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Communication Skills in Science

About this chapter

In this chapter we will discuss the importance of communication in science and the types of communication skills you will need both during and after your university course. We will look at some basic rules to follow when writing scientific English, and at general issues, such as paragraphing, common spelling mistakes, use of the apostrophe and problems that may arise with the use of spell-checkers. Although this book is aimed principally at bioscience students, much of the advice will be useful for science students generally.

Why are communication skills important for scientists?

When successful graduates move into scientific careers, they will be called upon to practise the communication skills they have learned during their training. In addition, they may be expected to talk about their work with scientists and with non-scientists. For example, scientists specializing in the molecular biology of cancer and who work in a research laboratory may be expected to communicate their work to:

- fellow scientists working in their laboratory;
- scientists who work in different laboratories, but who may wish to collaborate;

Communication Skills for Biosciences Maureen M. Dawson, Brian A. Dawson and Joyce A. Overfield

- scientists at national and international conferences;
- eminent scientists who sit on grant-awarding authorities;
- students undertaking a placement in their laboratory;
- research students whom they may be supervising;
- journalists who want to find out about (and possibly publicize) their work;
- ethical committees, which consist of scientists and non-scientists, if their work has ethical implications;
- community groups and representatives from business who may wish to donate funds to their research;
- senior managers who may influence the future course of their work.

The types of communication skills required by today's scientists include being able to communicate in writing, and to make presentations which involve both oral and visual communication. Examples of written communications include:

- laboratory reports;
- research papers, articles and reviews for scientific journals;
- grant applications;
- briefings for management;
- progress reports;
- product descriptions.

Examples of oral communications include:

- talks to a variety of audiences;
- team or management briefings;
- research papers delivered at conferences.

Examples of visual presentations include:

- scientific posters;
- information leaflets for target audiences.

Presentations using computer software such as PowerPoint require oral and visual communication skills. Above all, it is essential that scientists communicate the results of their work in a way which takes account of the audience, but which is always truthful and unambiguous.

New students studying science at university will quickly find that they are expected to acquire and demonstrate a wide range of communication skills throughout their course. It is no longer possible for students to obtain a university degree based almost entirely on the ability to pass examinations at the end of each year, as was the case in many degree programmes fifty years ago. However, even if successful science graduates choose a career other than one in science, they will find that they require good communication skills in any 'graduate' career they enter. For this reason, communication skills are regarded as 'transferable skills' which can enhance the employability of a student in many careers.

Scientific writing: a little bit of history

Table 1.1 shows some history of scientific writing which goes back to around 1400 BC. You can see that much of the reason behind recording natural phenomena (eclipses, floods etc.) had a very practical purpose, such as being able to predict when these phenomena would occur.

Table 1.1 A brief history of early science

Date	Who and where?	What and why?
1400 BC	China Egypt	Recorded information about, for example, solar and lunar eclipses and floods in order to predict when they would occur
800 BC	Homer, Hesiod	Indicated knowledge and study of stars and constellations, probably to indicate seasons for planting crops or to provide sailors with aids to navigation
500 BC onward	Greeks	Used mathematics to lay down definitions and first principles of geometry Study of anatomy and physiology (dissection being practised) Technical terminology and taxonomy being developed
372–287 BC	Theophrastus	Produced treatises on botany; distinguished between mono- and dicotyledonous plants
ca.100 AD	Roman Empire	'Sophisticated' clinical techniques being practised

After the fall of the Roman Empire science and medicine declined in much of Western Europe but continued to flourish in the Arabic and Chinese worlds. In fact, had Arabic scholars of the period not translated much of the scientific literature of the later Roman times and of the great period of Greek science and philosophy, it is probable that such literature would not have survived. It was only when the Arabic translations of lost texts became available in Western Europe that science and scientific understanding began to be revived, and by the fifteenth and sixteenth centuries the development of science began to take off again in the Western world.

Today, we are very familiar with the idea that science is an experimental subject in which findings from experiments allow us to build on the work of previous scientists. Early on, though, science was mostly about observing rather than experimenting. The beginning of the seventeenth century, however, saw the development and widespread acceptance of what is known as the 'scientific method'. Scientific method (see Figure 1.1) involves:

An example of this might be:

1. You have observed that young pea seedlings grow towards the light but you want to test this scientifically. So, you plant several trays of seeds. One tray you grow in darkness, another in full light, another with a sole source of light which comes from one side only.
2. You provide the conditions required for growth (water, warmth, air) and, after a certain time, you measure the length of the seedling above

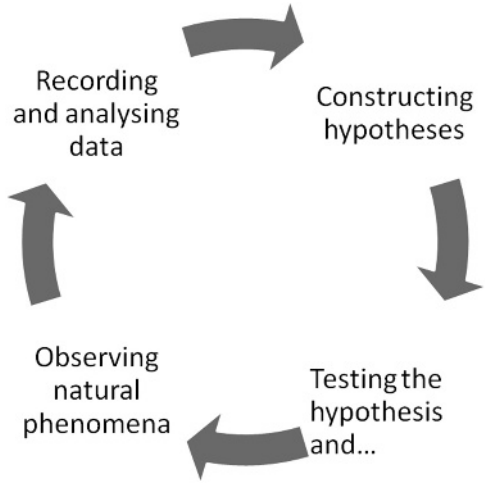

Figure 1.1 Scientific method

> the soil, and note any curvature. Your analysis shows that the peas grown in the dark have grown longer than those in full light, while those illuminated on one side only have curved towards the light source. You have tested the hypothesis that peas grow towards the light, but you now need to construct a hypothesis to suggest why those grown in the dark are longer, and so on.

Scientific experimentation is a continuous process, as observations from experiments can then lead either to the support of the hypothesis and/or to the construction of new ones. It is the reporting and sharing of data that allows others to reproduce, and, therefore, to revalidate the experimental studies that to a very large extent inform the modern approach to scientific writing.

Scientific language

For quite a long time Latin was the international language of science in Europe and it was not until the seventeenth century that the use of English in scientific literature began to take off. Until then, however, science was only communicated between those who were highly educated and (usually) male. Newton's great work, *Philosophiæ Naturalis Principia Mathematica (The Mathematical Principles of Natural Philosophy*) was published in Latin in 1687.

During the seventeenth, eighteenth and even the mid-nineteenth centuries, scientific literature written in English followed the prose styles of the day and was often very conversational. For example Elie Metchnikoff, who developed the theory of phagocytosis in 1882, following experiments with starfish larvae, wrote:

> I felt so excited that I began strutting up and down the room and even went to the seashore to collect my thoughts. I said to myself that, if my supposition was true, a splinter introduced into the body of a starfish larva … should soon be surrounded by mobile cells as is to be observed in a man who runs a splinter into his finger. This was no sooner said than done.

Through the influence of the Royal Society, it became increasingly the practice to use a much simpler and more straightforward style of writing, which remains to this day, and this is what you should be aiming for. The development of scientific journals and periodicals has undoubtedly led to a much more formalized and structured approach, both in the manner that articles are set out and in the language used. This helps ensure that ideas are conveyed effectively in a way that can be easily understood by the educated reader.

Peer review

Henry Oldenburg (ca. 1619–1677) was the secretary of the Royal Society of London. He was the first editor of the Royal Society's *Philosophical Transactions,* first produced in 1665, which published the work of eminent scientists. In order to persuade scientists to publish their work, Oldenburg guaranteed that scientific 'papers' would be published rapidly, ensuring that scientists received proper attribution for their original works. He also ensured the quality and standards of the publications by sending them to experts in the field, to comment on them and to recommend publication. This process continues throughout the world in those journals which publish 'peer-reviewed' articles. A paper which has been published in a peer-reviewed journal is more highly regarded by the scientific community than one which has not, since it has been recommended by fellow scientists. However, unfortunately, on occasion, the system of peer review has sometimes delayed the publication of important works which have challenged the current view.

Basic rules for writing (scientific) English

Whether you are writing for publication in a peer-reviewed journal, for a research thesis, or for a simple laboratory report, there are certain rules you need to follow. Other chapters in this book will look at specific examples of scientific writing, such as laboratory reports, essays and so on. Here are a few rules to absorb before you get there:

1. You are not trying to write a piece of light reading or a work of fiction. You have to aim for a straightforward personal style that is understandable and readable. The material contained in your essay, report or paper must be rigorous and comprehensive. Scientific rigour may be a cliché, but it does sum up the basic overall approach. The last things you want in scientific writing are woolliness in your approach to your data and findings, and sloppiness in your use of words. Try to be precise, but do not confuse precise with brief. Use clear and unambiguous language. It is always worth remembering that if you have difficulty in understanding a passage in a textbook, then it could be that the passage is badly written.
2. Use short sentences wherever possible.
   You may have heard of the 'Plain English Campaign'. It did much to get rid of badly written English from official documents. It recommends an average sentence length of fifteen to twenty words. Wherever

possible, try to make sure that any sentence can be understood in a single read through. Overcomplicated sentence structures are totally off-putting. On the other hand, do not be afraid to vary the syntax of your sentences. A string of sentences like 'the cat sat on the mat and the mouse played in the yard' can be boring in the extreme. So, a sentence such as 'while the cat was sitting on the mat, the mouse played in the yard' is both simple and more interesting. The phrase 'while the cat was sitting on the mat' is an example of a subordinate clause, whereas the phrase 'the mouse played in the yard' is the main clause. Use subordinate clauses whenever you can, as this will allow you to bring some flowing movement into your style. Think about what you want to emphasize in your sentence. Try to ensure that the key phrase or word is not lost or split up in a mass of other words. An example of a sentence which loses its way is

> While the cat was sitting on the mat, which had recently been swept and dusted in order to keep out the dust mites, whose droppings triggered asthma in the butler, a tall and handsome man of many years, the mouse played in the yard.

The main point of the sentence (the mouse played in the yard) has been lost in all the extraneous detail!

3. Use simple words that your readers/audience will understand. Nonetheless, the use of simple words should not be at the expense of accuracy. For example, use 'rain' rather than 'precipitation', unless the context demands precipitation. Do not try to impress by using big or uncommon words where shorter words will do.

   Technical words or phrases are generally a way of conveying a complex idea in as few words as possible. The same is true of acronyms and abbreviations.[1] If you do use technical words or acronyms, explain them when they first appear. For example 'The structure of deoxyribonucleic acid (DNA) differs from that of ribonucleic acid (RNA) in …'.

   This can be particularly important in undergraduate first-year essays, as it will show your tutor that you understand the concept. For the most part, the extent to which you use technical language will depend on the readers/audience at whom your paper is aimed. Always be consistent in the technical words, acronyms and symbols you use. As far as abbreviations, as distinct from acronyms, are concerned, only use them for units of measurement.

4. Avoid colloquialisms: for example, you do not store reagents in the 'fridge' or even the 'refrigerator'; you store them at 4°C. This is because it is the temperature that is important, not the location. Similarly, where necessary, you store reagents at −20°C or −70°C, rather than in the freezer. Some chemical reactions need to take place in the absence of light. The commonly used phrase is 'stored in the dark' rather than 'in a laboratory cupboard'.

5. Avoid vague adjectives which give a poor indication of what you mean, or which could be misinterpreted. For example, 'there was a large increase' depends on what you mean by 'large'. Also, you should avoid metaphors, similes and clichés as far as possible. By the way, if you are unfamiliar with any of these terms, like 'simile', we would recommend that you use a good, concise dictionary, such as the *Compact Oxford English Dictionary*. This will also be an invaluable tool when you come to write essays. Incidentally, this particular dictionary has a very useful appendix entitled 'Effective English'.

[1]An acronym is a word made from the initial letters of other words, for example *UNESCO* for the *United Nations Educational, Scientific, and Cultural Organization*.

6. You should, at all costs, avoid teleology. Teleology occurs when you ascribe thoughts and purpose to objects or organisms. So, for example: 'woodlice like the dark and when faced with a choice will always prefer the dark'.
7. Wherever possible use the active form of a verb rather than the passive form. For example, 'the experiments show/showed' rather than 'it was shown by the experiments'.
8. Use straightforward verbs rather than noun/verb combinations wherever possible. For example, instead of 'reached agreement', just use 'agreed'. This is particularly important when you are writing assignments with a strict word limit, where you may be penalized for excessive word length.
9. Find out what the convention in your discipline or department is about the use of the first person, as opposed to the third person, and stick to it. One disadvantage of writing in the third person is that you constantly have to resort to the passive voice (for example, you find that you have to write sentences like 'The mouse was injected with' rather than 'I injected the mouse with'). In many university departments students are actively discouraged from using the first person 'I' and 'we' in laboratory reports. This is also the convention with many scientific journals, though others do allow its use.

   A good example of where scientists have used the first person to great effect is in the groundbreaking paper of Watson and Crick in 1953 where they proposed a structure for DNA. This paper starts off:

   > We wish to suggest a structure for the salt of deoxyribose nucleic acid (DNA). This structure has novel features which are of considerable biological interest.

10. Be consistent in your use of the tenses of verbs. When you are reporting experiments, you must use the past tense; that is, you must say what was done (or what you did). On the other hand, when you are discussing and interpreting the results and data from the experiments, you will generally use the present tense. Ensure that there is agreement between the verb and subject. This is particularly important where you are using words that have a Latin or Greek plural form (see section on plural forms). Therefore while one bacterium **is**, two bacteria **are** – this is very often misused in popular journalism. Similarly, you need to be careful with the singular and plural of mitochondrion (mitochondria) and phenomenon (phenomena). One word which appears to be changing through common use is the term 'data',

which is actually a plural word (singular 'datum'). Strictly speaking, you should say 'the data show' rather than 'the data shows'.

Wherever possible, try to keep the subject of the sentence and the verb together. To do so normally helps the logical flow of the sentence. In addition, it will help you to avoid some of the pitfalls of subject/verb agreement. If the subject of your sentence is separated from its verb by ten or twenty words, you may inadvertently use the singular form rather than the plural.

You should also avoid other mix-ups between singular and plural in your sentences, such as using a singular noun in one part of your sentence, then using a plural possessive adjective or verb when you refer to it in the second part of the sentence. For example, do not write: 'The researcher will show … and their results indicate'; here you would use 'and the results indicate …' or 'and his results …' or 'and her results. …'.

11. Use accurate punctuation, as inaccuracies can confuse the reader, and make the meaning ambiguous. One very famous example of this is the title of the book by Lynn Truss: *Eats, Shoots and Leaves*. The title arises from a joke about a panda in a bar. As we know, pandas eat shoots and leaves. This panda, according to the punctuation, first eats, then shoots a gun, and then leaves the bar. A whole section in this chapter is devoted to punctuation.

12. Plan the structure of what you are going to write. Even under examination conditions this will help you get down what you want to say. Once you have a structure, particularly for an essay or report, work on a first draft, which you can revisit as often as time allows. With word-processing this is much easier than it is with handwritten text.

13. Find out how long the work is expected to be and stick to it. If you are expected to present a 3000 word essay, do not produce something that is 2000 words long, or for that matter an epic of 10,000 words. There is much value in being concise and keeping within the guidelines given – being able to read and act on instructions is a skill in itself. Find out whether there are any prescribed guidelines on layout (for example, double-spaced text, paper size, font size and so on) and stick to them. Try to avoid giving your tutors an excuse to lower your marks.

14. If you are writing a report or an essay, it is always worth looking at the styles used in the articles in the major journals of your discipline. It is particularly useful to look at the style of the summary or

the way in which data are presented. Very often there are also standard conventions for the labelling of tables and figures, and for the layout of mathematical formulae and calculations. There is more information about the use of tables and figures in Chapters 4 and 5.

15. Adopt a logical approach to your structure. Take your arguments step by step, ensuring that the second step follows logically from the first. Adopt a clear layout, particularly, for example, if you are producing a formal report. There will, of course, be differences in the layout required for a poster presentation from those for a laboratory report or essay. Long passages of text with few paragraphs can be daunting to the reader. Think hard about the use of bullet points. They allow us to get across in summary form a number of linked ideas and are very useful in poster or Powerpoint presentations, but you need to ask yourself if it is appropriate to use them in an essay.
16. Remember that, when you first produce a piece of work such as an essay, this is only a draft – the first production is not the end product. Drafts of work can be much improved by careful reading and restructuring if necessary. Depending on your assignment, your tutor may be willing to have a look at the draft before you complete the assignment. This is particularly true of drafts of project reports or dissertations. Remember also to give yourself time to work on drafts; you should not be starting your assignment at the last minute. Working on drafts may take the mark for your work up a grade.
17. Try to put yourself in the position of your readers/audience. For the most part your writing should be pitched at the educated general reader. If you are writing a presentation at the end of your first year, ask yourself whether your fellow students will be able to understand and learn from it.
18. Always check the accuracy of any mathematical calculations or data presented in tables before you begin to revise your first draft.
19. Try reading your draft out loud, and listen to the rhythm of the sentences. If you find one that seems awkward, consider restructuring or revising it. When you think you have something close to a final draft, let someone else see it. They will not be too close to the work, and are likely to be able to spot important omissions or even grammatical or punctuation mistakes. Always run a spell-check at every stage of revision and make sure that the spell-checker is set to UK English (see below) if you are in a university in the UK or another country

requiring the use of UK English rather than USA English. Remember that a spell-checker will ignore words which, though spelt correctly, are being used incorrectly, for example, using the word 'there' instead of 'their', or 'flour' instead of 'flower'.

20. If you are using Latin words, and in some areas of biology and medicine this is unavoidable, follow the established conventions. Latin names and phrases are always written in italics or are underlined. When writing a species name in Latin the genus has a capital letter at the beginning, and the species is written in lower case. The genus may be abbreviated if it has occurred once. For example, 'the bacterium *Neisseria meningitidis* occurs in three serotypes: *N. meningitidis* Serotypes A, B and C'.
21. If you are referring to human genes it is customary to use italics for the gene, for example, the *RHD* gene encodes the Rh D antigen in red blood cells.

Punctuation

Punctuation helps the reader to understand written language and can help to avoid confusion or misunderstandings. In a sense, it is a way to help you read a sentence, or paragraph, out loud, with marks like commas indicating where you need to make a break. The following are some brief notes about the use (and common misuses) of punctuation marks.

Apostrophe

The misuse of the apostrophe is often regarded by some as a cardinal sin, and many tutors may find it extremely irritating. However, it is probably fair to say that the majority of people have misused an apostrophe at some stage in their lives. The apostrophe has two primary purposes: to denote possession and to replace missing letters in some 'shorthand' or 'contracted' terms.

Contractions

Although contracted forms are popular in speech, especially informal speech, there are relatively few contractions used in formal, written English and very few are used in scientific writing. Thus, though contractions of verbs, such as I'd for 'I would' or 'I had' or I'll for 'I will', 'I'm' for 'I am', 'isn't' for 'is not' 'we're' for 'we are' are spoken frequently, they should not be used in formal scientific writing. Conventions do change and certain words which were origi-

nally contractions have become so ingrained in our culture that the apostrophe is seldom used. For example, phone used to be written as 'phone, as a contraction of telephone. Equally, plane used to be written as 'plane, as a contraction of aeroplane.

Possession

Where the apostrophe is used to denote possession, it takes two forms: for singular nouns, it will appear as 's, for example, the cat's paw or the dog's dinner: for plural nouns it will generally appear as s': for example, the asses' ears, and the dogs' dinner (i.e. the dinner of several dogs). The exception is where there are unusual forms of plural: for example, you would use children's rather than childrens', or women's rather than womens'.

An apostrophe is never used simply to indicate a plural term and 'the dogs went to dinner' does not require an apostrophe anywhere. Thus, a greengrocer who lists his vegetables as *tomato's* or *carrot's* is incorrect. Tomato's means belonging to the tomato.

The contraction 'it's' for 'it is' gives rise to one of the commonest confusions and misuses of the apostrophe. 'It's' is **never** used to denote something belonging to it.

A word of caution: American spell-checkers may sometimes mislead on the correctness or otherwise of the apostrophe as used in the UK, so make sure your spell-checker is set to UK English.

Inevitably, language does change and develop. By long-standing convention the plural form of abbreviations does not include an apostrophe. For example the accepted plural form of DVD is DVDs and not DVD's. Equally where numbers are used in place of words, for example, the 80s, as the term for the period 1980 to 1989, no apostrophe is needed. Again if you have hundreds of books, you could use the form 100s.

Comma

The comma is used to separate parts of sentences into manageable and logical bits. It is generally used to separate subordinate clauses from the main clause, or other subordinate clauses. For example: 'The dog, which had walked all the way from the station, went to get its dinner'. However, you do not generally use a comma before 'that', as, for example, in: 'the dog that had walked all the way from the station went to get its dinner'.

In addition, with some subordinate conjunctions, like 'who', the comma can be used to distinguish between what is a necessary part of the sentence and what is there for elaboration. For example, in the sentence 'Customers who steal will be prosecuted' the subordinate clause 'who steal' is a necessary and

conditional part of the sentence. In the sentence 'John, who came from London, was found wandering the streets', the subordinate clause 'who came from London' is merely an elaborative detail. It is generally conventional to use a comma before clauses beginning with 'which'. Where a subordinate clause is followed by another part of the same sentence, it is generally closed with a comma.

The comma is also used before other conjunctions like 'but', which join two main clauses. It is used after introductory words/participles: for example, 'nevertheless', 'for example', 'in general', and so on.

Other uses of the comma are: to separate a passage of direct speech from the main sentence and to separate adjectives in a list. It is used as a separator in constructions like dates, years (for example, September, 2007) or town, county (for example, Wilmslow, Cheshire). Another use is the so-called bracket comma, generally where you are linking two nouns in apposition; for example, 'His brother, William, was to become the leader of the group'.

You will normally use a comma to separate items in a list. However, if you have a long list introduced by a colon, you should use a semicolon as the separator. An example is given below:

> The aims of this project are as follows:
>
> 1. to investigate the effect of temperature on enzyme activity;
> 2. to investigate the effect of pH on enzyme activity;
> 3. to determine the K_m of an enzyme.

The commonest misuse of the comma is in the so-called comma splice. This is where a writer uses a comma instead of a full stop or semicolon where there are two separate main clauses without a conjunction. For example: 'he went to the shops, the streets were bare'. In these circumstances, you should always use a full stop or semicolon.

Colon

The colon is used as a mark to introduce a list, and each item in the list is separated by a semicolon. By convention it is also used with bullet points, and, again, each bullet point is separated from the next by a semicolon. The colon is also commonly used to introduce a linked explanation or expansion of the clause before it; for example, 'the one fact you should remember about chilli powder: it is hot'. A colon here represents a slightly more emphatic break than a comma. For this reason it is sometimes used to emphasize the following word or phrase; for example: 'she had one great discovery: radium'.

Dash

Do not use a dash to replace a comma, unless the use of a comma would be ambiguous, as in a list where you need to put something in parenthesis; for example, 'his two brothers – Jack and James – his father and his uncles…'. It may be more appropriate here to use parentheses (brackets).

Exclamation mark

As may well be expected, the exclamation mark is used to indicate surprise, astonishment: 'Surprise! Surprise!'. Try to avoid using exclamation marks just to add emphasis. They should rarely be used in scientific writing, but can add interest if used appropriately when writing for the general public.

Full stop

A full stop is generally used at the end of a sentence. An exception to this rule is where you have complete sentences in bullet points. At the end of each bullet point you should use a semicolon, with the exception of the final sentence of the final bullet point, where you will use a full stop.

Full stops are traditionally used with abbreviations, as with shortened species names such as *E. coli*. Full stops are not used with acronyms. Thus we write 'AIDS' not 'A.I.D.S' for acquired immunodeficiency disease.

Hyphen

The hyphen is most commonly used in compound words such as 'long-standing', and always with compounds that begin with: self, mid, all, ex, over and so on. You will also use it with part words; for example, 'you might want to check the full list of compounds beginning with fluoro-'. The hyphen is useful because it helps to avoid ambiguities. So, for example, the sentence 'the T lymphocyte kills the virus infected cells' could be confusing until the hyphen is added to make it clear that the lymphocyte is killing the virus-infected cells. Similarly the phrases 'drink induced disorder' and 'drink-induced disorder' have subtly different meanings. Unfortunately, the trend in publishing increasingly seems to be to leave hyphens out and this can lead to ambiguities and compound words strung together.

Parentheses (brackets)

Brackets can be useful in flagging up an alternative word or phrase, such as 'parentheses (brackets)' or to indicate an abbreviation such as deoxyribonucleic

acid (DNA). It is possible to overuse brackets and it is always worth considering whether commas could do the same job.

If you include a full sentence in parentheses, you will normally include the full stop before the final parenthesis.

Question mark

The question mark is self-explanatory. You can use it when asking real or rhetorical questions even though, with the latter, you are not expecting an answer.

Quotation marks (inverted commas)

Quotation marks are traditionally used to mark the beginning or end of a quoted passage. However, there is a growing convention that, for other than short quotations, italicized text indented from the main text is used. It is also commonly the case that italicized text, without indentation, is used for shorter passages. In the end it is a matter of style. Whichever approach you use, be consistent throughout your text, but also bear in mind that people who suffer from dyslexia may have difficulty reading italicized text. In this book, we have chosen to use quotation marks and normal text.

If you look at a computer keyboard you will see that there are two options for quotation marks: the double ("…") or the single ('…'). In general, they are used interchangeably. However, where you do get a quotation within a quotation, the convention is to use the single form to mark the beginning and the end of the main quotation, and the double form to mark the end of the quoted quotation. Again, be consistent in your use throughout your text.

Quotation marks are sometimes used to mark titles (for example, of books or articles). In general, italics are used in scientific literature.

Semicolon

In many ways the use of the semicolon overlaps that of the comma, but generally it is seen as indicating a more significant gap. The most common use of the semicolon is to separate two closely related statements that could each form a separate sentence. In these circumstances you cannot replace the semicolon with a comma. It is also used to separate items in a long list after a colon and in bullet points. As we have already seen, at the end of the final sentence of each bullet point you should use a semicolon, apart from the final sentence of the final bullet point, where you will use a full stop.

More on plural words

Many of the words used in science in general and the biosciences in particular are either derived from or are actually Greek or Latin words. This is not really surprising, as many of the major figures in science or the biosciences would have had Latin and Greek as part of their education, particularly those who lived in the nineteenth century or earlier. Very often writers may not always be aware that some words they are using are plurals. Even those guardians of English, the British Broadcasting Corporation (BBC), get it wrong on occasions. The commonest errors relate to the plurals of neuter words in Greek or Latin, which have an ending in -a. The four words that confuse people the most are: bacteria (singular bacterium); data (singular datum); media (singular medium) and phenomena (singular phenomenon). So, you should never say for example, 'this bacteria is', or 'this data is': it should always be 'these bacteria are' or 'these data are'. Other plural words include mitochondria (singular mitochondrion) and spermatozoa (singular spermatozoon).

In many cases the Greek or Latin plural form is retained. For example the plural of stoma (the epidermal pore in plant leaves) is stomata. In other cases, either the Greek or Latin plural form or an English plural form maybe used; for example, the plural of octahedron is octahedra but octahedrons is also acceptable. In other cases, only a normal English form is used: for example, the plural of virus is viruses. There are also several words that appear to have a Latin or Greek singular form. For example the plural of octopus is octopuses, similarly the plural of platypus is platypuses, and the plural of polygon is polygons. The reason for this is that the -pus element of octopus is derived from the Greek word for foot, and the -gon element of polygon is derived from the Greek word for corner.

The best approach is to try to remember those words with a confusing singular and plural.

Commonly confused words

There are many words that are commonly confused with others. In many cases they are homophones (words pronounced in the same way but having a different meaning) or homonyms (words spelt in the same way, but having a different meaning). Here are some of the pairs of words that you are likely to come across.

Accept and **except**: 'accept' means to receive; 'except' means (as a verb) to omit, or, as a preposition, it means 'not including'. Example: 'I accept all the terms of your offer except the one requiring me to jump off the cliff'.

Affect and **effect**: 'affect' means to influence; 'effect' (as a verb) means to cause to occur.

Albumin and **albumen**: 'albumin' is a plasma protein, whilst 'albumen' refers to the white of an egg.

Appraise and **apprise**: 'appraise' means to assess the worth of; 'apprise' means to inform.

Aural and **oral: '**aural' refers to the ears, while 'oral' refers to the mouth.

Complement and **compliment**: 'complement' means the part that completes something, or, in the biological sense, a group of proteins in serum that destroys cells when activated by antibodies; 'compliment' means a polite expression. Similarly, you should not confuse complementary with complimentary.

Continuous and **continual**: 'continuous' means without a break; 'continual' means recurring at regular intervals.

Council and **counsel**: a 'council' is an administrative body; to 'counsel' as a verb means to advise. As a noun 'counsel' is a legal adviser.

Draft and **draught**: you 'draft' a paper, but get cold when you stand in a 'draught'.

Defuse and **diffuse**: 'to defuse' means take the fuse out of (for example, a bomb) or remove the cause of tension; 'to diffuse' means to scatter over a wide area.

Discreet and **discrete**: 'discreet' means tactful or unobtrusive; 'discrete' means separate.

Formally and **formerly**: 'formally' means conventionally; 'formerly' means previously.

Imply and **infer**: 'imply' means to suggest or insinuate; 'infer' means to conclude or deduce.

It's and **its**: 'it's' is the contracted form of it is or it has; 'its' means belonging to it (see section on the (mis-) use of the apostrophe).

Lead and **led**: 'lead' pronounced with a short e sound is the metallic element; 'lead' with a long e sound is the present tense of the verb 'to lead'; its past tense form is 'led'. You should never use lead, if you want to express the past tense of the verb 'to lead'.

Lay and **lie**: 'lay' can only be used with an object; 'lie' can only be used without one. For example, he lays a cloth on the table; he lies on the bed.

Lightening and **lightning**: 'lightening' means making light or less heavy; 'lightning' is a flash of light in a thunderstorm.

Loose and **lose**: 'loose' (as a verb) means to release or set free; 'lose' means to cease to have.

Mitigate and **militate**: to 'mitigate' means to make something less severe; to 'militate' is to work against something.

Plural and **pleural**: 'plural' refers to more than one; 'pleural' refers to the lungs.

Past and **passed**: 'past' means completed or finished; 'passed' is the past participle of the verb to pass.

Practice and **practise**: 'practice' is the noun, and 'practise' is the verb. An easy way to remember the difference is to think of advice, and its corresponding verb advise.

Principal and **principle**: 'principal' (as an adjective) means first importance or main; principal as a noun refers to a head of an institution such as a college; 'principle' is a noun normally meaning a fundamental or general truth. For example, 'The principal reason I am here is to set out the principles of biology'.

Role and **roll**: 'role' is a part or character in a play; 'roll' has a great many meanings, including to move by turning, a rounded mass, a cake of bread etc.

Stationary and **stationery**: 'stationary' is an adjective meaning not moving; 'stationery' is a noun meaning paper or any writing materials.

There, their and **they're**: 'there' is an adverb meaning at that place; 'their' is an adjective meaning belonging to them: 'they're' is the contracted form of they are.

To and **too**: 'to' is a preposition generally used to indicate direction or to mark the infinitive of a verb; 'too' is an adverb meaning either as well or extremely. A nice example of the differences can be seen in the sentence: he was too ill to go to work.

Weather and **whether**: 'weather' refers to meteorological conditions; 'whether' is which of the two.

Who's and **whose**: 'who's' is the contracted form of who is or who has; 'whose' generally means belonging to who.

Your and **you're**: 'your' means belonging to you; 'you're' is a contracted form of you are. A nice example of use is: you're your own worst enemy.

If you work on the principle that you will not use abbreviations like 'they're' for 'they are' or 'it's' for 'it is', you are half way to solving some of the most common confusions in English. 'There's' will never be confused with 'theirs'.

Commonly misspelled words

Nowadays, when most assignments are required to be word-processed, it is far easier to check your spelling before your assignment is handed in. Tutors will be very sympathetic about the problems of students with dyslexia, and will make reasonable adjustments to accommodate and recognize their difficulties. However, amongst non-dyslexic students there are few things that irritate tutors, examiners and supervisors more than essays or presentations that contain misspellings and typographical errors as these usually indicate poor, or no, proofreading. Occasional mistakes under examination conditions are understandable. However, where an essay is presented as part of the written coursework of your programme, or where materials for overhead projection or a poster have been prepared for a presentation, to neglect to use a spell-checker is to throw away marks unnecessarily. Table 1.2 lists a few commonly misspelled words. As you will see, some of the words crop up in the list of commonly confused words.

Table 1.2 Some common spelling errors

Correct	Note
Accommodate	Two 'c' and two 'm'
Address	Double 'd'
Amend	Only one 'm'
Business	An 'i' between the 's' and 'n'
Committee	Double 'm', a double 't' and a double 'e'
Controversy	An o in the middle
Definite	Spelt with -ite at the end
Fluoresce, fluorescent and fluorescence	Fluor- not flour- or flor-
Independent	end in 'ent' not 'ant'
Inoculate	One 'n' not two
Liaise	Two 'i'
Licence and license	Licence is the noun; license is the verb
Millennium	Double 'l' and a double 'n'
Miniature	Do not forget the 'a' after the mini
Necessary	One 'c' and a double 's'
Practical	Spelt with a -cal at the end not -cle
Rhythm	One of those commonly misspelled words, like phlegm, derived from Greek, that are best committed to memory
Withhold	And its related forms (like withholding) have a double 'h'

UK and American English

The spellings in this book are in UK (Oxford) English, which is the publisher's requested style. American English is often different and spellings may vary. This is worth knowing since many publishers are now multinational and may choose to produce all books in American English. However, journals based in the UK will require UK English. It is always best to find out before you begin writing.

When you are writing your assignments in the UK it is important for you to remember that UK English is required. Note also that most personal computers, particularly those which use the Windows operating system, have American English as the default. It is possible to change to UK English but if you forget, the spell-check may indicate that an English spelling is incorrect. Some common differences are shown in Table 1.3.

Note also that many English words which end in '-ise', such as 'advise' and 'surprise' end in '-ize' in American English. Also, you may find some English words ending in 'ise' or 'ize', such as 'recognise' and 'recognize'. The forms we use in this book are those given in the *Oxford English Dictionary*. If in doubt, use this dictionary as your source of reference. Also, in UK English, the

Table 1.3 Some differences between American and UK English

UK English	American English
anaemia	anemia
centre	center
chequered	checkered
colour	color
defence	defense
foetus	fetus
glycaemia	glycemia
haemoglobin	hemoglobin
humour	humor
licence (noun)	license (noun)
manoeuvre	maneuvre
metre	meter
oedema	edema
oestrus	estrus
programme (except a computer program)	program
skilful	skillful
speciality	specialty
sulphur	sulfur
traveller	traveler
tyre	tire

noun ‘practice’ is distinguished from the verb ‘to practise’ by its spelling – in American English, they are both spelt as ‘practise’.

Further reading

Barass, R. (2002) *Study! A Guide to Effective Learning, Revision and Examination Technique*. London: Chapman & Hall.

Collins Essential English Dictionary, 2nd edition (2006) Glasgow: HarperCollins.

Committee on Science, Engineering and Public Policy (1995) *On Being a Scientist: Responsible Conduct in Research*, 2nd edition. London: The National Academies Press.

Compact Oxford English Dictionary, 3rd edition (2005) Oxford: Oxford University Press.

Metchnikoff, E., quoted in F. Heynick (2002) *Jews and Medicine: An Epic Saga*. KTAV Publishing House.

Northedge, R.A. (2005) *Good Study Guide*. Milton Keynes: Open University Press.

Parkinson, J. (2007) *i before e (except after c)*. London: Michael O’Mara.

Trask, R.L. (1997) *The Penguin Guide to Punctuation*. London: Penguin.

Truss, L. (2005) *Eats, Shoots and Leaves: the Zero Tolerance Approach to Punctuation*. London: Profile.

Watson, J.D. and Crick, F.H.C. (1953) Molecular structure of nucleic acids: a structure for deoxyribose nucleic acid. *Nature*, **171**, 737–38.