audience and write clearly.
- Avoid digressions. Only include material that is relevant to your discussion or the overall message you want to convey to the reader; do not be tempted to cram in unnecessary information.
- Don't be tempted to over explain your point.
- Avoid overstatement; be truthful when stating the facts. Especially avoid hyperbolae in technical writing.
- Be concise; eliminate unnecessary words. Get into the habit of constantly reviewing your document and developing good editing practices.
- Avoid repeating ideas and sentence fragments unnecessarily. Some repetition can reinforce your point; too much becomes annoying.
- Use affirmative, rather than negative, sentences.
- Whenever possible use simple, rather than complex, words i.e. choose words with unambiguous meanings. Many people seem to feel that writing in a complicated way makes them sound serious, scholarly and authoritative. However, it often comes across as pompous and overbearing. It is no more authoritative than writing that is simple and direct.

Pre Session Preparation

Ensure that you have read all of the information in this section before arriving at the session.

Before coming to the session you should consider the following questions (which will be discussed in detail in the session):

- Who is the report for and how does this affect your style? 30 minutes
- How can I structure my report and what information does it need to contain? 30 minutes
- How can I make the text clear and accessible to my audience? 30 minutes

Who is the report for?

The concept of 'audience' is extremely important; scientific and technical writing can never be 'general purpose'. In all cases you must adopt the style and level of writing that is appropriate for your audience.

Target your audience by identifying their level of expertise, your audience's purpose in reading the document and their attitude towards both you and the document contents. These considerations will influence specific features of the document including organisation, language, level of scientific 'jargon', introductions/conclusions and how you present your results.

Audience types, and level of expertise their associated level of expertise, can be roughly broken down into four categories:

- **Experts.** Either 'general' or 'specific' experts; both kinds are readers with extensive technical knowledge of the document's subject matter.

- **Technicians.** Technicians are people who construct, operate and fix things.
- **Managers.** Assume that managers are busy people who need to use documents primarily as a decision making tool; they will often read and review many different documents.
- **Laypersons / novices.** A 'layperson' is someone who does not have an existing technical knowledge of the subject matter under discussion. A 'novice' is a person who does not yet have any technical expertise in the subject field but is in the process of acquiring it.

In groups discuss the following questions for each audience:

1) What level of existing knowledge does this audience have?
2) How would you change the style, content and presentation of your own writing to best suit the audience?

Allow the students 10 minutes to discuss this amongst themselves. After this time open the discussion to the whole class, taking each audience type in turn. Below are some suggested answers to each question.

EXPERTS:

What level of existing knowledge does the audience have?

- General experts will possess extensive knowledge about the field in general but they may be unfamiliar with particular technical terms, specific equipment, the latest advances in the field of study or the detailed theoretical background to the subject.
- Specific experts will have highly detailed knowledge about the subject matter on par with, or more in-depth, than your own knowledge.

How would you change the style, content and presentation of your own writing to best suit the audience?

- You probably won't have to provide extensive background information on the subject area.
- You will not have to explain key technical terms *in detail* (remember you will always have to provide some level of description no matter who your audience is).
- Do not just present a concept to an expert; you need to explain the theory/results/processes in detail.
- You can use a high level of subject specific technical 'jargon'.
- You will be able to use complex and/or technical figures/diagrams to illustrate your text.
- Results can be present in graphical or tabular format (whichever is most appropriate).
- You can go into a high level of detail when discussing your results.
- Always reference your sources with sufficient detail that the reader can find the original material for themselves.

TECHNICIANS:

What level of existing knowledge does the audience have?

- This audience are experts (often moreso than the 'Expert' audience) in how a particular thing works or why it doesn't work; their knowledge is often solely derived from 'hands-on' experience.
- You can assume that they are familiar with common technical terms associated with any relevant devices or physical processes.
- They might not be familiar with the theory underpinning the subject or abstract concepts

associated with the subject.

How would you change the style, content and presentation of your own writing to best suit the audience?

- Keep introduction and background information to a minimum as you can safely assume that they are familiar with it already.
- When appropriate reduce information to instructions on how to perform a procedure or diagnose and fox a problem.
- You can use complex and/or technical figures/diagrams to illustrate your text, though you may have to provide a higher level of description of such figures than you would normally do for an 'Expert'.
- Results can be presented in graphical or tabular format (whichever is most appropriate).
- Keep sections and overall instructions as short as possible.
- Index and cross-reference the content as much as possible; make it easy for your audience to find specific sections/information.
- Provide short definitions or explanations of any unfamiliar terms/tools/devices/procedures.

MANAGERS:

What level of existing knowledge does the audience have?

- Managers vary widely in their technical knowledge.
- Many managers, especially in technical organizations, are general experts in the given subject matter.
- Managers often supervise a number of projects, so they may not be familiar with the detailed theory behind the subject or the most recent developments in the field.
- Outside of technical organisation managers are often specialists in the fields of marketing or management but have little detailed technical knowledge.

How would you change the style, content and presentation of your own writing to best suit the audience?

- Distil key information into an executive summary. An executive summary, unlike an abstract, is a document in miniature that may be read in place of the longer document. Executive summaries are placed immediately after the title page of a report and typically range between 10 and 25 percent of the original document.
- In general present information in the order of importance.
- Emphasise information that will aid in making decisions.
- Present sufficient background information in your introduction to set the scene and provide context for the rest of the document. Avoid the temptation to overload the reader with facts and information.
- Summarise all recommendations for action in your conclusion.
- Use sub-headings to break down the text to allow for easy reading of specific parts of the document.
- If necessary put long, technical explanations into appendices.
- Use simple graphs or graphical representations to summarise information. Avoid complex or technical figures.
- Explain any unfamiliar terms using non-technical language.
- Avoid using subject specific jargon.

LAYPERSONS / NOVICES:

What level of existing knowledge does the audience have?

- Assume that a layperson / novice has no technical background at all; either in the specific subject under discussion or in a much more general context.

How would you change the style, content and presentation of your own writing to best suit the audience?

- Present extensive background information in your introduction. Remember to restrict this to topics that are relevant to the latter text; do not overload your audience with information.
- Organise information from the familiar (to give the reader a sense of security) and progressively work towards the unfamiliar. Do not 'dump' the audience in the 'deep end' as they are likely to get confused and may stop reading altogether.
- Simplify information to the level sufficient for the audience's purpose in the document – avoid subject specific jargon at all costs.
- All technical terms and concepts must be explained carefully using non-technical language. Where possible use examples and analogies that the reader is likely to be familiar with (i.e. "Your hard disk is like an attic; if it is too full, you may have trouble retrieving a specific item.").
- Use simple graphs or graphical representations to illustrate or summarise information. Avoid complex or technical figures.

Document feature	**Expert**	**Technician**	**Managerial**	**Layperson**
Introduction	Technical	Technical	Problem/solution	Relevance
Mathematical models	Ok	Depends on relevance; in general avoid	Avoid	Avoid
Equations	Ok	Keep simple or avoid	Keep simple or avoid	Avoid
Graphics	Detailed, analytical	Detailed, analytical	Simple, presentational	General, illustrative.
Detail level	Accurate, numerical	Technical, accurate	General, accurate	Simple, narrative
Technical terms	Expert, technical	Expert (but with more description), technical	Administrative	General, illustrative
Emphasis	Analysis	Solutions, methods	Operations, costs	informational, interest

TIME: 30 minutes

How can I structure my report and what information does it need to contain?

One very important aspect of report writing is getting the structure of the document right. The structure is critical factor in presenting information to the audience in a way they not only expect but also in a way they can understand. The structure should naturally lead them through the 'argument' or point of view you are trying to convey to them in a convincing manner.

In groups discuss the following questions:

- What section headings might you use in a report and how would you decide which ones to use?
- What information should you include in each section?
- How useful is a plan/rough draft?

- How should you present data/information/figures etc in your report?
- Is there a standard style you should adopt?
- How do you reference a) materials in your own document (figures, tables etc) and b) information in another document?

What section headings might you use in a report and how would you decide which ones to use?

Title Page/Cover sheet:

Its generally a very good idea to include either of these as a matter of course. It serves an administrative purpose by containing important information (title, contributers, date, affiliation etc) and it sets up the 'impression mangement' of your document from the start.

Contents List:

This generally isn't needed for shorter reports and certainly not for academic papers. However it is vital for longer reports and ones aimed at Managerial audiences (as people may need to quickly skip to relevant sections rather than leaf through the pages).

Ordinarily a simple section list is enough, however, if the report is particularly long (or the standard style requires it) then you should also include a list of figures and tables, which contain the page number *and* the captions of each.

Abstract:

Abstracts are vitally important for most scientific reports and essential for academic papers as they are used by scientists to quickly assess the sum total of your work and select out of hundreds of others. They should always be the last thing in the report that you write. The exact word count varies depending on who you are submitting it to but a good rule of thumb is 300-400 words.

Hypothesis:

This may be a section heading you are used to from school laboratory write ups, however, its very rarely encountered in scientific reports. The point being that you should be presenting what you *know* not what you *suspect to be true*. Its role is taken over by the Abstract/Introduction.

Executive Summary:

This takes the place of an Abstract in a report aimed at a Managerial audience.

Introduction:

This section should always be included in any report that you write, even if its only a paragraph long. No-one likes being thrown into the deep end when reading a report. Even if you are fully au fait with the subject area you can't assume that your audience is therefore you need to provide some context for the information that follows.

Theory:

This is also a section heading that you may be used to from school/college. It is generally subsumed into the Introduction if the report is short or given a unique heading/sub-headings (e.g. Short duration Gamma Ray Bursts) if the report is long.

Method:

This section should always be included if you have carried out a physical experiment or computer simulation. Sometimes it will simply be called 'Method' Or given a unique but

sensible title (e.g. N-body simulations on UKAFF). It is unlikely that you would include this if the report is a literature review or a discussion piece.

Results:

This is also a section heading that you may be used to from school/college. It is generally subsumed into the (Data) Analysis and/or Discussion section.

(Data) Analysis/Discussion:

You should always include this section. Sometimes its split into 'Data Analysis' and 'Discussion' or the two aspects are merged into 'Discussion'. Choose whichever is more appropriate to your report and audience.

Conclusions/Summary:

You should always include this section.

References:

You should always include this section.

Appendices:

Appendices are only necessary if you need to include supplementary materials or large datasets.

What information should you include in each section?

Title Page/Cover sheet:

Title, author list, author contact information, affiliations, date etc.

Contents List:

Obvious! Remember lists of figures/tables should include captions.

Abstract:

Be warned – writing these is somewhat of a dark art. You only get good at writing them with practice, readying a lot of them and using them to select research papers. This needs to be a concise summary of the report highlighting the important outcomes. Include additional information if its relevant e.g. analysis methods, instruments used etc.

Hurkett et al (2006) *GRB 050505: a high-redshift burst discovered by Swift*, MNRAS, v368, p1101-1109.

"We report the discovery and subsequent multiwavelength afterglow behaviour of the high-redshift (z= 4.27) Gamma Ray Burst (GRB) 050505. This burst is the third most-distant burst, measured by spectroscopic redshift, discovered after GRB 000131 (z= 4.50) and GRB 050904 (z= 6.29). GRB 050505 is a long GRB with a multipeaked γ-ray light curve, with a duration of T_{90}= 63 +/- 2s and an inferred isotropic release in γ-rays of ~ 4.44 × 10^{53}erg in the 1-10^4 keV rest-frame energy range. The Swift X-Ray Telescope followed the afterglow for 14 d, detecting two breaks in the light curve at $7.4^{+1.5}_{-1.5}$ and $58.0^{+9.9}_{-15.4}$ ks after the burst trigger. The power-law decay slopes before, between and after these breaks were $0.25^{+0.16}_{-0.17}$, $1.17^{+0.08}_{-0.09}$ and $1.97^{+0.27}_{-0.28}$, respectively. The light curve can also be fitted with a `smoothly broken' power-law model with a break observed at ~T+ 18.5 ks, with decay slopes of ~0.4 and ~1.8, before and after the break, respectively. The X-ray afterglow shows no spectral variation over the course of the Swift observations, being well fitted with a single power law of photon index ~1.90. This behaviour is expected for the cessation of the continued energization of the interstellar medium shock, followed by a break caused by a jet, either uniform or structured. Neither break is consistent with a cooling break. The spectral energy distribution, indeed, shows the cooling frequency to be

below the X-ray but above the optical frequencies. The optical-X-ray spectrum also shows that there is significant X-ray absorption in excess of that due to our Galaxy but very little optical-ultraviolet extinction, with E(B-V) ~ 0.10 for a Small Magellanic Cloud like extinction curve."

Executive Summary:

An executive summary previews the main points of an in-depth report; it is written for nontechnical people who don't have time to read the main report. The executive report contains enough information for a reader to get familiarized with what is discussed in the full report without having to read it. http://www.ehow.com/how_16566_write-executive-summary.html

Introduction / Theory:

This section must set the scene for the rest of the document. Start off my talking about the broader, overall themes before getting into specific details.

Sometimes its useful to write a 'broad summary' paragraph and then divide the rest of the Introduction into relevant subsections. If you do this make sure that the order of the subsections makes sense. This is where any relevant theory should be introduced. Figures, tables and equations as relevant.

Method:

This section should describe any methods that you used in concise prose format. *Most reports:* This is not the same as the method you would write in your laboratory notebook – you do not have to give *every* step in detail, just the relevant points. *Formal Report:* more information in another Methods and Techniques section but this should contain more detail on the method. Figures, tables and equations as relevant.

(Data) Analysis/Discussion:

This should contain sufficient detail that the reader understands how you have analysed the data and can be confident that you've completed the analysis correctly. Figures, tables and equations as relevant.

The choice to write these as two separate sections or one merged section is entirely dependent on what you are discussing. If you have a lot of different data analysis methods then its generally a good idea to talk about these separately before you devote the next section to explaining in detail what the results mean.

Conclusions/Summary:

Summarise the key points from the (Data) Analysis/Discussion sections pulling out the key Conclusions.

References:

Obvious.

Appendices:

These sections are only included if you have supplementary materials that have to go with the report but can't be referenced to another piece of work or if you have large data tables that would break up the flow of your report. Remember you should never report all of your data – only the summary points.

How useful is a plan/rough draft?

Very useful!

It doesn't have to be massively detailed, just a list of the headings with bullet points about what information/discussion/figures to include. Get students to pick a lab script and quickly rough out a plan there and then.

How should you present data/information/figures etc in your report?

Figures/tables:

Only include them if they are relevant to the report or would aid your readers' understanding in some way. The nature of these will depend upon the audience you are writing for.

These must always be numbered; distinguish between figures and tables, e.g. a report may contain figure1, table 1, figure 2, figure 3, table 2 etc. They must always be captioned. The caption must give the reader an understanding of what is being shown and its relevance to report.

Equations:

Only include them if they are relevant to the theory/discussion. You do not need to show all intermediate steps if you are manipulating equations – just the key steps.

These must be numbered, by convention this number appears on the right-hand side of the page. Numbering systems can run straight numerically (1, 2, 3 ...) or by section (1.1, 1.2, 3.1 ...) etc.

Why do they have to be numbered – because you must *reference* them in the text. If you include a figure without referencing it then you clearly did not need to include it in the first place.

Is there a standard style you should adopt?

Depends on what the report is going to be used for.
General neat, well laid out, numbered sections, headers, footers etc.
Specific – style guidelines will be provided (i.e. for journal submission).

How do you reference a) materials in your own document (figures, tables etc) and b) information in another document?

Always reference your figures and tables!
Examples:
A plot of temperature versus time shows a linear relationship, as shown in figure 1.
A plot of temperature versus time shows a linear relationship (figure 1).
A plot of temperature versus time shows a linear relationship (Bloggs et al 2003: figure 1).
Bloggs et al (2003) show that there is a linear relationship between temperature and time (their figure 1)

How can I make the text clear and accessible to my audience?

The final thing we need to cover is how you can make your text clear and therefore accessible the your readers. Again there is no point carrying out any research or experiment if you are not able to effectively communicate what you have done – no amount of figures will make up for that!

What can you do to make your writing clear?

All of the following points are covered in the pre-session materials above. You may need to stop and go through these concepts as necessary.

- Know when to use the Active and Passive voice – and don't skip between them!
- Understand and use the Topic and Stress position as much as possible.
- Avoid separating the subject and the verb in the sentence.
- Avoid unnecessarily complex sentences.
- Short words and sentences are ok - you don't have to show off!

Above all you need to develop the ability to put yourself in the reader's shoes - would you be happy reading what you had just written? It always helps to let another person read over it and get CONSTRUCTIVE critism.

TIME: ~ 30 minutes