Australian Government

Australian Centre for International Agricultural Research

# Communicating Science

# ACIAR Training Manual

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# 1. Introduction

## *Why should scientists communicate?*

Scientists have a number of responsibilities to themselves and others:

1. Professional
It is a responsibility the scientific profession to ommunicate new findings to other scientists and fellow agricultural workers, and to discuss their work. It is also part of the scientific way to present work for critical review.
2. Institutional
Government departments, research institutes and public corporations are responsible to the country.s people to provide new information for the further development of local communities, industries and commodities, such as rice, fish and forests.
3. Personal
Scientists are able to have their work critically reviewed, and hopefully accepted, and so gain personal .points. for their work. It can be used to justify their work, particularly where governments allocate funds according research papers previously published.

## *What is scientific writing?*

Scientific writing is disseminating new knowledge for the good of the country, society and the scientist, as well as for the wider scientific community.
(See reading at end of Section 1: .Why scientists must write..)

### Types of scientific writing

Different types of writing from scientists include:
1. Refereed and non-refereed journal articles;
2. Conference and meeting papers;
3. Technical reports;
4. Annual research reports;
5. Project proposals;
6. Extension pamphlets;
7. Extension articles; and
8. Media articles (newspaper or magazine).

### Specific writing styles

***1. Journal article***
A scientific journal article is a way of formalising, recording, storing and retrieving original scientific thought. If the article is refereed - i.e. subject to comments from other knowledgeable researchers before publishing - it is also subject to scrutiny from scientific colleagues in your country and overseas. Publishing in journals is one way of becoming known in scientific circles, particularly if you are looking for recognition overseas. It also reduces the duplication of scientific effort, particularly if you have used sound methods, good analysis and clear, concise reporting.

The differences between a refereed journal article and other types of writing are:
1. it is more difficult to publish your work initially
2. it is refereed by your peers and the writer will need to deal with criticisms
3. there is a long time between writing the article and appearing in print
4. it is much more exact
5. the science must be correct - in design and analysis.

The scientific journal article usually follows the IMRaD model, which is described in the next section.

***2. Research report***
This type of writing can take many styles, according to the reporting requirements set out by a government department, a United Nations agency or an overseas funding agency who is the main target for the report. Timing can also vary, depending on the organisation. It may be required quarterly, annually or at prescribed times during the life of a project.

***3. Conference paper***
Attending scientific and technical conferences is another way of becoming known in scientific circles, increasing credibility and widening contacts among other researchers. A conference paper delivered orally should be short. It should basically follow the IMRaD model, briefly outlining objectives and issues for discussion, and emphasising the methods and results of research.

A longer, revised, written version of the oral presentation is often required for the conference Proceedings. The written paper allows more detail to be included in the introduction and discussion sections and more closely follows the IMRaD model. Note that papers for some conferences may also be refereed, which gives the papers greater prestige.

**Questions**

1. What are the differences between the types of scientific writing, according to their:
a) purposes?
b) audiences?
c) assumed knowledge of the audience?

***4. Annual research report***

An annual research report describes work completed in a 12-month period - the timing depends on who you are writing the proposal for. Reports concentrate on work objectives, methods used and any results obtained rather than stating and proving hypotheses. It also justifies expenditure for the year.

***5. Project proposal***

A project proposal outlines and justifies a work program; states the expected outputs and clearly defined objectives of the proposal; estimates a budget; and  utlines methods of measuring the success of the program.

## *Reading: Why scientists must write*

If, in each of our lifetimes, we wanted to find out about the world in which we live, how far would we get? As individuals, working alone and without information, firstly we wouldn.t get very far and secondly, we would repeat much of what everyone else was finding out. Einstein made a comment referring to the increment of knowledge, how it is built up, built upon and made available through publishing. He said: .If I have seen a long way it is because I stood on the shoulders of giants.

**Science is discovery based on observations and the accurate recording of those observations and discoveries.** If Einstein (or anyone) had worked alone, there would have been no shoulders to stand upon. If he had stood upon weak shoulders, he would have fallen. The relevant point is that **science reporting must be accurate and soundly based.** Shoddy reporting and poor science make weak shoulders, will not support discovery and ultimately are a disservice to the community, the environment and yourself.

Communicating your discoveries can be done in writing or by speaking, or both. Because science is built on observations of real phenomena, it is factual, and hence your discoveries must be open to judgement. It is nice to be recognised as a learned person in your field of expertise, but this recognition carries responsibility. You are required to produce evidence of your conclusions. The onus of proof is upon you, not on your readers. Convincing, or proving your case to your audience requires sound experimental design and the drawing of logical conclusions. Make your case water-tight. Rise above (helicopter over) your discoveries to assess them and locate the outcome of your work. Apply logic (Does it make sense?)

### Better science writing

***Don't:***

- Write a paper if you have nothing to say (consider your readers, referees and the future).
- Write a paper if you don't know what you found out.
- Write a paper if your information is not original (i.e. you've copied from others).
- Write a paper if you have nothing new to say.

***Do:***

- Apply sound experimental design.
- Find out what data you have; what data you can collect; and what do they mean?
- Ask whether your conclusions and writing make sense?
- Ask yourself what you mean to say; and then did you say it?
- Decide on your main message.
- Ask yourself why you are writing the report; and will your report say anything new?

Research is not collating and analysing information: research is asking questions.

### Why do scientists write

Scientists must write to communicate ideas and information to people they know and whom they don.t know. People who don.t know you and have never met you can only assess you and your work by how you write.

If you can put down your ideas clearly and in a logical sequence, then your work is on the way to being recognised. On the other hand, if your written message is not clearly presented then your work will not be well considered - even if it is .earth-shattering.! - simply because the reader had difficulty in following your logic through poor sentence construction, repeated information, poor grammar or English expression.

- Writing helps you to remember.
- Writing helps you to observe and think - focuses attention and ideas into a logical sequence.
- Accuracy and peer review

The writer must accurately report what he observed. If he doesn't he will eventually be found out: is that a good thing? Negative information (i.e. reporting that a null hypothesis, when tested, was untrue) adds to the core of knowledge.

### Peer review

Scientists are great critics. They are always willing to 'swoop on' illthought-out or illogical conclusions and errors in experimental design. They will 'shoot you down' if you try to get away with sloppy science... and, come to think of it, is sloppy science enhancing the core of knowledge?

The most effective way to ensure accuracy in your reporting and to preserve your integrity is to seek peer review. Peer review provides a valuable opportunity to improve your papers. The attitude of the reviewer is not one of 'scoring points' but of finding and fixing things that might confuse a reader and which hamper the logical telling of your work.

A peer group is a group of people of the same age, education or experience. It is better to have your peer group check out your work before you submit it to someone outside the group - such as to a journal referee.

Why ?

- the referee.s opinion of your work will colour his attitude to later papers submitted by you which he or she referees.
- the referee will not think well of you as a scientist and may relay that information to others.

Is such an end result worth all the effort of doing the work and writing the paper? Your peer group will be much more forgiving - and supportive – than any referee!

Some useful references on editing

Barrass, B. 1978. Scientists Must Write: A Guide to Better Writing for Scientists, Engineers and Students. Chapman & Hall, London. 176 p.

Booth, V. 1993. Communicating in Science. 2nd ed. Cambridge University Press, Cambridge. 77 p.

## Questions

1. Discuss these questions in your group:
    a. Who has submitted papers for conferences or journals?
    b. Who has submitted to both?
    c. Were these national or international journals or conferences?
    d. How is writing for a national conference different to writing for an international conference?
    e. How is writing for a scientific journal different to writing for an international meeting?

2. From this discussion, write down how you would prepare to write a paper on a research project for a national conference compared to writing about the same research for an international scientific journal.

# 2. Structure in Scientific Writing

## *Introduction*

Many people choose to become scientists because they believe that scientists do not do very much writing (McMillan 2001) and that they will spend most of their time performing experiments. This is far from the case: scientists spend much of their time writing a wide range of different subject matter, including papers for journals, review articles, books and grant applications. It is also the case that most good scientists are also good writers (McMillan 2001). Good writers put logical structure into their writing and this module will help you develop structure in your writing. Understanding the structure of articles helps you understand their con¬tent and also helps readers of your articles understand your ideas. In this chapter, we are going to look at the overall structure of scientific articles and in subsequent chapters look at the structure of individual sections, focussing on the language coomponents.

### Standard Format of Research Papers

Most scientific research papers have the same broad organisational structure (The IMRaD structure):

| | |
|---|---|
| | Title and Abstract (or Summary) |
| **I** | Introduction |
| **M** | Methods and Materials |
| **R** | Results |
| **a** | and |
| **D** | Discussion |

## Questions

Answer the following questions;
1. Why are scientific papers presented in the IMRaD format?
2. What do most people look at when they first pick up a scientific paper to read?
3. How ofter are scientific papers read in full?

Where would you look in a scientific paper to find answers to the following questions;
1. How would you repeat this research?
2. Did the results confirm the hypothesis?
3. What were the reasons for the methods chosen?
4. Are the results in agreement with previous research?
5. Who are the most relevant researchers working in the topic area?

In what sections of a scientific research paper do these questions get answered?
1. Why?
2. How?
3. What?
4. So what?

## *The Language of Scientific Research Papers*

Can we say that each different section of a research paper seems to have its own recognisable language features? Which language clues allowed you to recognise that a sentence was from a particular section of the research paper? Without using subheadings, can we identify where one section of a research paper (eg. Introduction) ends and the next section (Methods section) begins?

Read the following sections of a paper by van der Heyden, Holford and Richards (1997). From which section have they been taken? How did you tell which section the paragraph was from? Underline any clues in the paper which indicated to you that it was from a particular part of the paper. Does the grammar (verb tense, active or passive voice, modal verbs or qualifying phrases) change from one section to another? How?

Fruit from the clingstone and semi-freestone categories did not vary significantly for TA, SSC, or skin color (Table 1). Clingstone fruit were firmer than semi-freestone fruit (46 vs. 42 N; n = 28 and 30 respectively; $P \leq 0.001$). In addition, the resistance to penetration of the nonmelting flesh of these two fruit types was nearly twice that of freestone/melting flesh fruit (28 N; n = 3).

……………………………………………………

*Statistical analysis.* Data for flesh firmness, skin color, TA, and SSC were subject to analyses of variance. Least significant differences (LSD) were calculated using Duncan's multiple range test. The ratio of progeny in the semi-freestone and clingstone classes was compared to a 1 : 1 ratio using a chi-square test.

……………………………………………………

The flesh of the clingstone peaches was significantly firmer than that of the semi-freestones and, hence, there are differences in flesh adherence and flesh texture. As mutations are rare events, it is unlikely that they would occur simultaneously in two separate genes. Lester et al. (1996) have shown by Southern analysis that Fla. 9-20C is homozygous for a deletion that spans the region containing the polygalacturonase gene. The absence of this gene would explain the nonmelting nature of Fla. 9-20C. This deletion alone

……………………………………………………

The germplasm used in this study was developed from the Florida selection, Fla. 9-20C, and contains individuals with nonmelting flesh and a semi-freestone adhesion. Classes of flesh adhesion and texture have previously been defined by Blake and Edgerton (1946). Our nonmelting, semi-freestone fruit are not found in their classification. This new germplasm offers the opportunity for several new developments with nonmelting types that would be suitable for the domestic and export markets.

……………………………………………………

Two distinct classes of flesh-to-stone adhesion were discovered among 58 open-pollinated progeny of Fla. 9-20C. The first conformed with Blake and Edgerton's (1946) description of nonmelting, clingstone fruit (class 5), the flesh remaining attached to the stone. These fruit were also compared to those from 94-60, a known clingstone type, and showed the same flesh adherence phenotype as this latter line. The other class of progeny

……………………………………………………

Besides facilitating transport, the combination of nonmelting flesh and the freestone characteristic may be advantageous to the canning and dried peach industry, since pit removal is facilitated. In addition, this material also offers the possibility for a low-chill canning and dried fruit industry to emerge. In this paper we report the discovery of nonmelting flesh peaches with a semi-freestone condition.

……………………………………………………

## *Structure in Writing*

### Thesis and topic sentences

**The thesis**

Many people think that a thesis is the long report that students write to gain their degree (that report is called a dissertation). More correctly, a thesis is the main idea of a piece of writing such as an essay or dissertation, and is also called the claim, the position or the central argument. Usually, a piece of writing contains a thesis statement. The thesis statement can be found in the introduction to a piece of writing, and is one or a few sentences that state and summarise the main idea or argument that the author is about to present. A thesis statement has two parts: a topic that states the subject of the argument and a focus that makes an important point about the topic:

*Topic Focus The first firm evidence has been uncovered to link environmental pollution with cancer in human beings.*

Nuttall (1999) The Times (London)

*Topic Focus A better understanding of this physiological disorder [chilling injury] would be available today if researchers had taken certain basic precautions when working with peaches and nectarines.*

Luchsinger and Walsh (1998) Acta Horticulturae 464: 473-480

Because a thesis statement summarises the claim or argument to be presented, it will usually:

- **provide an explanation**
  '*callus production in plant tissue cultures is due to the breakdown of antibiotics to plant hormones*'
- **make a judgement**
  '*rock phosphate is the most appropriate form of phosphate fertiliser in the Mekong Delta*'
- **offer a solution or recommendation**
  '*project evaluation methods should be adopted in Viet Nam to improve the efficiency of research outcomes*'

Identifying the thesis statement will help you:

- determine what the piece of writing is about
- understand the ideas presented by the author

Pieces of writing may contain more than one thesis statement.

**The topic sentence**

A paragraph is a group of sentences that develop one main idea. When writing in English, good paragraphs usually start with a topic sentence; this is a general statement that expresses the main idea of a paragraph. The topic sentence has two main parts:
*subject*—what the paragraph is about
*focus*—what the paragraph is going to say about the subject

Example of a topic sentence:

***The skin colour of peaches and nectarines is determined by various pigments that change dur¬ing the development of fruit.*** Skin colour changes can be brought about by the breakdown of chlorophyll, accompanied by biosynthesis of either anthocyanins or carotenoids (Tucker 1993). As fruit mature and ripen, peaches and nectarines show a change in ground colour from green to white or yellow (Kader and Mitchell 1989) due to chlorophyll breakdown. These changes in the ground colour are a major criterion for determining fruit maturity. The development of red pigments in peaches and nectarines is due to the production of anthocyanins and this depends on exposure to light. Therefore, a fruit's position on the tree influences its red colouration (Kader and Mitchell 1989).

## Activity

In the following paragraphs find the topic sentance and identify the subject and focus:

Paragraph 1:
Huanglongbing, a phloem-limited disease of Citrus and Citrus relatives, is the most serious impediment to ci¬triculture in Asia. The disease is caused by a proteobacterium (Candidatus Liberibacter asiaticus), spread by the Asiatic citrus psyllid (Diaphorina citri) and can destroy orchards within 5 years of planting. It has pre¬vented the establishment of viable citrus industries in tropical and subtropical Asia and as a consequence seri¬ously affects the welfare of farmers and national economies. Huanglongbing's gradual movement eastward through Asia to Australia and Oceania is a potential threat to the biodiversity through the loss of citrus species and citrus relatives that are endemic to the region.

Paragraph 2:
The formulation of minerals for tissue culture media has, historically, been empirical in nature. In the early days, media formulations were based on solutions used for hydroponic systems, and components were varied singularly or in groups to suit individual species and systems. However, after Murashige and Skoog pub¬lished their paper, A Revised Medium for Rapid Growth and Bioassays with Tobacco Tissue Cultures, many plant tissue culturists began using the mineral combination contained in this article for the growth of a great variety of plant species. It has been estimated that MS minerals are used for 50–75% of all plants produced by micropropagation. In

addition, when new species are introduced into tissue culture, researchers will often trial growth on a medium with MS minerals and, if growth is adequate, no further investigation is undertaken. Thus, media are often selected without extensive testing of their suitability.

Paragraph 3:
Rapid advances in the field of molecular biology have now made it common practice to transfer genes from an organism with favourable traits into the genome of most major crop species. The transferred genes operate in a number of ways including increasing resistance to diseases by stimulating the plant host defence system or by producing toxic compounds specifically targeted at particular problems, including insects, nematodes and plant diseases. The most widely commercialised example is that of Bt-transgenic plants, which currently include cotton, corn, potato and tomato. Bt plants incorporate genes from the bacterium Bacillus thuringien¬sis (Bt) that produce insecticidal proteins that kill susceptible insect pests when ingested. Other examples of transgenic plants include tomatoes that withstand longer postharvest storage, squash and potatoes with virus resistance, as well as soybean and oilseed rape with herbicide resistance. These crops have shown positive economic benefits to growers and have reduced the use of other pesticides.

**Why are good topic sentences important?**

- Topic sentences help readers understand the information in a paragraph
- The order of the topic sentences gives order to the information in a piece of writing
- A good logical order helps readers understand an argument
- Help readers understand evidence in support of the thesis statement

## Logical structure in writing

Every piece of writing has:

- an introduction
- a body
- a conclusion

**Structures used in scientific writing**

Oulined here are 6 difference argument types with examples of a logical flow of ideas on different topics;

1. Real-world criteria → time / place

*Examples:*

Time: HLB - thought to be a physiological disorder, recognised as a disease, transmitted by an insect, causal organism thought to be a virus or mycoplasma, causal organism identified as a bacterium, rRNA se¬quencing recognises a new genus *Liberibacter*.

Time: Insect development - egg, larva, pupa and adult.

Place: AIDS - discovered in USA and France simultaneously.

2. Interpretiva Criteria → Importance to the field / Centrality to your research

*Examples:*

Importance to the field: breeding plants for resistance to disease - major gene, minor gene, induced resis¬tance

Centrality to your research: Diet for fish - carbohydrate, protein, digestibility

3. Thematic criteria → research approaches and methods / taxonomic / issues

*Examples:*

Research approaches and methods; Studies on the plant hormone ethylene - the use of blocking agents, the use of manometry and GLC, molecular biology.

Taxonomic: Crop loss - insects, mites, nematodes, fungi, bacteria, viruses.

Issues: Genetic engineering - benefits, impacts on human health, gene transfer to wild relatives, production of super weeds.

4. Problem / cause / remedy

*Example:*

Cattle production - production is low, Jembrana disease is common, vaccine can be produced but production is expensive, produce a recombinant vaccine.

5. Pros and Cons

*Example:*

Aquaculture - Pros: cost effective, stops exploitation
Cons: escapees upset natural populations, environmental damage

6. Conclusion followed by supporting ideas

*Example:*

A new cultivar of peanuts should be adopted because it:

- is high yielding
- has better disease resistance
- has better tolerance of adverse environmental conditions
- requires less inputs

## Developing a structure

### Brainstorming

The Oxford English Dictionary defines brainstorming as "A concerted intellectual treatment of a problem by discussing spontaneous ideas about it"

Brainstorming is a good way to quickly and roughly work out what the major topic areas, issues, concepts and themes are that should be covered in a piece of writing. Some good tips for brainstorming include:

- Write down everything
- Suspend criticism and judgment
- Generate as many ideas as possible
- Do not worry about wild or exaggerated ideas

### Mind mapping

Mindmapping is one way of arranging the ideas that you may have brainstormed into a logical sequence, and gives you a good picture of how the ideas link together. To make a mindmap:

- Write down the topic in the middle of a page
- Write any words, ideas or associations as branches or sub-branches from the central theme

Once you have used brainstorming and mind mapping to develop ideas, organise them into one of the struc¬tures above so that you have:

- a logical structure
- smooth transitions from section to section
- smooth transitions from paragraph to paragraph

## Group Tasks

1. Imagine you have to write an article on Indonesia. Brainstorm the types of information that should go into the article. Your ideas will be collected, then we will discuss the order in which they should appear in the article

2. Split into groups and chose a research topic of one of the members of the group. Imagine you have to write an article on that topic. Use the brainstorming and mind mapping techniques to determine topic areas and then decide on the structure of the article.

Reflection task

Read through some of the paragraphs in your piece of writing. Identify the topic sentences and their subjects and foci. Are the topic sentences clear? Does the information in the paragraphs expand upon the in¬formation in the topic sentences?

# 3. Title and Abstract

## *Introduction*

For many papers, only the title may be read. If readers think the paper is relevant to their research, they may then go on to read the abstract. If new knowledge is to be efficiently disseminated, then readers must be able to easily understand a paper's content. Searches of research literature produce a long list of titles; therefore, a title must impart a strong first impression if researchers are to select the paper for further consideration.

This module looks at ways of writing titles so as to give them their greatest impact. Next, the material presented on abstracts looks at their structure so that their content is accurate and concise. This module then focuses on structures of titles that give them impact and on the structure and content of abstracts.

## *The perfect title (after Day 1998)*

*First impressions are strong impressions; a title ought therefore to be well studied, and give to, so far as its limits permit, a definite and concise indication of what is to come.*

T. Clifford Allbutt

Therefore, a title needs to be concise and informative.

### Length and information content

Compare the following:

- Action of fungicides on plant pathogens
- Action of benzimidazole fungicides on Botrytis cinerea
- Inhibition of growth of Botrytis cinerea by benzimidazole fungicides
- Benzimidazole fungicides inhibit the growth of Botrytis cinerea
- Benzimidazole fungicides inhibit growth of Botrytis cinerea through interference with microtubule formation

Which is the most effective title? Why did you chose this one?

### Wasted words

Titles can be both too short and too long. Expanding your title can result in confusion as to the focus of the paper and lose the attention of readers.

Try to avoid phrases such as:

- Observations on ...
- A study of ...
- Investigations on ...
- A, An or The (as the first word)
- The effect of ...
- The influence of ...

### Some other tips for writing good titles

Put the most important information first

- Start with a key word
- Easiest for a reader scanning a list to see

Chose the right format

- 'Main title: subtitle' format
- Description or statement

Compare the following:

- The effects of drought, ageing and phosphorus status on leaf acid phosphatase activity in wheat
- Leaf acid phosphatase activity in wheat leaves: effects of drought, ageing and phosphorous status
- Leaf acid phosphatase activity in wheat leaves is decreased by drought, ageing and phosphorous status

### Some things to avoid

- abbreviations
- chemical formulae
- jargon
- proprietary names (names owned by companies)

**Title and abstract task 1**

Pick one of the titles taken from published articles given below. Examine its information content and try to amend the title to give it more impact.

The concentrations of fatty acids in organo-mineral particle-size fractions of a Chernozem

An investigation of phosphate adsorbed on aluminium oxyhydroxide and oxide phases by nuclear magnetic resonance

Factors relating to soil fertility and species diversity in both semi-natural and created meadows in the West Midlands of England

An evaluation of current perspectives on consciousness and pain in fishes

The effects of kin and familiarity on interactions between fish

The relationship between fishing methods, fisheries management and the estimation of maximum sustainable yield

A review of the suppression of soil-borne plant diseases with composts

Effects of Tolypocladium cylindrosporum and its secondary metabolites, efrapeptins, on the immune system of Galleria mellonella larvae

Impact of sixteen chemical pesticides on conidial germination of two entomophthoralean fungi: Conidiobolus thromboides and Pandora nouryi

Effects of row spacing and liquid manure on directly drilled winter wheat in organic farming

Behavioural effects of artificial light on fish species of commercial interest

Influence of water supply and endophyte infection (Neotyphodium spp.) on vegetative and reproductive growth of two Lolium perenne L. genotypes

A simple method to control the seed purity of japonica hybrid rice varieties using PCR-based markers

## *Abstract*

### Function

- summarises the main aims and findings of the paper
- provides a preview of the whole paper

Therefore, an abstract should be:

- complete
- accurate
- brief
- intelligible

### Structure of an abstract

B = background
P = purpose/ principal activity/ scope of the investigation
M = methods
R = results
C = conclusions (or recommendations)

### Length

An abstract should be 250 words, or less than 5% of the article—whichever is the shortest
As a general rule - *Keep abstracts of most popular papers to portions of monographs to fewer than 250 words, abstracts of reports to and theses to fewer than 500 words (preferably on one page), and abstracts of short communi¬cations to fewer than 100 words.*

Anon (1979)

### Style

Use specific rather than general statements:
For example ‘40 and 80 kg P’ rather than ‘two levels of P’
OR
‘Nitrogen fertiliser increased the grain content from 1.3% to 1.5%’ rather than ‘Nitrogen fertiliser increased the grain N content’

### Some things to avoid

- wasted words (‘is discussed’, ‘is described’)
- abbreviations
- formulae
- references
- citations of tables and figures

### Verb tenses in an abstract

***Background***
Present tense
Fuji apples *have* low rates of ethylene synthesis

***Purpose or scope***
Past or present perfect
We *investigated* whether chilling at 0 °C would stimulate ethylene synthesis
Net energy analyses *have been carried out* for eight pasture systems

***Methods***
Past tense
Preclimacteric apples *were stored*

***Results***
Past tense
Ethylene production *remained* low

***Conclusions***
Present / tentative verbs / modal auxiliaries
Water *is* obviously not a ripening trigger
These results *suggest* that...
Therefore, short heat shocks *can be used* to prevent ...

## Title and abstract task 2

Read the following abstract:

**Anthesis, Anther Dehiscence, Gametophytic Receptivity and Fruit Development in the Longum Group of Capsicum annuum**

Aleemullah et al. 2000

1Despite chilli peppers being a major horticultural crop, little attention has been paid to the events associated with fruit production including flowering and seed set. 2To ad¬dress this deficiency we examined flowering phenology in the cv. Red Hot Glory. 3Measurements of bud length and width, made before the flowers opened, showed that these parameters provided an effective measure of the number of days required by a bud to reach anthesis and suggests that bud size can be used to predict anthesis in the Longum group of C. annuum. 4Anthesis itself, recorded when the petal segments sepa¬rated from each other, mainly occurred during the morning with a second, smaller peak of flower opening in the afternoon. 5In flowers which opened before 17:00 h, anther dehiscence took place one hour after the flower bud opened; in flowers which opened later, dehiscence was delayed until the following morning. 6This pattern of flower opening and anther dehiscence suggests that these events are controlled by the flower's endogenous rhythms. 7Artificial pollinations showed that the period of female receptiv¬ity lasted for five days before anthesis to three days after anthesis with maximum fertil¬ity, as judged by seed set, occurring on the day of anthesis. 8Therefore, to achieve maximum seed set, artificial pollinations should be made as close to the day of anthesis as possible. 9This study has provided baseline data which will aid the production of new, hybrid cultivars and will facilitate further studies on the factors affecting fertility in this species.

What elements of the abstract are present in each sentence?

1 ______________________________

2 ______________________________

3 ______________________________

4 ______________________________

5 ______________________________

6 ______________________________

7 ______________________________

8 ______________________________

9 ______________________________

Does the abstract contain each of the elements of an abstract?

## Title and abstract task 4

Read the following abstract:

**The production of ethylene and ethylene oxide in some tropical fruits and the increased synthesis of these gases due to cobaltous sulfate**

1The phytohormone ethylene is synthesised by plants from methionine which is con¬verted firstly to S- adenosyl methionine (SAM), then to 1- amino cyclopropane – 1 carboxylic acid (ACC) and finally to ethylene (Adams and Yang, 1979). 2This paper reports on the production of ethylene and ethylene oxide by tropical fruits such as Carica papaya , Artocarpus altilis (breadfruit), and Manilkara zapota (naseberry). 3The rate of respiration (O2 uptake) was investigated in these fruits and a correlation between ethylene production and the rate of respiration was made with the aim of characterising the naseberry as either being climacteric or non - climacteric. 4The effect of Co2+ on the production of ethylene is also reported with rather interesting results. 5Cobaltous ions according to the literature is supposed to inhibit ethylene synthesis ; however we report on the activation of ethylene synthesis by Co2+ at concentrations ranging from 0.110 mM to 1.123 mM. 6Potassium cyanide (13.092 mM) inhibited ethylene synthesis but activated ethylene oxide synthesis. 7Both ethylene and ethylene oxide were detected by the method of GC-MS analysis.

What elements of the abstract are present in each sentence?

1 ________________________________________

2 ________________________________________

3 ________________________________________

4 ________________________________________

5 ________________________________________

6 ________________________________________

7 ________________________________________

Does the abstract contain each of the elements of an abstract?

***Quick Reference Guide***
***Abstract***

Your abstract must have:

- the context of the research
- a brief description of the methods
- the major results
- the most significant conclusions

Your abstract should not contain:

- references
- figures or tables
- sections pasted in from the body of the report
- acronyms or abbreviations

Style

- Do not exceed ~250 words
- Mostly write in the past tense

# 4. Introductions

## *An Introduction to a Scientific Paper*

A well written introduction to a scientific paper gives its readers sufficient information for them to fully appreciate why the study was carried out (McMillan 2001). Introductions typically contain three types of information (Gustavii 2003):

- the research problem and hypothesis
- the findings reported in other studies
- the main features of the methods used

Linguists use the term 'move' to describe the purpose or function of a piece of text. Much scientific writing is very structured and follows a usual pattern of moves. If you understand the purpose of the moves found in each section of a paper (or thesis) and the order in which they occur, then this will help to you write your papers and to understand and criticise papers written by other authors. In this module, we are going to look at the structures and moves found in the introductions to scientific paper, theses and reports.

The moves of a typical introduction and the way that the information they contain is used are given in the table below (after Swales 1984).

| Move | Functional name of move | Brief explanation of move |
|---|---|---|
| 1 | Establishing the field | This move introduces the topic by showing that the field is significant, or the research is relevant, by stating or summarising what is known. |
| 2 | Summarising previous research | Summarising from the perspective of the current research and showing the relationship between this research and the whole field. |
| 3 | Preparing for present research A. indicating a gap B. raising a question | This justifies the need for the current research by showing that there has not been enough research in this field yet or that there have been problems or errors in previous research. |
| 4 | Introducing the current research A. stating its purpose B. giving an outline | This move clarifies the research by stating its purpose and outline. |

Introduction Task 1

Below is the introduction to a paper on tissue culture. Read it and discuss in your group whether or not it follows the four moves outlined above. Determine whether there are any sentences or phrases that can be clearly linked to the four moves.

**Introduction:** The formulation of media for tissue culture is an important process that, histori¬cally, has been empirical in nature. In the early days, media formulations were based on solu¬tions used for hydroponic systems (Cohen, 1995; Leifert, Murphy and Lumsden, 1995), and components were varied singularly or in groups to suit individual species and systems (Williams, 1993). However, after Murashige and Skoog published their paper, A Revised Medium for Rapid Growth and Bioassays with Tobacco Tissue Cultures (1962), many plant tissue cul¬turists began using the mineral combination contained in this article (commonly called MS minerals) for the growth of a great variety of plant species. It has been estimated that MS minerals are used for 50–75% of all plants produced by micropropagation (George, Puttock and George, 1987; Leifert et al., 1991; Debergh, De Riek and Matthys, 1994). In addition, when new species are introduced into tissue culture, researchers will often trial growth on a medium with MS minerals and, if growth is adequate, no further investigation is undertaken (Leifert et al., 1995). Thus, media are often selected without extensive testing of their suitability (De Fos-sard, 1976). Perhaps the common usage of MS minerals is associated with a belief that there is a large tolerance of plantlets to different mineral concentrations (De Fossard, 1976). However, since it is known that plants ex vitro have specific nutrient requirements for maximum growth (Hewitt, 1966), it is unlikely that the MS mineral formulation is optimal for all species.

The development of media formulations for some species has proved problematic and there are some plants that do not respond well to established media, such as MS, and for which simple medium adjustment is also unsuccessful. It has been found that some plants require undefined ingredients such as potato, banana or pineapple homogenates in order to grow successfully, which suggests that the existing formulations for these plants are not optimal (Debergh et al., 1994). Since the empirical method described earlier is the most common way of producing mineral formulations, the development of new media recipes is laborious due to the large number of treatments required by such experiments. Thus, in order to reduce the size of these experiments 'short cuts' have been proposed. For instance, Cohen (1995) suggested that it is necessary only to vary K+, NH4+ and NO3 in mineral trials because Ca2+, Mg2+ and PO3 are rarely found to be beneficial for plantlet growth at levels lower than those contained in MS. However, this excludes the possibility that higher concentrations of these minerals may in¬crease growth.

The possibility of optimising mineral formulations in vitro without having to manipulate large experiments has arisen from recent research showing that medium mineral concentrations strongly influence plantlet concentrations in vitro (Gribble, Conroy and Holford, 2000). Gribble et al. (2000) also showed that critical mineral concentrations in vitro are similar to those of field-grown plants. This study suggested that analysis of plantlet mineral concentrations can be used to optimise media concentrations in the same way that plant tissue analysis is used to adjust fertiliser regimes ex vitro. Thus, analysis of healthy plants in the field may be used to influence the initial selection of a medium for tissue culture. Following this, plantlets may be grown on that medium, analysed at the end of a culture period and these results used to adjust and optimise the medium formulation. This paper investigates the validity of the protocol using a hybrid eucalypt, Eucalyptus europhylla × grandis, a species that is difficult to micro-propagate and that does not grow well on MS minerals.

Gribble et al. 2002

## *An Introduction to a thesis, report or proposal*

In contrast to writing the introduction to a scientific paper, which is often only three or four paragraphs in length, an introduction to a thesis, report of proposal is often more detailed and lengthy. As a result, intro¬ductions to these types of writing are often divided into the following three sections:

- Scope
- Literature review
- Research objectives

Scope
This section:

- provides an overview of the research as a whole
- indicates where the research problem came from
- contains a thesis statement
- contains the major research questions or hypotheses to be addressed
- shows that the project is significant
- demonstrates the worthiness of the project with respect to gaps or conflicts in present knowledge or understanding
- shows how the various research questions are interrelated
- provides insights into how research questions will be answered

Also, when writing an introduction:

- engage your reader
- make clear links between the research question and the information presented
- be selective about what you include

**Writing introductions task 2**

Below is the scope section. Read it and discuss in your group whether or not it addresses the points listed above. Determine whether there are any sentences or phrases that can be clearly linked to these points.

Onions are an important crop in the United Kingdom with over 16,000 ha under cultivation producing 309,000 Mt. Much of the UK crop (~75%) is now produced from hybrid varieties due to their superior yield and quality. The production of hybrid varieties requires a system to ensure that all seed produced is truly hybrid and that no self-pollinated seed is produced. In the onion crop, a trait called cytoplasmic male sterility (cms) is used to prevent self fertilisation. This is a valuable trait for plant breeders that allows plants to be fully female fertile but pre¬vents flowers producing or shedding viable pollen. Hence, when producing hybrid onions, the female parent of the cross exhibits CMS whilst the male parent is normally fertile. During the production of a new, hybrid variety at Horticulture Research International (HRI), the male sterile female parent apparently reverted to full fertility and produced pollen. The cause of this apparent reversion is unknown and may have been due to a biological cause, to the environment or simply due to the mislabelling of bags of seed. Currently, there is no way of distinguishing male sterile from male fertile plants other than through their production of pollen. Therefore, the overall aim of this study is to develop a system for easily distinguishing male fertile from male sterile onions.

Work on cms in other species has shown that the trait it is controlled by a cytoplasmically en¬coded lesion and, where molecular studies have been carried out, the lesion has been shown to occur in the mitochondrial genome. In onions, genetic studies have shown that cms is also a cytoplasmically inherited trait. However, no molecular studies have been made and it is not known in which organelle the trait is encoded. Therefore, this study will attempt to determine the cellular location of the lesion.

A range of onion cultivars are available that contain either the normal (N) cytoplasm and so are male fertile, and that also contain one of the two cytoplasms called the cms-S and cms-T that can confer male sterility. The study will separate mitochondria and chloroplasts from other cell contents of these varieties and then purify DNA from these organelles. The DNA will be cleaved using restriction endonucleases and the fragments separated using agarose gels. The DNA will then by subjected to Southern analysis using mitochondrial and chloroplastal genes from other species as probes. Using these techniques, this study will look for restriction length polymorphisms in mitochondrial and chloroplastal DNA that will identify the organellar location of the cms lesions and that will act as genetic markers for the different cytoplasm found in male sterile and fertile onions.

70% of cytoplasmic male sterility systems studied are sensitive to exogenous factors. In many systems, the nature of these factors is unknown and alterations in fertility phenotype may be the result of certain features of the climatic and edaphic environment in which the plants are grown. Where the nature of these influences has been studied, temperature has been the cause of phenotypic instability in 50% of cases. This study will determine the stability with respect to temperature of the cms-S cytoplasm used in breeding hybrid onions at HRI in controlled temperature chambers and will assay pollen production by cms-S breeding lines.

Although the weight of evidence suggests that the lesion causing male sterility in plants is located in the mitochondrion, the actual processes that result in sterility are not clear. The lesion has its effect only within the anther and other tissues are apparently unaffected by it. Genes controlling male sterility may have their action during anther development, during pollen production or after the pollen is formed. No work has been performed on the nature of the lesions leading to male sterility in cms onions. Therefore, the final section of this study will use light and electron microscopy to determine the stage at which the gene causing male sterility in cms-S onions has its effect and to follow the fate of organelles in anther tissues to determine their role in the de¬velopment of cms.

## *Literature review*

This section:
- provides an intellectual context for the study
- gives a detailed discussion of the conceptual and empirical aspects of the research
- should present a comprehensive literature review related to the problem situation
- demonstrates that the author is familiar with the research area
- explains how the thesis is related to the literature or other research
- can have a more relaxed writing style than the scientific norm

The contents of literature review will be covered in the next module.

## *Research objectives*

This section:
- may contain a general statement(s) of the research objectives
- provides a list of specific aims associated with the general objective

**An Example:**

**Aims**
The general aim of this thesis is to examine the phenomenon of vitrification, looking at possi¬ble causes and remedies whilst also attempting to understand some of the processes involved in growth of plantlets in vitro. In particular, the role of plantlet water relations and mineral nutri¬tion in vitrification and plantlet growth are addressed. The specific objectives are to:
- Develop a vitrification scoring system for G. paniculata that predicts plantlet survival ex vitro and to determine a benchmark level of acceptable vitrification level (Chapter 2).
- Examine the water contents and osmotic potentials of vitrified and non-vitrified plantlets (Chapter 3).
- Use environmental scanning electron

microscopy to examine the water regulatory structures of in vitro and ex vitro grown plants (Chapter 4).

- Use nuclear magnetic resonance imaging to investigate the distribution and concentration of water within vitrified, non-vitrified and glasshouse-grown plants (Chapter 5).
- Determine the level of ventilation required to reduce vitrification to an acceptable level and to distinguish between high water availability and lack of transpiration as the primary cause of vitrification (Chapter 6).
- Measure how vessel placement and shelf material influences relative humidity in vitro and determine whether small decreases in relative humidity can influence growth and vitrifica¬tion (Chapter 7).
- Investigate the relationship between mineral nutrition in vitro and vitrification and exam¬ine the effect of medium mineral concentration on plantlet mineral concentration (Chapter 8).
- Use in vitro plantlet tissue analysis to modify an existing growth medium for E. europhylla × grandis to improve growth (Chapter 9).

**Quick Reference Guide**

**Introduction**

Your introduction must have:

- the purpose of the study
- important background information
- what is not known about the experimental system you are studying
- the aims of the study

# 5. Literature Reviews

## *Introduction*

Reviewing the current literature on a research topic is a common form of scientific writing and literature reviews are an essential first step of any research project. All research aims to fill some gap in our understanding of some area of research and it is important to discover what has been done before and what is already known. Literature reviews form the basis to the introductions to papers, theses and grant proposal or they may be written in their own right as scholarly reviews of some aspect of science.
The function of literature reviews for papers, theses and proposals is to give background information so that readers can understand why a study was performed and to show that the author is familiar with research that has been carried out in his/her area. Literature reviews also show how research is linked to an ever expanding chain of research that is going on worldwide. In this module, we will overview the function of literature reviews and ways of efficiently critiquing published work. In the following module, we will then look at how the work of other scientists is acknowledged.

## *The place of the literature review in research*

| Purposes for reviewing literature | | Development as a researcher |
|---|---|---|
| Developing your own understanding | • To learn about knowledge in a particular field from reading about research • To gather material for writing essays and reports • To discover how knowledge in a particular field has been developed and accumulated • To identify what is still unknown • To confirm that your own research is worthwhile to do • To learn how others have made their discoveries | Gradual shift from science student and novice researcher |
| | • To identify which researchers to contact to exchange views | |
| | | ↓ towards ↓ |
| Demonstrating your own understanding | • To demonstrate that you understand what is known in a particular field • To explain how different pieces of research fit together • To explain how knowledge has been developed and accumulated over time • To explain how your own research is connected to what is already known • To explain how your research is justified as needing to be done • To acknowledge the work and achievements of others | Science scholar and expert researcher |

Source: Holford et al. (1999).

### Literature Reviews Task 1

Answer the following questions:
- What types of material are you going to read to enable you to perform your research and write your scientific article?
- How do you read a scientific article or book?
- How do people choose which scientific papers to read?

*Different types of literature reviews*

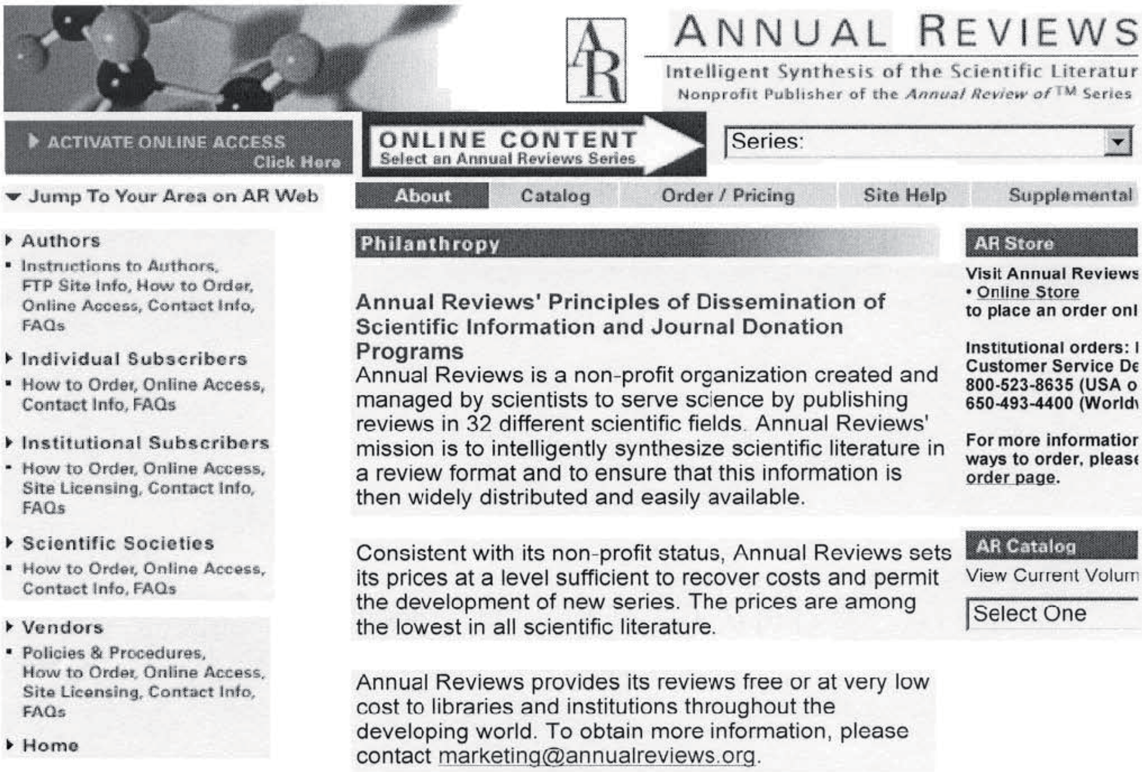
| Literature review type | Brief description of this type |
|---|---|
| Survey of literature (including 'state of the art' surveys) | A critical analysis of relevant sources showing inter-relationships among them, and intended to encompass the existing knowledge in this field |
| Research or thesis literature review | A critical analysis of relevant sources showing inter-relationships among them, and intended to extend the knowledge in this field |

Source: Holford et al. (1999).

## *Finding information*

What resources are available to you to perform literature reviews? Below are some examples of places to find information, including abstracts, scientific journal artilces and other literature reviews. Free online access to a range of journals is available developing economies, based on either programs such as HINARI or AGORA or on a HighWire-based program offering access to countries appearing in the World Bank's list of low income economies plus Angola, Armenia, Azerbaijan, Djibouti, Georgia, Indonesia, Turkmenistan, and Ukraine.

**Annual Reviews**
(http://www.annualreviews.org/about/philanthropy.asp)




**HINARI**

The HINARI network contains over 2000 journals from 70 different publishers. The service is offered free to not-for-profit institutions in certain countries

## AGORA

AGORA Registration: If your institution is an academic, government or research institution located in one of the countries listed below, you may be eligible to join AG¬ORA.

Browse journals by subject category

Agriculture Animal Science Biology Biotechnology/ Applied Microbiology Chemistry/Biochemistry/Biophysics Economics/Social Science Entomology/Pest Control Environment/Ecology/Natural Resources Fisheries/ Aquatic Science Food Science/Nutrition Forestry Multidisciplinary/Miscellaneous Plant Science/Soil Science

**AGORA - Access to Global Online Research in Agriculture**

http://www.aginternetwork.org

The Food and Agriculture Organization of the United Nation's Access to Global Online Research in Agriculture (AGORA) is an initiative to provide free or low-cost access to major scientific journals in agriculture and related biological, environmental and social sciences to public institutions in developing countries.

The goal of AGORA is to increase the quality and effectiveness of agricultural research, education and training in low-income countries, and in turn, to improve food security. Launched in October 2003, AGORA provides access to 700+ journals from the world's leading academic publishers to FAO- approved institutions in the developing world.

HINARI and AGORA will continue to have a positive impact on the ability of developing world scientists to find solutions and solve their own health and food crises. They will ensure that developing world scientists are part of the global scholarly community and that doctors and agriculturalists practicing in the region have access to up-to-date information.

## TEEAL

Subject coverage: The journals in TEEAL were selected by 600 international scientists as the most essential to research and education conducted in the developing world. Some of the subject areas covered in the TEEAL journal collection include:

Agricultural Economics and Engineering Crop Improvement Environment and Natural Resources Food Processing and Nutrition Forestry Livestock Production Plant Protection Range Management Rural Development Soil and Water Management Sustainable Agriculture Veterinary Medicine

**TEEAL - The Essential Electronic Agricultural Library**

http://teeal.cornell.edu/

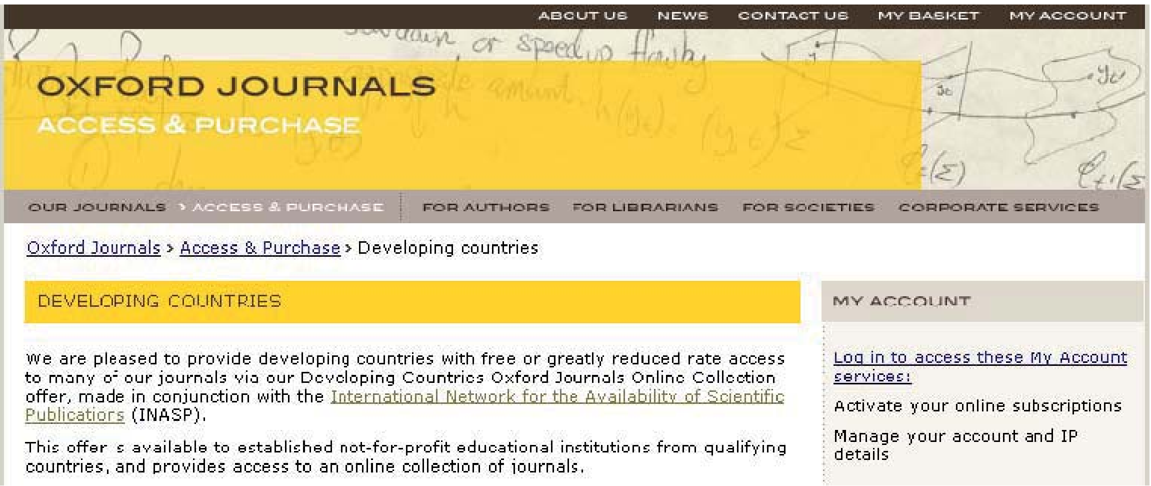
TEEAL is a full-text and bibliographic CD-ROM library of over 140 of the world's most important scientific journals selected by 600 international scientists as the most essential to research and education in the field of agriculture. It is available well below cost to over 100 of the lowest-income food deficit countries, as listed in the World Bank's 1998-9 World Development Report.

## International Network for the Availability of Scientific Publications

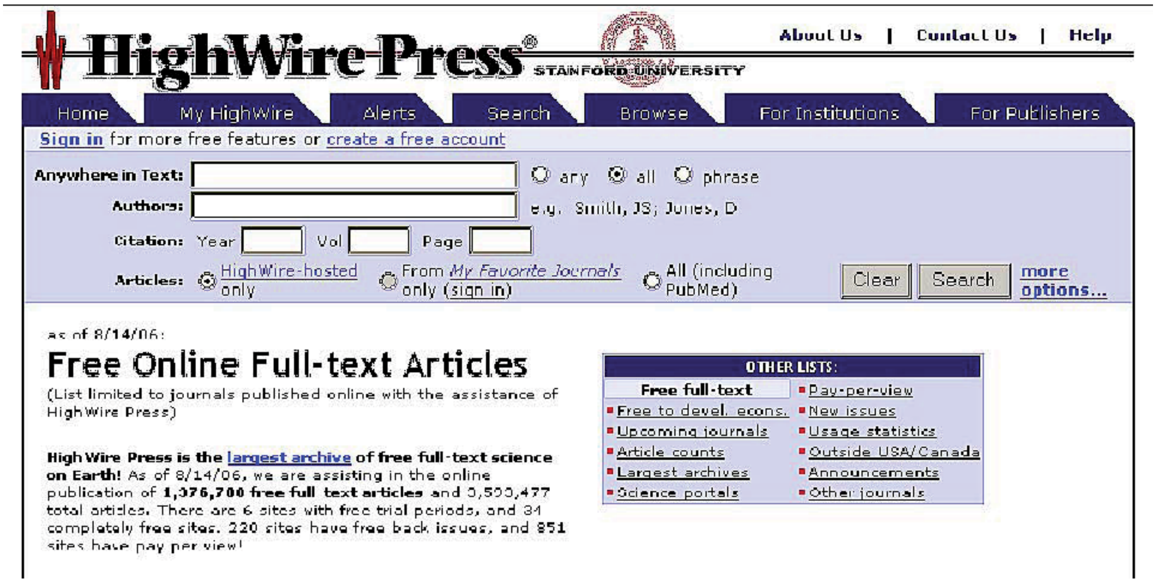
http://www.inasp.info/peri/index.shtml

INASP was established in 1992 by the International Council for Science to improve access to information and knowledge through a commitment to capacity building in emerging and developing countries. INASP's vision is that "all people are able to access and contribute information, ideas and knowledge necessary to drive sustainable and equitable development". INASP seeks to achieve this vision through activities and programmes that im¬prove access to scientific and scholarly information.

**Oxford Journals**
http://www.oxfordjournals.org/access_purchase/developing_countries.html




**HighWire Press**
http://highwire.stanford.edu/lists/freeart.dtl




**Free abstracting services available on the WWW**

Agricola http://agricola.nal.usda.gov/
PubMed http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?DB=pubmed
PubChem http://pubchem.ncbi.nlm.nih.gov
TOXNET http://sis.nlm.nih.gov/enviro/toxicologyinformation.html
SCIRUS http://www.scirus.com
ScienceDirect http://www.science direct.com

**Other sources of information**
Google Scholar
Google Books
The WWW Virtual Library http://vlib.org/
FAO Agris database http://www.fao.org/agris/
Pesticide Information Profiles http://extoxnet.orst.edu/pips/ghindex.html
Sydney Postharvest Laboratory http://www.postharvest.com.au/
South Australian Research and Development Institute http://www.sardi.sa.gov.au/
Rural Industries Research and Development Corporation http://www.rirdc.gov.au/
Australian Database Resources http://www.anbg.gov.au/cpbr/databases/index.html
Bad Bug Book http://vm.cfsan.fda.gov/~mow/intro.html
NIST Chemistry WebBook http://webbook.nist.gov/chemistry/
Plant Pathology Internet Guidebook http://www.pk.uni-bonn.de/ppigb/ppigb.htm

**Evaluating Information Sources**
Cornell University Library: Evaluating web sites: criteria and tools
http://www.library.cornell.edu/olinuris/ref/research/webeval.html
New Mexico Sate University Library: Evaluation criteria
http://lib.nmsu.edu/instruction/evalcrit.html
James Cook University: It must be true, I got it off the web
http://www.library.jcu.edu.au/LibraryGuides/eval.shtml

## *Critically reading and reviewing*

Research at any level requires scientists to collect and read several hundred papers published in scien¬tific journals and review articles and book chapters before they can even start their research, let alone submit it for publication. Critically reading large amounts of material is a time-consuming process. Therefore, it is important that you develop the skills necessary for reading efficiently. Developing the ability to critically read material (including your own) is fundamental to learning about and understanding your study topic. Therefore, it is also important to develop a process to help analyse the material you have selected. Addition¬ally, through developing good reading skills, you will write more effectively and improve your ability to communicate your ideas. This section will help you develop your critical reading skills.

As discussed earlier, you will read many articles on your topic. These articles may present differing ideas or theories about aspects of your topic. This is a usual part of science; senior, reputable scientists often disagree over the meaning of data, may hold differing views or opinions, and may support opposing theories. In addition, the authors of each piece of writing you read have come from diverse backgrounds and have pro¬duced pieces of writing for different purposes. Therefore, each piece of writing will have a particular bias. When you read a piece of writing, you should try to identify this bias.

### Get yourself organised

- Develop a filing system
- Referencing—manual or computerised (e.g. Endnote)?

### Why are you reading?

- Understanding
- Critically reviewing

### Reading for understanding

- Look up new vocabulary (English, scientific) and write down the definition
- Identify the thesis / claim / position / central argument
- Identify all topic sentences
- Trace the organization (examine the order in which points are presented)
- Identify the support for the thesis
- Are there any counter-arguments (arguments against)? If so, what support do they have?
- What authority does the author have on the subject and what bias?
- Highlight important or interesting sections
- Highlight sections to which you would like to refer in your own writing

### Critically reviewing

As scientists, you are often required to evaluate and comment on the work of others. In particular, you may be invited by national and international journals to review manuscripts sent to them for publication, or you may assess grant applications. Also, you may be asked to review theses submitted by students for re¬search degrees. Therefore, in addition to reading for understanding, you need to develop the ability to criti¬cally read (looking for good and bad) pieces of writing. It is easier to critically read a piece of writing by reading through it several times, concentrating on different aspects of the text each time. (Also, remember to focus on these areas when you write your own work.)

Check the following when reading a piece of writing:

**1. Thesis statement or argument**
What is the thesis? Is the thesis supported by a logical argument? Is support for the thesis complete? Are there any counter-arguments? If so, what support do they have? Do you agree or disagree with the thesis statement? If so why?

**2. Content**
Does the author include all possible issues? Is each issue covered fully? If not, what is left out? If issues are left out, why are they left out? Do the data presented support the thesis? Could there be alternative explanations for the data? What is (are) the major conclusions(s)? How well are they supported?

**3. Organization**
How is the piece of writing structured? Is the structure logical, well-organized and easy to follow? If not, how should the structure be changed?

**4. Use of English (or other language)**
Spelling Punctuation Syntax (word order) Flow

## Critical reading task 1

Read the following article from New Scientist: Coghlin (2004)

**Shock Waves Tear Food Bugs Apart**

Shock waves have been used for the first time to destroy a host of common food bacteria. If the technique can be perfected, it could one day be used instead of pasteurisation to sterilise baby foods, dairy products and fruit juices without spoiling their taste. The process is being developed by Achim Loske and colleagues at the Autonomous University of Mexico's Centre for Applied Physics and Advanced Technology in Queretaro.

Loske subjected vials of bacteria to shock waves in a device called an electrohydraulic generator, which generates shocks with pressures of up to 1000 atmospheres, accompanied by intense flashes of visible and ultraviolet light. This combination, Loske says, killed bacteria in the vial. "A possible advantage of the treatment is that, as far as we know, shock waves don't change the taste of the food," he says.

The pressure waves cause microscopic air bubbles in the liquid surrounding the bacteria to expand momentarily and then violently collapse—a process known as cavitation—generating small regions of intense heat. This, along with the pressure of the shock wave and the intense pulses of visible and ultraviolet light are what we think kill the bacteria. "It's a combination of compression cavitation and electromagnetic radiation," says Loske, whose results will be published in a forthcoming edition of the journal Innovative Food Science and Emerging Technologies. The system needs further development as it doesn't yet kill enough bacteria to be useful. The best results were with Listeria monocytogenes, a food-borne bug which can trigger miscarriages. Least affected were E. coli O157:H7 bacteria, which have caused fatal food poisoning outbreaks. At best, populations of bacteria shrank a thousandfold following some 350 shock waves given over 15 minutes.

Loske is confident of achieving million-fold reductions, which would be enough to make food safe. 'It's a matter of increasing the shock wave energy and dose, and has been achieved recently in our lab with Listeria monocytogenes,' he says. His team is also investigating just how the shock waves kill the bacteria. "We still don't know whether this would be cheaper than conventional technologies," he says.

Morse Solomon, a food safety expert at the US Agricultural Research Service lab in Beltsville, Maryland, says that understanding exactly how the bacteria are killed is essential if the technique is ever to be commercialised. Solomon's team once tried tenderising meat using shock waves from a small dynamite explosion. That also killed bacteria, but not in practical quantities.

**Now answer the following questions**

1) Identify the topic sentences in each paragraph and their subjects and foci (plural of focus).

2) Does each topic sentence express the main idea of a paragraph?

3) What is the thesis of the author?

4) How is the article organised?

# 6. Paraphrasing and Citation

A major difficulty in writing is to paraphrase the ideas of other authors when you need to use these ideas within your writing. Paraphrasing is especially difficult when translating text from one language to another. First, this module introduces ways of modifying language so that plagiarism is avoided.  Associated with paraphrasing material is the need to cite sources and to produce a reference list. Scientific writing uses a number of different citation systems, and each journal has its own style of citing references both in the text and in the reference list.  The second part of this module introduces each citation system and presents a number of common citation styles used by different journals.

## Plagiarism

Plagiarize: to steal and pass off (the ideas or words of another) as one's own: use (a created production) without crediting the source: to commit literary theft: to present as new and original an idea or product derived from an existing source
Source: Webster's New Collegiate Dictionary, 9th ed.

Why you should not plagiarise

- It does not give credit to the person(s) who created the original idea
- It does not allow you to clarify your own ideas
- It does not allow you to improve your writing skills
- It does not demonstrate knowledge or comprehension

## Terminology

Quote: An exact copy of something someone else has said or written (and citing your source)
Paraphrasing: Rewriting text in your own words (and citing your source)
Citation: Naming the text that identifies the source of a quote or idea

When to quote (Anderson et al. 1970)

- When the original words of the author are expressed so concisely or convincingly that you could not possibly improve on these words
- When you wish to comment upon, refute, or analyse ideas expressed by another writer
- When changes through paraphrasing might cause misunderstanding or misinterpretation
- When the exact words of an authority lend support to your own ideas

Example of a direct quote
The simplicity of the ethylene molecule is in striking contrast to its complex role in plant biology.
Abeles (1992)

When should I paraphrase?

- Most of the time—your work (paper, thesis etc.) should be in your words
- In general, it is the meaning or ideas that you should take from others (and cite the authors) the wording they use is not important
- When a direct quote is too long

It's the idea, not just the words, that must be cited!
Rodgers (1977)

## How to paraphrase and avoid plagiarism (Rodgers 1977)

- Ensure that you give yourself plenty of time for writing
- Read the material that you want to paraphrase many times until you are sure that you understand its meaning
- Try writing first drafts without looking at your sources (papers, books etc.)
- When making notes or writing drafts, always ensure that you write down the full citation of your source at the time of writing
- Ensure that you fully understand any technical terms
- Include only those ideas from your source that are of direct relevance to your topic remove any unnecessary information
- Paraphrasing does not consist of changing one or two words in each sentence

Example

Original: Contrary to popular belief, food prepared from genetically modified organisms has never been shown to be harmful.

Poor paraphrase: Contrary to popular thinking, food made from genetically engineered organisms has never been shown to cause harm (Bloggs 2000).

Better paraphrase: No one has ever proved that harm is caused by foods made from genetically engineered organisms (Bloggs 2000).

## Modifying sentences to help with paraphrasing

**Using signal phrases**

According to Agrios (1992), the organisms causing disease in plants are similar to those affecting humans and other animals.

In their review of abscisic acid, Adicott and Lyon (1969) argue that the unusual chemical structure of this compound motivated much speculation about its mechanism of biosynthesis.

**Using synonyms**
Genetics is a branch of science that seeks to understand the nature of heredity that leads to particular phenotypes in individuals through knowledge of the interactions that occur between genes and the environment.

Genetics is an area of science that attempts to comprehend the basis of heredity that leads to particular phenotypes in individuals through knowledge of the interactions that occur between genes and the environment.

**Changing the sentence type**
Genetics is an area of science that attempts to comprehend the basis of heredity that leads to particular phenotypes in individuals through knowledge of the interactions that occur between genes and the environment.

Genetics is an area of science that attempts to comprehend the basis of heredity that leads to particular phenotypes in individuals. This is achieved through knowledge of the interactions that occur between genes and the environment.

**Reducing a clause to a phrase**
Genetics is an area of science that attempts to comprehend the basis of heredity that leads to particular phenotypes in individuals. This is achieved through knowledge of the interactions that occur between genes and the environment.

Attempting to comprehend the basis of heredity that leads to particular phenotypes in individuals, genetics, an area of science, studies the interactions that occur between genes and the environment.

**Changing the parts of speech**
Attempting (verb) to comprehend the basis of heredity that leads to particular phenotypes in individuals, genetics (noun), an area of science (noun) studies (verb) the interactions that occur between genes and the environment.

In an attempt (noun) to comprehend the basis of heredity that leads to particular phenotypes in individuals, a geneticist (new noun) undertakes studies (noun) of the interactions that occur between genes and the environment.

**Changing the voice of a verb**
In an attempt to comprehend the basis of heredity that leads to particular phenotypes in indi¬viduals, a geneticist undertakes studies of the interactions that occur between genes and the environment.

In an attempt to comprehend the basis of heredity that leads to particular phenotypes in indi¬viduals, studies of the interactions that occur between genes and the environment are undertaken by geneticists.

**Word order**
In an attempt to comprehend the basis of heredity that leads to particular phenotypes in individuals, studies of the interactions that occur between genes and the environment are undertaken by geneticists.

In an attempt to comprehend the basis of heredity that leads to particular individual's phenotype, studies of the interactions that occur between genes and the environment are undertaken by geneticists.

## Paraphrasing and citation practices task 1

Use two of the techniques given above to paraphrase the texts below.

**Text 1** The most appropriate design of extension programs for developing countries has been the subject of much debate. The most recent approach to extension to be adopted is that of Farmer Field Schools (FFSs). FFSs were started in 1989 in Indonesia to reduce farmer reliance on pesticides in rice. They have proven effective at involving a wide range of people in the learning processes associated with integrated pest management, animal husbandry and organic production. Typically, FFSs consist of about 25 participants who meet regularly for the duration of an entire cropping season. Participants learn by observing what is happening in their fields and by conducting small experiments. In FFSs, extension workers act as facilitators of learning rather than instructors and help participants experiment and problem-solve independently. Studies of FFS have shown that they provide a better basis than other extension systems for continued innovation and local adaptation. (Source: Paul Holford)

Text 2 The diamondback moth (DBM, Plutella xylostella), is universally distributed and is the single most destructive insect of cruciferous plants, particularly in tropical climates, where it can survive throughout the year. It can complete its life cycle in as little as two weeks and there may be up to 20 generations per year. The moth larvae feed on Cruciferae that contain mustard oils, including both weed and crop species. Among the crop plants, the larvae cause serious damage to cole crops such as cabbage, cauliflower, broccoli, Brussels sprouts and Asian leafy brassicas as well as members of the mustard family, including canola. Young larvae invade spongy mesophyll tissues resulting in mines and small holes. Older larvae feed on the adaxial sides of leaves, consuming all tissues except the wax on the upper surface, causing the formation of windows. On broccoli and cauliflower, the damage is indirect because the larvae feed on the leaves and not on the commercial flower head. Larvae also feed on the growing tips of young plants, preventing further development and, on cabbages, it can cause a deformation of the head as it enlarges. This latter type of damage creates an environment that encourages the growth of soft rots resulting in further losses. Caterpillars or cocoons may also be hidden in produce and may cause it to be rejected for export. (Source: Paul Holford)

Text 3 Indonesia has some of the most extensive and biologically diverse tropical rainforests in the world; however, they are now under threat. Up to the beginning of the Soeharto era, 75% of Indonesia's land area (~144 million ha) was still covered by forest with tropical rain forests making up the majority of forest cover, particularly in Kalimantan, Sumatra and Papua. Commercial exploitation of forest resources started in the 1970s, and when oil and gas prices reduced sharply in the early 1980s, the forestry sector became Indonesia's second largest earner of foreign exchange. Estimates of forest depletion vary and ranged from 700,000 to more than 1 million hectares per year during the mid-1980s. Illegal logging is also widespread and is thought to have destroyed approximately 10 million ha of forest. (Source: Paul Holford)

# 7. References and Citation

## *Referencing styles and requirements*

When referencing material you must consider:

- citing references in a body of writing • order of references in the reference section
- style of citation

Referencing styles

- Harvard (name and year)
- Number by alphabetical order
- Vancouver

**The Harvard name and year system**
Citations in a text give the name(s) of the authors(s) and the year of publication of the article or book. In a reference section, references are arranged according to the alphabetical order of the author(s) and then the date of publication.

Example: The formulation of media for tissue culture is an important process that, historically, has been empirical in nature. In the early days, media formulations were based on solutions used for hydroponic systems (Cohen, 1995; Leifert, Murphy and Lumsden, 1995), and components were varied singularly or in groups to suit individual species and systems (Williams, 1993). However, after Murashige and Skoog published their paper, A Revised Medium for Rapid Growth and Bioassays with Tobacco Tissue Cultures (1962), many plant tissue culturists began using the mineral combination contained in this article (commonly called MS minerals) for the growth of a great variety of plant species.

Reference section: Cohen (1995) … Leifert, Murphy and Lumsden (1995) … Murashige and Skoog (1962) … Williams (1993) …

**Numbering by alphabetical order**
Citations use the number of the reference. References are ordered according to the alphabetical order of the author(s) and then the date (like in the Harvard system).

Example: The formulation of media for tissue culture is an important process that, historically, has been empirical in nature. In the early days, media formulations were based on solutions used for hy¬droponic systems,1,2 and components were varied singularly or in groups to suit individual spe¬cies and systems.4 However, after Murashige and Skoog3 published their paper, A Revised Medium for Rapid Growth and Bioassays with Tobacco Tissue Cultures, many plant tissue cul¬turists began using the mineral combination contained in this article (commonly called MS minerals) for the growth of a great variety of plant species.

Reference section: (1) Cohen (1995)…
(2) Leifert, Murphy and Lumsden (1995)...
(3) Murashige and Skoog (1962)…
(4) Williams (1993)…

**The Vancouver system**
Citations use the number of the reference. References are numbered in the order in which they appear in the text.

Example:
The formulation of media for tissue culture is an important process that, historically, has been empirical in nature. In the early days, media formulations were based on solutions used for hydroponic systems,1,2 and components were varied singularly or in groups to suit individual species and systems.3 However, after Murashige and Skoog4 published their paper, A Revised Medium for Rapid Growth and Bioassays with Tobacco Tissue Cultures, many plant tissue culturists began using the mineral combination contained in this article (commonly called MS minerals) for the growth of a great variety of plant species.

Reference section: (1) Cohen (1995)…
(2) Leifert, Murphy and Lumsden (1995)...
(3) Williams (1993)…
(4) Murashige and Skoog (1962)…

## *Citations in the text*

Single authors
(Bloggs, 1990) (Bloggs 1990) According to Bloggs (1990) (Bloggs 1990a, b) (Bloggs, 1990a, b)

Two authors
(Bloggs and Jones, 1990) (Bloggs and Jones 1990) (Bloggs & Jones, 1990) (Bloggs & Jones 1990) According to Bloggs and Jones (1990)

Multiple authors
et al.—abbreviation for et alii (and others) (Bloggs et al., 1990) (Bloggs et al., 1990) (Bloggs et al. 1990) According to Bloggs et al. (1990)

Multiple references (Charles, 1984; Smith, 1984; Bloggs, 1990; Jones, 1997)—date order: common (Bloggs, 1990; Jones, 1997; Smith, 1984)—alphabetical order: rare

# 8. The Materials and Methods Section

## *Introduction*

The materials and methods section of a paper or dissertation is usually the most straightforward to write. However, common errors in M&M sections occur in the ordering of information and in the amount of detail that is required by journals.  This module discusses these issues and provides you with the opportunity to criticise an M&M section from a paper, determine the order of its contents and look at the level of precision.

### Contents

- Materials—what you used
- Methods—what you did and how you did it

### Completeness

- A M&M section should contain sufficient information to allow the experiment to be repeated
- If reviewers and editors cannot tell how experiments were performed, the paper or dissertation will not be accepted
- Readers may want to know which method was used so that they can replicate or extend your re¬sults

## *Style of a Materials and Methods section*

The Materials and Methods are usually written in:

- sentence form
- sections with related methods collated together
- chronological order
- the past tense
- the passive voice

### Precision

**Give details of materials used:**

- important chemicals (purity and name of supplier)
- important apparatus (type, brand, model) • organisms (species, strain, cultivar, race or line etc.), especially
  if developed yourself

**Give details of experimental procedures:**
'the mixture was heated' vs. 'the mixture was heated to 70 °C for 30 min'

'embryo viability was determined as previously described (Bloggs 1980)' vs. 'embryo viability was determined by using tetrazolium as previously described (Bloggs 1980)'

If you are using a well-known method, give name and reference.

### Things to avoid

- repetition
- unnecessary information
- misuse of capital letters

## Materials and Methods Task 1

How is this M&M section organised?

How does it show precision?

**Materials and Methods** Aleemullah et al. (2000)

*Plant material and growth conditions*
These experiments were conducted in a glasshouse at the School of Horticulture, University of Western Sydney, Richmond, Australia, during August to November using plants of Capsicum annuum Longum Group, cultivar 'Red Hot Glory' (Henderson Seeds, Vic.). The glasshouse temperature varied from 24 to 36 °C during the day and 19 to 26 °C during the night. Plants were grown under natural light conditions with an average day length of 13 h and an average photosynthetic photon flux density of 650 µmole m–2 s–1 at midday.

Ten-week-old seedlings, grown in cell trays, were transplanted singly into 25 L plastic pots containing 16.5 kg (dry wt.) of potting mix. The composition of the potting mix by volume was three parts composted hardwood sawdust, four parts composted pine bark and three parts dry washed coarse sand. To minimise evaporation from the potting mix, each pot was mulched with 1 kg of crushed quartz gravel. The following nutrients (kg ha–1) were applied monthly to every pot: N, 60; P, 9.22; K, 48; Fe, 0.08; Mn, 0.042; Zn, 0.015; Cu, 0.042; B, 0.022; Mo, 0.0005. The pots were watered to field capacity daily.

*Anthesis and dehiscence of anthers*
When the plants began to flower (11 weeks after transplanting), observations and investigations were carried out in respect of anthesis, anther dehiscence, female gametophytic receptivity and the effect of pre- and post-anthesis pollination on fruit development. Observations on anthesis and anther dehiscence were made at hourly intervals

commencing from 5:00 to 19:00 h each day for twenty-five days: this period of observation lasted from pre-dawn to post-sunset. Anthesis was deemed to have occurred when the petal segments separated from each other. The number of flowers which opened were recorded and the counted flowers were pinched off to avoid recounting. Twenty or more flowers that had opened were tagged and retained on the plants (not pinched off at anthesis) to record anther dehiscence. Anther dehiscence, in this study, was taken as the time at which a rupture in the anther lobe was observed.

*Pollination and fruit development*
To collect pollen, anthers were removed from freshly opened flowers, placed in a Petri dish and exposed for over an hour to the conditions within the polyhouse to liberate the pollen. The rubber head of a pencil was used to collect pollen from the Petri dish and for pollinating the stigmas.

Flowers were hand pollinated at different stages of development to determine the period of receptivity. Pollination commenced seven days before anthesis (days –7 to –1) to four days after anthesis (days +1 to +4). Pre-anthesis flower bud stages were determined on the basis of bud length and width. These measurements were recorded daily from 20 buds and the relationship with the number of days to anthesis was determined. Following the removal of petals, flowers in the pre-anthesis stages were emasculated, hand pollinated, tagged and covered with a pollination bag. Flowers to be pollinated post-anthesis were emasculated at anthesis and covered with a pollination bag to prevent chance pollinations. On the day of pollination, the bag was removed and pollen was transferred to the plant's stigma after which the flowers were tagged and rebagged. To determine the precise time at which the pistil ceased to be receptive, flowers were pollinated at two-hourly intervals, as described above, from the night of the second day (+2) to the morning of the fourth day (+4) after anthesis. The pollination bags were removed from all flowers six days after pollination to allow fruit development to occur. Receptivity was determined on the basis of fruit set. The fruit were harvested at maturity when the whole fruit had turned red, at which time fruit length, weight, diameter and seed number where determined.

*Statistical analysis*
Regression and correlation analysis and analyses of variance were preformed using COSTAT version 4.02. Least significant differences were determined using Duncan's multiple range test.

**Quick Reference Guide**

**Materials and Methods**

**Your Materials and Methods must:**

- contain sufficient details to enable another researcher to be able to repeat the experiment
- avoid trivial details

**Your Materials and Methods must be written using:**

- sections that follow the same order as the procedures performed in the experiment
- the past tense
- the third person
- the passive voice
- flowing paragraphs

# 9. The Results Section

## *Introduction*

After the M & M section of a paper, the results section is usually then next most straightforward to write. The main issues with writing results sections involve sequencing the results and the clarity of their presentation and explanation.

### Composition

- Paragraph for each major analysis
- Background information—briefly describe objective(s) and method(s)
- Use words to describe trends, patterns, relationships that are evident
- Direct the reader to supporting evidence (tables, figures)
- Figures and tables should be properly labelled and should be self-descriptive
- Do not report what you expected to happen in the experiment
- Do not discuss the meaning of your results in this section
- Do not duplicate what is found in other figures, tables or text
- Avoid presentation of 'raw' data

### Sequencing the results

- From most important to least important
- From most significant to least significant
- From general to specific
- From most surprising to least surprising
- From most controversial to least controversial

### Common pattern for describing results

1 Background information
eg "In this study we have examined the contrasting ripening behaviour shown by climacteric and suppressed-climacteric cultivars of Japanese-type plum. "

2 Description of table or graph
"The patterns of ethylene production and respiration … are shown in Figure 1. "

3 Statement of results by itself
eg "Propylene increased respiration of the climacteric cultivars within 48 h of application. "

4 Statement of results by comparison between results
eg "In comparison with the climacteric cultivars, the enhancement of respiration rates of the suppressed-climacteric types by propylene was delayed. "

5 Statement of results by comparison with other published results
eg "In contrast, the climacteric fruit treated with 1-MCP became ripe (soft, juicy and aromatic as described in Abdi et al. 1997) and rotted without the production of an ethylene climacteric."

## Results task 1

Below is the results section taken from a paper by Nukaya et al. (1995). The paper concerns the development of two physiological disorders of tomatoes called blossom end rot and golden speck that are associated with calcium levels in the plant. The researchers grew two cultivars of tomatoes (Momotaro and June Pink) in solutions containing different concentrations of nitrogen in its ammonia form (NH4-N). The researchers then measure the incidence and/or severity of these disorders as well as the mineral concentrations withing various parts of the tomato plants. Read this results section and answer the following question:

What is the order of the results and why do you think they were presented in this way?

Blossom end rot incidence at fruit thinning increased with increasing NH4-N in the nutrient solution in both cultivars. Blossom end rot was higher in 'June Pink' (from 11.3% at 0 me/L to 76.9% at 2.0 me/L) than in 'Momotaro' (from 0.9% at 0 me/L to 47.7% at 2.0 me/L). Blossom end rot incidence at the 1st and 2nd truss was relatively low and tended to become higher in the upper trusses.

On the other hand, gold speck incidence decreased with increasing NH4-N concentrations in the nutrient solution in both cultivars. Gold speck percentage and index decreased from 72.9% to 0.8% and 1.63 to 0.01, respectively, in 'Momotaro' and from 93.9% to 3.6% and 1.49 to 0.04, respectively, in 'June Pink'. Therefore, blossom end rot and gold speck incidence are inversely related. However, the relationship was only observed within the same cultivar. The percentage of fruit with both blossom end rot and gold speck was much higher in 'June Pink' than in 'Momotaro'.

The cumulative uptake of Ca and Mg tended to decrease with increasing NH4-N concentrations. The cumulative NH4-N uptake markedly increased in proportion to the NH4-N concentration in nutrient solution. The P uptake rate

and amount was reduced at 0 me NH4-N/L. The K and NO3-N uptakes were not influenced by the treatment (data not shown).
The Ca content in the laminae decreased markedly from 5.40–6.28% at 0 me NH4-N/L to 2.75–3.32 % at 2.0 me NH4-N/L (data not shown). The Ca content in fruit also decreased from 0.04 to 0.02% in 'Momotaro' and 0.05 to 0.03% in 'June Pink'.

Nukaya et al. (1995) Acta Horticulturae 401:381-388

## *Make data understandable to your reader*

Compare the following tables:
How do they display the same data? What features of the tables make the data more or less accessible?

| Treatment | % germination after 60 days in culture | | |
|---|---|---|---|
| | **Hass** | **Fuerte** | **Sharwill** |
| Control | 45 | 48 | 42 |
| Basal and apical ends of seeds sliced off | 54 | 51 | 51 |
| Seedcoat removed | 57 | 60 | 57 |
| Ends of seeds sliced off and seedcoat removed | 62 | 72 | 63 |

| Treatment | % germination after 60 days in culture | | | Average by treatment |
|---|---|---|---|---|
| | **Hass** | **Fuerte** | **Sharwill** | |
| Control | 45 | 48 | 42 | 45 |
| Basal and apical ends of seeds sliced off | 54 | 51 | 51 | 52 |
| Seedcoat removed | 57 | 60 | 57 | 58 |
| Ends of seeds sliced off and seedcoat removed | 62 | 72 | 63 | 67 |
| Average by cultivar | 56 | 58 | 53 | |

## Results Task 2

Study the following figures and the accompanying legends.

(1) Do the figure legends adequately describe the data? Does the legend allow you to interpret the data in the figure? If not, how would you change it?

(2) How would you describe the data in the results section of a paper or thesis? What are the important points? In what order would you place them?

(3) Write a paragraph describing the data.

Figure 1 from Postharvest Biology and Technology 1: 137–142 (1990)

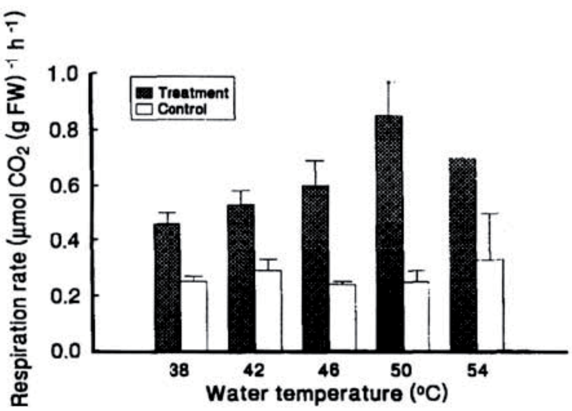



Fig. 1. Respiration rate (mean + SEM) of kiwifruit immediately following dipping in water at several temperatures and at 20°C (control) for 8 min.

Figure 2 from Plant Breeding 118: 205–113 (1999)

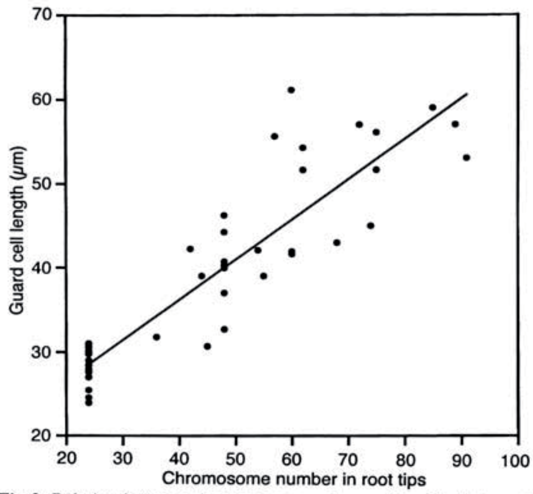



Fig. 2: Relation between chromosome number and length of stomatal guard cells in intraspecific somatic hybrids and parental dihaploids ($y = 17.0985 + 0.4776x$, $r^2 = 0.7887$)

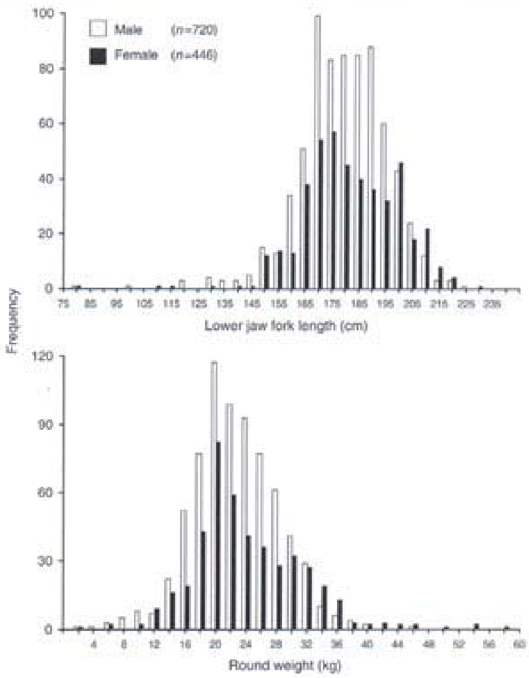



**Figure 3**

The size-frequency distributions by 5-cm intervals (upper figure) and by 2-kg intervals (lower figure) for male and female sailfish (*I. platypterus*) collected from the waters off eastern Taiwan.

Figure 3 from Fishery Bulletin, 102: 251 and following (2004)

Figure 4 from Applied Soil Ecology (2005) 29: 27–37

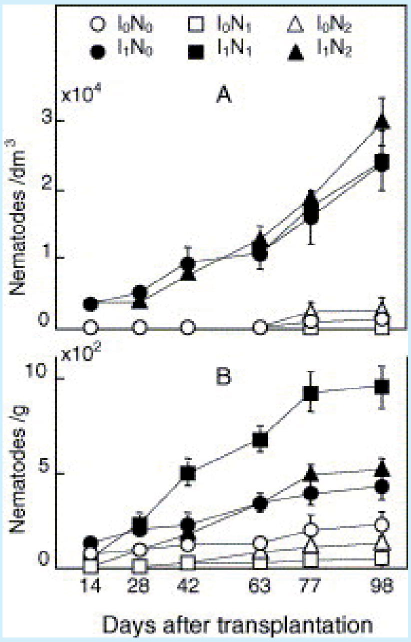



Fig. 1. Effects of different nitrogen levels (N0: 0 mg N per hill; N1: 80 mg N per hill; N2: 160 mg N per hill) on the development of Hirschmanniella oryzae populations (cumulative data) in soil (A) and rice roots (B) in non-infested (I0) or nematode infested (I1) containers (bars represent 95% confidence interval, n = 8 for the N0 treatments and n = 6 for the N1 and N2 treatments until 77 days, n = 12 for the N0 treatments and n = 9 for the N1 and N2 treatments at 98 days).

Figure 5 from Aquaculture (2005)246: 231–238

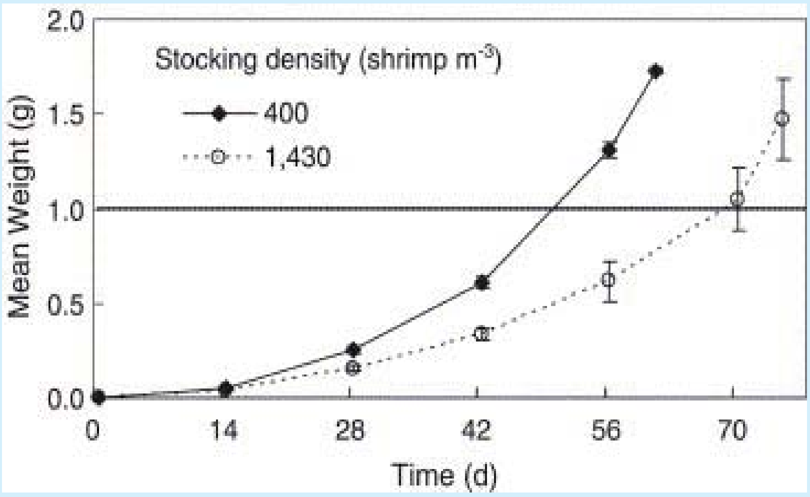



Fig. 5. Mean weights of P. esculentus grown in a tank system with artificial substrates from PL16 for 61 and 75 days at stocking densities of 400 shrimp m–3 and 1430 shrimp m–3, respectively. .

Figure 6 from Australian Journal of Experimental Agriculture (2006) 46 689–696

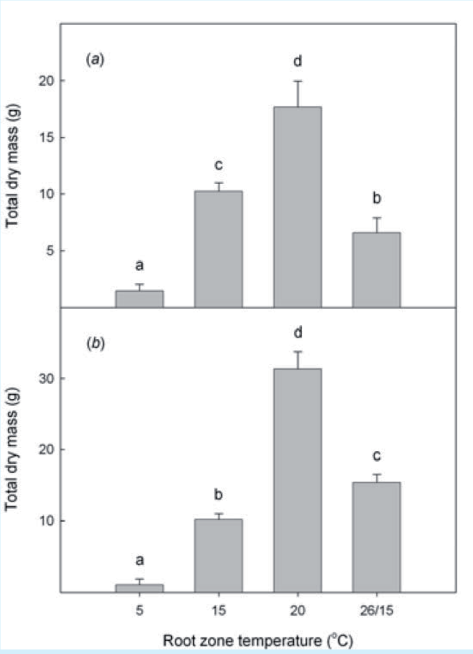



Figure 1. Mean (n =10) values of total dry mass (g) of Green Leaf Nemaguard peach rootstock seedlings after being subjected to various RZT treatments for six weeks. The plants were at two phenological stages, either (a) actively growing or (b) at bud-break, at the time the treatments were applied. Each error bar represents standard error for that particular treatment. Within each graph, means accompanied by the same letter are not significantly different at the 5% level according to Duncan's Multiple Range test.

## Quick Reference Guide

### Results

A results section contains:
- tables
- figures
- written description of tables and figures

A results section does not contain:
- interpretation of the results

Ensure that figures and tables:
- are referred to in the text
- have a legend and number

Ensure that:
- legends allow the data in figures and tables to be understood
- axes of graphs are labelled
- appropriate units are used

# 10. The Discussion and Conclusion

## *Introduction*

Discussion sections focus on giving meaning to results and are the least structured of all types of scientific writing. This module looks at the forms of language used in typical moves found in a discussion section and a common order in which they occur. To reinforce this information, you will dissect the 'moves' in a short discussion section taken from a paper. To help form the discussion sections for your own writing, you will be asked to consider the implications of your studies and report to the workshop the importance of your results to the scientific community and to Indonesia, and how your research has furthered your area of science.

General comments

- Most important
- Least structured
- Answers the 'so what?' question

Contents of a discussion (from University of North Carolina Writing Center)

- A discussion of your results
- An explanation of whether your data support your hypothesis
- An acknowledgment of any anomalous data
- Conclusions, based on findings, about the process you have been studying
- The relationship of your findings to earlier work in the same area
- An exploration of the theoretical or practical implications of your findings

Contents of a conclusion (after Murison and Webb 1991)

- Generalisations
- Implications
- Recommendations

The conclusion(s) may form the last paragraph of a discussion section.

Ordering your information (after Weissberg and Buker 1990)

1. A reference to the purpose or hypothesis of the study

2. A review of the results, whether or not they support the original hypothesis, and whether they agree with the findings of other researchers

3. Possible explanations for or speculation about the results

4. Limitations of the study that restrict the extent to which the findings can be generalised

5. Implications from the study

6. Recommendations for future research and practical applications

Information types (after Hopkins and Dudley-Evans 1988)

**A. Background information**
In this study, we have looked at some of the events associated with pollination and fruit set in peppers of the Longum group, including the effects of pre- and post-anthesis fertilisations.

**B. Statement of results**
During the pre-anthesis period, good relationships were found between measurements of bud size and the number of days to anthesis. Between each 24 h period before anthesis, sufficient differences were detected in bud length and width to allow these attributes to be used as indices of the number of days required by a bud to reach anthesis.

**C. (Un)Expected outcome**
Fruit size in Red Hot Glory was positively correlated with seed number, as has been found in other capsicums. However, in our study, …

**D. Explanation of (un)expected outcome**
However, in our study, for the fruit resulting from pre- and post-anthesis pollinations, the overall relationship was not linear, and an asymptotic equation was required to describe the data. … The differences between our results and those from the other studies on the relationship be¬tween seed number and fruit size may be a consequence of changes in the ovular and surrounding tissue's ability to produce or respond to this hormone during bud and fruit development.

**E. Exemplification**
In the Grossum group, a significant linear relationship was found between seed number and fruit dry weight; this relationship was not improved by fitting a polynomial equation (Marcelis and Baan Hofman-Eijer 1997). Similar linear relationships have been reported by Rylski (1973), de Ruijter, Van den Eijnde and Van den Steen (1991) and Shipp, Whitfield and Papa¬dopoulos (1994).

**F. Reference to previous research (comparison)**
As there were no published reports of critical mineral concentrations for G. paniculata, the results of these trials were compared to published data for Dianthus caryophyllus, a species in the same family as G. paniculata (Reuter and Robinson, 1997). The growth of plantlets, as assessed by dry weight, to increasing

K+ levels showed that the adequate K range was 2–4% (Figure 5), which was similar to the reported range for D. caryophyllus ex vitro (see Table 2).

**G. Reference to previous research (support)**
Based on the lignin:N and lignin:P ratios of Quercus alba seedlings, for example, Norby et al. (1986) similarly concluded that the rates of litter decomposition might not be affected by CO2 enrichment…

**H. Deduction**
This study suggests that some of the reported dry-weight-based reductions in nutrients might not have been statistically significant had the changes been examined on a leaf area basis to remove the dilution effect by accumulated carbohydrates.

**I. Hypothesis**
Starch/sucrose ratio in our study remained relatively unchanged in loblolly pine foliage grown at elevated CO2 concentrations, which might imply that photosynthesis and growth were equally enhanced by elevated CO2.

**J. Recommendation**
Although receptivity in Red Hot Glory commenced five days before anthesis, the percentage of pollinations resulting in fruit set varied considerably during this period, with only 26% of flowers pollinated on day –5 producing fruit, compared with 78% on day –1. Therefore, if bud pollinations are required, these pollinations should be performed close to the day of anthesis.

**K. Justification of recommendation**
Reliable estimates of ovule longevity, made under optimal climatic conditions, are also required to determine the cause of poor seed set, yields, or quality. There is evidence from cytological studies that under certain environmental conditions, such as frost damage, ovules may be non-functional by the time pollen tubes arrive in the ovary (Stosser and Anvari 1982).

## Discussion and conclusions task 1

Below is part of the discussion section taken from a paper by Aleemullah et al. (2000). Divide into groups. Each group will be given one or two paragraphs of the Discussion section to read. Firstly, determine what information types suggested by Hopkins and Dudley-Evans (1988) occur in the paragraphs. Secondly, can you match the information in the paragraphs with the six purposes proposed by Weisburger and Buker (1990).

In this study, we have looked at some of the events associated with pollination and fruit set in peppers of the Longum group, including the effects of pre- and post-anthesis fertilisations. During the pre-anthesis period, good relationships were found between measurements of bud size and the number of days to anthesis. Between each 24 h period before anthesis, sufficient differences were detected in bud length and width to allow these attributes to be used as indices of the number of days required by a bud to reach anthesis. Of these two measurements, length may provide the better index, as there was a greater absolute variation in this attribute. Therefore, it should be possible to use bud size to determine the time to anthesis so facilitating bud pollination and the production of hybrid chilli cultivars.

A study of anthesis, using several unnamed varieties of peppers, suggested that the duration of anthesis is similar in all capsicums with only one period of opening that is completed within 5 h of sunrise (Erwin 1932). Quagliotti (1979) also suggested that there is only one period of anthesis in capsicums, which is complete by 09:00 h. In contrast, this study with the cv. Red Hot Glory showed that anthesis occurred in two main peaks each day: a morning peak that lasted from pre-dawn to 12:00 h and a second peak in the afternoon (14:00-15:00 h). The detection of the afternoon peak may be due to the large number (over 1100 per day) of flowers observed. Therefore, this study shows that the pattern of anthesis within peppers is not as similar as Erwin's (1932) study suggested, an idea reiterated in Rylski's (1986) review.

The reason for the two periods of anthesis is unclear. Capsicums, like other members of the Solanaceae, have wet stigmata that secrete a fluid (Heslop-Harrison and Shivanna 1977). This stigmatic fluid has a number of roles including pollen adhesion, hydration and germination (Hoekstra and Bruinsma 1975). Exposure to the low humidities that result from temperature increases may cause the stigmatic surface to dry thereby hindering pollen germination. Therefore, during the hottest part of the day, it may be an advantage to plants if anthesis is delayed until temperatures drop. However, in other members of the Solanaceae, such as Nicotiana and Petunia, the exudate does not play an important role in pollen germination, as young stigmata that are free from exudate support satisfactory germination (Shivanna and Sastri 1981). Therefore, the role of the stigmatic fluid and any effect of the environment on the germination of capsicum pollen need further investigation.

Whilst it is well documented that temperature influences flower development in capsicums (Erwin 1932; Polowick and Sawhney 1985; Rylski 1973, 1986; Pressman et al. 1998), with low temperatures affecting ovary development and petal expansion, little is known of the effects of daylength in peppers other than they are short day plants (Auchter and Harley 1924; Deats 1925; Cochran 1942). Our data suggest that flower opening in the

Longum group of C. annuum is regulated, at least in part, by daylength. The two years of early spring observations showed identical patterns of flower opening and there was an approximate one-hour shift forwards in the morning peak during summer as a result of a 1 h 20 min earlier sunrise. The daily temperatures during these three periods of observations were similar (due to temperature regulation in the polyhouse); however, the light intensity would have differed substantially between early spring and mid-summer. It would be interesting to determine whether other factors, such as temperature or light intensity, also influence flowering phenology in chillies.

The timing of anther dehiscence in many species is associated with mechanisms to ensure cross-pollination, with final yield and fruit quality being determined by the co-ordination of this event with stigma receptivity. In Red Hot Glory, dehiscence occurred an hour after anthesis ensuring that pollen grains are liberated at the time of maximum stigmatic receptivity. The slight delay between anthesis and dehiscence may be required for anthers to dry sufficiently for the cells of the stomium to separate so that the pollen grains can be shed. Erwin (1932) reported that the anthers of other capsicum flowers did not dehisce until 3 h after the flower petals opened which also suggests that dehydration may affect the timing of dehiscence.

An understanding of stigmatic receptivity in crop plants is important for several reasons. Firstly, seed set may be maximised by pollinating receptive stigmas at the optimal time. Secondly, pre-anthesis bud pollination may be able to overcome self-incompatibility mechanisms, thereby facilitating the production of hybrid cultivars. Lastly, the period of receptivity in emasculated flowers of self-pollinated crops may be brief as in cotton, wheat and tomato giving a limited time when pollinations can be performed (Leopold and Kriedemann 1975; Shivanna, Cresti and Ciampolini 1997). A number of biochemical tests are available for the assessment of receptivity; however, controlled pollinations, the technique used in this study, provide the most reliable results as well as being a quantitative procedure (Dafni 1992). As with many other species, receptivity in Red Hot Glory commenced before flower opening, starting on day -5 before anthesis and lasting until day +3 after anthesis: this gives an effective pollination period (EPP) of nine days. The post-anthesis period of receptivity of Red Hot Glory is similar to that of C. frutescens where maximum receptivity occurred on the day of anthesis and lasted for three or four days after anthesis depending on time of the year (Cochran and Dempsey 1966).

Although receptivity in Red Hot Glory commenced five days before anthesis, the percentage of pollinations resulting in fruit set varied considerably during this period, with only 26 % of flowers pollinated on day -5 producing fruit compared with 78% on day -1. Therefore, if bud pollinations are required, these pollinations should be performed close to the day of anthesis. For this, a reliable estimate of the number of days to anthesis is needed and, as we have shown, this can be obtained from measurements of bud size. Although this study suggests that the EPP in the Longum group is about nine days, only the pollinations made on days -1, 0 and +1 resulted in a high percentage of fruit set. Therefore, it may be better to consider that the useful pollination period lasts for only three days, which supports Cochran and Dempsey’s (1966) assertion that the dura¬tion of receptivity is short in all capsicums.

In this study, we have detailed flowering behaviour and fruit set in chilli peppers from the Longum group. This information will enable plant breeders to produce cultivars more efficiently, as breeders seem to be unaware that pre-anthesis pollinations are possible (Jaime Mendez, pers. comm.). This study also provides baseline data that can be used to discover the causes of poor fruit formation during stress conditions. In particular, as the useful pollination period in the Longum group can be considered to be only three days, it would be desirable to investigate further both the progamic phase of fruit formation and subsequent embryo development to determine the factors leading to successful fruit set or abortion.

## Quick Reference Guide

### Discussion

A discussion section should:

- interpret results
- relate results to the aim of the study
- compare the data to other studies
- explain anomalous data
- state any implications of the study
- discuss any limitations of the study
- explain how the results demonstrate theory
- contain logical arguments to support any conclusions

A discussion section may:

- suggest further work
- include conclusions
- contain recommendations

# 11. Giving a Presentation

## *Introduction*

Giving spoken presentations is an essential part of the work of scientists. Despite this, most scientists are poor public speakers and shy away from speaking in public. This module covers the practicalities of producing a presentation, understanding your audience and ways of dealing with nerves. During the module you will explore your attitudes towards public speaking and, here and from the presentations given in the second part of the workshop, discover areas of your presentation style which you can work on and improve.

### Your Presentation Style

In order to be a more effective presenter it is useful to examine your present skills. The following evaluation can help determine the areas on which to focus to increase your competency. Please read the statement and then circle the number that best describes you. Then concentrate during this session on those items you marked 1, 2, or 3.

Always 1 2 3 4 5 Never

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | I determine some basic objectives before planning a presentation. | 5 | 4 | 3 | 2 | 1 |
| 2 | I analyse the values, needs and constraints of my audience. | 5 | 4 | 3 | 2 | 1 |
| 3 | I write down some main ideas first, in order to build a presentation around them. | 5 | 4 | 3 | 2 | 1 |
| 4 | I incorporate both a preview and a review of the main ideas as my presentation is organized. | 5 | 4 | 3 | 2 | 1 |
| 5 | I develop an introduction that will catch the attention of my audience and still provide the necessary background information. | 5 | 4 | 3 | 2 | 1 |
| 6 | My conclusion refers back to the introduction and, if appropriate, contains a call-to-action statement. | 5 | 4 | 3 | 2 | 1 |
| 7 | The visual aids I use are carefully prepared, simple and easy to read, and have impact. | 5 | 4 | 3 | 2 | 1 |
| 8 | The number of visual aids will enhance, not detract from, my presentation. | 5 | 4 | 3 | 2 | 1 |
| 9 | If my presentation is persuasive, it uses arguments that are logical and that support my assertions. | 5 | 4 | 3 | 2 | 1 |
| 10 | I use anxiety to fuel the enthusiasm of my presentation, not hold me back. | 5 | 4 | 3 | 2 | 1 |
| 11 | I ensure that the benefits suggested to my audience are clear and compelling. | 5 | 4 | 3 | 2 | 1 |
| 12 | I communicate ideas with enthusiasm. | 5 | 4 | 3 | 2 | 1 |
| 13 | I rehearse, so there is a minimum focus on notes and maximum attention paid to my audience. | 5 | 4 | 3 | 2 | 1 |
| 14 | My notes contain only ‘key words’ so I avoid reading from a manuscript. | 5 | 4 | 3 | 2 | 1 |
| 15 | My presentations are rehearsed standing up and using visual aids. | 5 | 4 | 3 | 2 | 1 |
| 16 | I prepare answers to anticipated questions, and practise responding to them. | 5 | 4 | 3 | 2 | 1 |
| 17 | I arrange seating (if appropriate) and check audio-visual equipment in advance of the presentation. | 5 | 4 | 3 | 2 | 1 |
| 18 | I maintain good eye contact with the audience at all times. | 5 | 4 | 3 | 2 | 1 |
| 19 | My gestures are natural and not constrained by anxiety. | 5 | 4 | 3 | 2 | 1 |
| 20 | My voice is strong and clear and is not a monotone. | 5 | 4 | 3 | 2 | 1 |
| | Total score: | | | | | |
| | Average score: | | | | | |

## Giving a presentation task 1

Thinks about the presentations you have listened to. Some will have been given by good and bad presenters. What did the presenters do to make the presentations good or bad?

## *Plan your presentation*

### Preparation

- When and where are you going to give your presentation
- Prepare early—don't leave your presentation until the last moment
- Review your presentation after a break
- Know your material
- Who are you going to give your presentation to?

### Practice

- Practise the entire presentation, including use of visual aids
- Practise in front of a group of colleagues

### Organisation

- Set priorities for topics and allocate time accordingly
- Have a well-thought-out and logical structure
- Avoid trying to cover too much

### Timing

- Ensure you fill up the time allotted
- Ensure you don't go over time
- Leave time for questions

## *Giving your presentation*

### Structure

Tell your audience what you are going to tell them … tell them … then tell the what you've told them.

**Introduction**

- Introduces the subject and thesis; signposts the frames or topics of you presentation; gets the audi¬ence's attention; may indicate each topic's importance

**Main body**

- Questions and answers
- Problems and solutions
- Hierarchical decomposition (topic – subtopic – smaller topic)
- Simple to complex

**Conclusions**

Lets the audience know you are about to finish; summarises the major ideas of each topic or whole presentation; leaves the audience with a 'take-home' message; don't fade away

### Style

- Use simple words
- Use simple sentences
- Use repetition
- Use personal language
- Sound spontaneous
- Avoid using notes
- Keep eye contact with audience
- Vary tone, speed and volume of voice
- Don't use fillers like 'um'
- Be enthusiastic
- Interact with audience
- Relate the talk to your audience

## *Visual aids*

**General**

- Talk to the audience—not to the visual aids
- Place yourself at centre stage
- Use pointer sparingly
- Make sure the visual aid supplements the speech rather than becoming the speech itself
- Integrate visual aid into your presentation

**Using visual aids**

- Ensure that the equipment is running and you know how to use it
- Do not display a visual aid until you are ready to use it
- When finished with it, remove it or cover it
- Do not stand directly in front of the screen
- When referring to the visual aid, point to it
- Do not distribute materials during your presentation

**Making effective visual aids**

- Keep it simple
- Each slide should convey a single significant message
- Use key words or phrases
- Consider visibility
- Slides should be balanced and pleasing to the eye
- Colour adds impact—but use it sparingly
- Use graphs in preference to tables
- Simplify all graphs and diagrams

## *Dealing with nerves*

**Before the presentation**

Mental and physical

1. Be at ease and relax. They want to listen to you
2. Breathe deeply as you walk to the venue
3. Mentally rehearse the sequence of your presentation
4. Use the self-fulfilling prophecy

Preparation

5. Practise your session beforehand
6. Warm up your voice before starting
7. Try to anticipate questions
8. Practise with your visual aids
9. Research and know your topic
10. Attend presentation or public speaking courses
11. Find out in advance who your participants are
12. Remember your audience's attention span

Style and presentation

13. Don't have a heavy night before a day of presentations
14. Arrive early so that so that you can settle in
15. Dress the part and look professional
16. Check all of your support equipment beforehand
17. Create a physical setting you feel comfortable with
18. Be comfortable with the arrangement of your resources

**During the Presentation**

19. Establish credibility at the beginning of your presentation
20. Always appear to be enthusiastic
21. Motivate the group—make them want to listen to you
22. Give your audience an outline of the events and topics
23. Use brainteasers as an opening
24. Use your tension to enhance your performance
25. Move around
26. Use unobtrusive isometric exercises
27. Admit your mistakes, but only if you make them
28. Use your prepared session notes
29. Don't read from the text
30. Keep eye contact with all of your audience

**After the presentation**

31. Use a video or tape recorder to evaluate your performance
32. Develop your own style of presentation
33. Get feedback from your audience

# 12. Putting it all together

## *Introduction*

As we discussed in the first module of this workshop, writing is a process that most people find difficult and do not like. One of the biggest problems that authors face is deciding where to start—there is nothing scarier than a blank piece of paper or computer screen. Writing and publishing is also a slow process. Throughout this workshop, you have seen that scientific writing is very structured and you should use this structure to plan your writing. This final module of this workshop provides you with a method for overcoming any fear of starting to write and to maximise the efficiency of the writing process. You are to use the linguistic structures given to you in each of the different modules to form what is called the skeleton of your writing. Once the skeleton of the piece of writing has been created, it is relatively easy to add flesh to the bones.

**Step 1**

Either on fresh sheets of paper or on separate pages of a WORD document put the headings and subheadings

- Title, authors and addresses
- Abstract and key words
- Introduction
- Materials and Methods
- Results
- Discussion
- References

**Step 2**

For each section:

If you have started writing the sections of your manuscript, look at their structure and write the structure down on each page

If you have not written the section of your manuscript, think about the structure it should have and write it down

This will produce what the "skeleton" of the manuscript

**Step 3**

For each section:

Add flesh to the "skeleton"

To do this add more and more layers of detail as further subheadings

Also, where possible, add in the details of the work you want to cite

### An example of this process is given you below:

**Introduction – Step 2**

Purpose Move 1 - Use of antibiotics in plant transformation Move 2 - Antibiotics can stimulate plant growth and development Move 3 - No mechanism suggested Move 4 - Aims

**Introduction – Step 3**

Purpose

The purpose of my paper is to show that commonly used antibiotics breakdown to plant hormones

Use of antibiotics in plant transformation

Agrobacterium-mediated transformation Controlling or removing contaminating microorganisms

Antibiotics can stimulate plant growth and development

No mechanism suggested

Aims

To show that antibiotics affect the in vitro growth of plants Propose a mechanism for the action of penicillin G and carbenicillin

**Introduction – Step 4**

Purpose

The purpose of my paper is to show that commonly used antibiotics breakdown to plant hormones

Use of antibiotics in plant transformation

Agrobacterium-mediated transformation Bacteria-free cultures Selectable marker genes

Controlling or removing contaminating microorganisms

Brassart et al. 1976 Falkiner 1990 Phillips et al. 1981 Pollock et al. 1983

Antibiotics can stimulate plant growth and development

De Ropp (1949) H. annuus and Vinca rosea Catlin 1990 Mathias and Boyd 1986

No mechanism suggested

Assumed that antibiotics mimic plant hormones

Aims

To show that antibiotics affect the in vitro growth of plants Propose a mechanism for the action of penicillin G and carbenicillin

**Materials and Methods –Step 2**
Tissue culture
Auxin Bioassay
HPLC
GC
GC-MS
Materials and Methods –Step 3
Tissue culture
Plant material Culture conditions Additions of antibiotics and growth regulators
Auxin bioassay
Plant material Culture conditions Assay procedure
HPLC
GC
GC-MS

**Materials and Methods –Step 3**
Tissue culture
Plant material Cultivar Surface sterilisation
Culture conditions Medium Temp and light
Additions of antibiotics and growth regulators
Auxin bioassay
Plant material Culture conditions Assay procedure
HPLC
GC
GC-MS

**Results - Step 2**
For the Results section, think about what figures and tables you need to illustrate you results
Structure
Table(s)
Figure(s)

**Results - Step 3**
Structure Effect of antibiotics on growth in tissue culture Coleoptile growth experiment HPLC GC GC MS
Table(s) Table 1 Callus shoot and root growth
Figure(s) Fig 1 Structural formulae Fig 2 Coleoptile growth Fig 3 GC retention times Fig 4 Electron impact mass spectra

**Results – Step 4**
Structure Effect of antibiotics on growth in tissue culture
Callus production –Table 1 Shoot production–Table 1
Root production–Table 1
Coleoptile growth experiment
Effects of antibiotics–Fig 2 Effects of PAA–Fig 2
Effects of 6APA–Fig 2
HPLC GC GC MS
Table(s)
Table 1 Callus shoot and root growth
Figure(s)
Fig 1 Structural formulae Fig 2 Coleoptile growth Fig 3 GC retention times Fig 4 Electron impact mass spectra

**Discussion – Step 2**
A reference to the purpose or hypothesis of the study A review of the results Possible explanations/speculation about the results Limitations of the study Implications from the study Recommendations for future research and practical applications

**Discussion – Step 3**
A reference to the purpose or hypothesis of the study
PAA naturally occurring auxin
A review of the results
PAA stimulates callus growth PMA did not stimulate plat growth HPLC, GC GCMS of carbenicillin presence of peaks of PAA and PMA
Possible explanations/speculation about the results
Antibiotic breakdown to plant hormones Sufficient breakdown occurs at levels used in tissue culture
Limitations of the study
Mechanism only applies to penicillin-like antibiotics
Implications from the study
Provides an explanation for observations of others
Recommendations for future research and practical applications
Further mechanisms for aminoglycoside and otherantibiotics needs to be found

**Discussion – Step 4**
A reference to the purpose or hypothesis of the study
PAA naturally occurring auxin Abe et al. 1974 Okamoto et al.1967
PAA may be higher than IAA (Wightman and Lighty 1982) Stimulates callus growth (Milborrow et al. 1975)
A review of the results
PAA stimulates callus growth PMA did not stimulate plat growth HPLC, GC GCMS of carbenicillin presence of peaks of PAA and PMA
Possible explanations/speculation about the results
Antibiotic breakdown to plant hormones Sufficient breakdown occurs at levels used in tissue culture
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Provides an explanation for observations of others
Recommendations for future research and practical applications
Further mechanisms for aminoglycoside and other antibiotics needs to be found

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