



Scientific English



科技英语

中国学生专业英语应用指南

An Essential Guide to Academic English for Chinese Scientists

● (澳) Ken Chan 许忠能 编

清华大学出版社



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北京

内 容 简 介

澳籍外教 Ken Chan 先生先后在中国内地多所大学担任科技英语教师。在教学过程中,他发现中国学生学习科技英语时存在不少困难和问题。为了帮助中国学生尽快提高其科技英语的听、说、读、写能力,他特意编写了本书。本书系统介绍了科技英语基本词汇、口语表达、听力、阅读理解、写作等方面知识,书中内容多围绕中国学生学习科技英语常犯错误展开,贴近实际,好学易懂,针对性强,读来饶有趣味。本书是 Ken Chan 先生多年教学经验的结晶,是一本很适合中国学生阅读的科技英语读本。

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图书在版编目(CIP)数据

科技英语:中国学生专业英语应用指南 = Scientific English: An Essential Guide to Academic English for Chinese Scientists/(澳)肯·陈,许忠能编. —北京:清华大学出版社, 2009.8

ISBN 978-7-302-18890-2

I. 科… II. ①肯…②许… III. 英语—自学参考资料 IV. H31

中国版本图书馆 CIP 数据核字(2008)第 175875 号

责任编辑:罗 健

责任校对:刘玉霞

责任印制:李红英

出版发行:清华大学出版社

地 址:北京清华大学学研大厦 A 座

<http://www.tup.com.cn>

邮 编:100084

社 总 机:010-62770175

邮 购:010-62786544

投稿与读者服务:010-62776969, c-service@tup.tsinghua.edu.cn

质 量 反 馈:010-62772015, zhiliang@tup.tsinghua.edu.cn

印 刷 者:北京四季青印刷厂

装 订 者:三河市李旗庄少明装订厂

经 销:全国新华书店

开 本:185×260 印 张:17.75 字 数:502 千字

版 次:2009 年 8 月第 1 版 印 次:2009 年 8 月第 1 次印刷

印 数:1~3000

定 价:30.00 元

本书如存在文字不清、漏印、缺页、倒页、脱页等印装质量问题,请与清华大学出版社出版部联系调换。联系电话:(010)62770177 转 3103 产品编号:029204-01

PREFACE

Being essentially a “westerner” with a Chinese heritage, I have an inherent interest in Chinese affairs. I am excited about the current phase of education in China, which is serious about traditional knowledge-based learning. The major reforms to China’s higher-education system that took place in the late 1990s have improved the country’s capacity to teach students in a variety of disciplines. Postdoctoral positions were instituted in China in 1985, though postdoctoral training is still seen by many as unattractive compared to overseas training. Reasons include a general lack of intellectual laboratory culture and of intellectual exchange, and a knowledge-based learning that does not seem to progress sufficiently to skills in analysis and problem solving. These will only be fixed with increasing input from foreign expertise.

I went through my entire education under the Australian system at a time when tertiary (university) education in the country was rigorous and respected. This was before the 1990s when there were only seven universities in the entire nation. Now there are more than 35 universities. But instead of traditional knowledge-based teaching and research, a vast majority of these so-called universities direct their resources primarily to job-oriented courses that are dependent on societal demands of the time, such as degrees on tourism or human resource management. After teaching and research for some 15 years at several (both traditional and new) universities, I no longer feel intellectually challenged in Australia and I need to broaden my horizons abroad.

In 2005, I took my family with me to China where I taught biology over two semesters at two different universities. Teaching biology in English was a great challenge but frustrating at the same time. There was much misunderstanding of the material through differences in classroom culture, teaching method, depth of understanding and application of concepts, as well as language barriers. Those 12 months in China allowed me to assess the status of English at various levels of life, the way English is used, its impact on the Chinese society, how it is taught, and the problems it creates for science students. Many students treat science as hard work rather than something to enjoy and to improve as a person. But I found they quickly regain their interest and motivation once their command of English has improved and have experienced the cross-cultural interaction.

After returning to Australia, I decided the best contribution I could make to Chinese education is not through classroom teaching of science, but through writing a book that deals with the base roots of communicating science in English. Such a book would reflect the requirements of *scientific* academic English, which differs from books on conventional academic English. It would identify the common problems that stem from cultural behaviour, old habits and language-related obstacles, and provide solutions for effective communication in science at the academic level. I believe there is enormous potential in China to produce great scientists, but they must first break the scientific English barrier.

This book is not about the English language *per se* — that is, it is not about linguistics—

rather, it is written specifically for Chinese scientists who have already some background in English. Although it explains some “rules” of the English language, these are presented as useful guides only. An ultimate objective of the book is to link understanding of scientific English with conciseness, preciseness, consistency, clarity and related issues because these are the real rules of *scientific* academic English. In many ways the true problems Chinese people have with scientific communication are concealed within these issues.

It is not the intention of the book to help the reader to translate English words and phrases directly into Chinese. Rather, it is intended to help the reader to “think” more like a native English person when speaking, listening, reading and writing. Competency in scientific English is not just about writing, which is the main focus of most books on scientific English. Scientific communication involves also speaking (such as to English-speaking scientists at a conference), listening (such as to presentations and when conversing with English-speaking scientists), and reading (such as science books and journal articles that are written in English). The English involved in each of these is interrelated in some ways but different in other ways. For instance, speaking is natural to the native speaker but writing is learnt. This means speaking and writing are not the same. Yet if you can speak English, it will help you to write it well. I firmly believe you will probably never be able to write well if you cannot speak the language proficiently. This is particularly true for scientific English. To be able to speak (and to listen), there is a language barrier that must be broken first. To break the language barrier means to think more like the person who speaks the other language. It is the intent of this book to guide the student to think this way when dealing with academic English relevant to science.

The way the book is written allows it to be treated also as a reference book or simply as an interesting book to read. Although the chapters can be viewed as stand-alone chapters, they are written in a way that they lead on to the next so that you will understand more if you are familiar with the earlier chapters in the order. Many examples are provided to improve understanding, and you should practice what you have learned before progressing to the next chapter. There are exercises to add to the examples and to assist with practice.

The book could not have materialised without the help of Xu Zhongneng from Guangzhou’s Jinan University who helped with communication that led to the publication of the book. Both he and Zhu Hong translated parts into Chinese, to whom I am very grateful. My initial idea of a book was on a specialised biological subject; but Luo Jian from Tsinghua University Press suggested a book on English would have more appeal and more useful for Chinese students. So I thank him for his suggestion which has led to this book, which I found more enjoyable to write than I had envisaged. Finally, I would like to thank all my students in China who inspired me into writing this book, known or unbeknown to them. Some of these students also read drafts of the book and, like my wife Anne, gave encouraging comments.

Ken Chan

CONTENTS

CHAPTER 1	INTRODUCTION	[1]
1.1	What is science	[1]
1.1.1	The scientific method is essential to scientific English	[1]
1.1.2	Fields of science: is scientific English essential for you	[3]
1.1.3	Pure/applied and academic/industrial sciences	[4]
1.2	Why learn scientific English	[5]
1.2.1	Will you or do you make scientific contribution to society	[5]
1.2.2	Communication of science	[6]
1.2.3	Scientific English is not the same as common academic English	[8]
1.3	Aims and objectives of the book	[11]
CHAPTER 2	THE DIFFERENT TYPES OF ENGLISH AND THEIR RELEVANCE TO THE LANGUAGE OF SCIENCE	[14]
2.1	Old and modern English	[14]
2.2	Impact of science and Latin/Greek on English	[15]
2.3	There are differences between British English and American English	[24]
2.3.1	What is American English	[24]
2.3.2	Differences in pronunciation and spelling	[25]
2.3.3	Never use informal words and phrases in science	[26]
2.4	How did “Chinglish” come about	[27]
CHAPTER 3	WORD ROOTS AND PARTS	[30]
3.1	Knowing word roots can help you with scientific English	[30]
3.2	Many common words are formed using prefixes and suffixes	[31]
3.3	Many science words are formed using prefixes and suffixes	[34]
3.3.1	Some disciplines use certain prefixes frequently	[34]
3.3.2	Some prefixes are common to all science disciplines	[38]
3.3.3	Many science words are formed using suffixes	[45]
3.3.4	Suffixes that determine the part of speech	[47]
3.3.5	Plural suffixes can be different in science words	[49]

3.4	Many adjectives come from Latin	[52]
3.5	Other word roots useful to science	[52]
3.6	Exercises	[56]
CHAPTER 4	SCIENTIFIC ACADEMIC SPEAKING	[59]
4.1	Correct pronunciation of scientific words	[59]
4.1.1	Pronunciation; why speaking is as important as writing	[59]
4.1.2	How to stress syllables and words correctly	[62]
4.2	Sentence stress is important also	[67]
4.3	The effect of intonation on conveying meaning	[68]
4.4	Other pronunciation problems for the Chinese	[70]
4.5	How much vocabulary do I need	[73]
4.5.1	Remember that an English word can have multiple meanings	[73]
4.5.2	Never take word definitions from a dictionary for granted	[74]
4.5.3	Typical words all Chinese scientists should know	[75]
4.6	Answering to negative questions	[81]
4.7	When to use singular and plural words in speaking	[83]
4.8	Exercises	[85]
CHAPTER 5	SCIENTIFIC ACADEMIC LISTENING	[91]
5.1	Bad English-class listening habits and how to rectify them	[91]
5.2	How to get the best out of listening to instructions	[95]
5.3	Do you know how to take notes in English	[96]
5.4	Important English markers that connect phrases and sentences	[101]
5.4.1	How to look for markers when listening	[101]
5.4.2	Clauses containing "if" can cause problems to the Chinese listener	[103]
5.4.3	How to distinguish between facts and opinions when listening	[104]
5.5	Listening comprehension during conversation	[105]
5.6	Exercises	[106]
CHAPTER 6	SCIENTIFIC ACADEMIC READING FOR UNDERSTANDING	[109]
6.1	How to improve your vocabulary for reading comprehension	[109]
6.2	How to deal with difficult sentences	[114]
6.3	Do not forget to take and make notes when reading	[119]
6.4	How to concentrate and remember what you read in textbooks written in English	[124]
6.5	Scientific research-paper format and its role in communication	[127]
6.5.1	The scientific-paper format	[127]

6.5.2	Questions you could ask when reading a scientific paper	[128]
6.6	Do not memorise word by word	[135]
6.7	Exercises	[135]
CHAPTER 7	SCIENTIFIC ACADEMIC WRITING	[139]
7.1	Writing a scientific report	[140]
7.1.1	The research paper format	[140]
7.1.2	Writing format for different types of reports	[144]
7.1.3	Suggestions on how to start writing a paper	[145]
7.2	Style of writing	[145]
7.3	Difficulties with grammar for a Chinese student	[147]
7.4	Personal pronouns and their associated verb forms	[148]
7.5	Singular and plural subjects and their verb forms—again	[150]
7.5.1	Singular nouns can become plural nouns—so why the confusion	[150]
7.5.2	There are nouns that are singular only or plural only	[152]
7.5.3	Can nouns which do not have plural forms be made plural	[153]
7.5.4	Are collective nouns singular and plural	[156]
7.5.5	Confusion about using whether singular or plural forms in sentences	[158]
7.6	Misuse of “many” and “much” by Chinese students	[159]
7.7	Confusion about positioning adverbs in a sentence	[160]
7.8	Should I use past or present tense when writing papers	[161]
7.9	Chinese writers too often choose the wrong words	[164]
7.9.1	Unnecessary phrases commonly used by Chinese students	[164]
7.9.2	Chinese writers commonly misuse “the”	[166]
7.9.3	Chinese writers commonly misuse “respectively”	[170]
7.9.4	Inappropriate use of “such as”, “etc.” and “and so on”	[172]
7.9.5	Use of “which” or “that”	[173]
7.10	How to deal with double negatives	[175]
7.11	Numbers; numerals or spell out the word	[176]
7.12	So you think you know how to use punctuation marks	[178]
7.12.1	Are you really using commas correctly	[178]
7.12.2	How to use apostrophes (') correctly in scientific writing	[182]
7.12.3	Chinese writers often capitalise letters inappropriately	[183]
7.12.4	Punctuation concerning word abbreviations	[185]
7.12.5	Hyphens (-) can be useful in writing	[190]
7.12.6	The true functions of dashes (-)	[195]

7.12.7	The true functions of brackets, colon, semicolon, and the slash	[196]
7.12.8	Rules for spacing between punctuations and words in scientific writing	[199]
7.13	The problem of sentence structure for Chinese writers	[200]
7.13.1	How to make simple sentences and put them together	[201]
7.13.2	Effect of prefacing the main idea of a sentence	[204]
7.13.3	Chinese authors often write sentences that are too long	[205]
7.14	More advanced scientific writing	[206]
7.14.1	Summary on how to be concise	[206]
7.14.2	How to make sentences precise and not ambiguous	[215]
7.14.3	How to make sentences clearer	[220]
7.14.4	How to make sentences and paragraphs more objective	[224]
7.14.5	Consistency is important in science	[226]
7.15	It is unacceptable to plagiarise	[231]
7.15.1	What is plagiarism and why should Chinese writers care	[231]
7.15.2	Paraphrasing can be used to avoid plagiarism	[232]
7.15.3	When to cite and when not to cite	[233]
7.16	Exercises	[235]
	ANSWERS TO EXERCISES	[242]
	GLOSSARY	[258]
	INDEX	[265]

目 录

第 1 章 绪论	(1)
1.1 什么是科学	(1)
1.1.1 科学方法是科技英语的基础	(1)
1.1.2 科技英语对你重要吗	(3)
1.1.3 基础科学与应用科学	(4)
1.2 为什么要学习科技英语	(5)
1.2.1 你为社会作出了科学上的贡献吗	(5)
1.2.2 科学领域的交流	(6)
1.2.3 科技英语不同于一般的专业英语	(8)
1.3 本书的写作目的	(11)
第 2 章 英语的不同类型及它们与科学语言的关系	(14)
2.1 英语简史	(14)
2.2 科学与拉丁文/希腊文对英语的影响	(15)
2.3 英国英语与美国英语	(24)
2.3.1 什么是美国英语	(24)
2.3.2 认清英国英语与美国英语发音与拼写中的差别	(25)
2.3.3 不要在科学语言中使用不正式的词与短语	(26)
2.4 中国式英语是怎样产生的	(27)
第 3 章 科技英语的词根与基本词汇	(30)
3.1 了解词根与基本词汇有助于你了解科技英语	(30)
3.2 许多日常词汇是由前缀与后缀构成的	(31)
3.3 科技英语中由前缀与后缀构成的词汇	(34)
3.3.1 一些学科使用频率较多的前缀	(34)
3.3.2 适合所有科学的前缀	(38)
3.3.3 许多学科的词汇由后缀构成	(45)
3.3.4 后缀改变词性	(47)
3.3.5 科学词汇中的复数后缀是不同的	(49)
3.4 许多形容词来自拉丁文	(52)
3.5 科学词汇用得较多的其他词根	(52)
3.6 习题	(56)

第4章 科技专业英语的口语表达	(59)
4.1 科技词汇的正确发音	(59)
4.1.1 为什么科技英语的说与写同样重要	(59)
4.1.1 如何处理音节与词汇的重读	(62)
4.2 句子的重读同样重要	(67)
4.3 语调对表达意思的影响	(68)
4.4 中国学生发音的其他问题	(70)
4.5 你需要多少词汇	(73)
4.5.1 记住:一个英语单词有多种意思	(73)
4.5.2 不要认为字典的解释在什么时候都是对的	(74)
4.5.3 中国学者应该知道的典型词汇	(75)
4.6 如何回答否定疑问句	(81)
4.7 在说话中什么时候用单、复数	(83)
4.8 习题	(85)
第5章 科技英语的听力	(91)
5.1 如何克服不好的听力习惯	(91)
5.2 如何更好地通过听去学习	(95)
5.3 如何在听的时候做英语笔记	(96)
5.4 连接短语与句子的重要标记	(101)
5.4.1 如何在听的时候寻找标记	(101)
5.4.2 “if”短语是中国学生听力的重要问题	(103)
5.4.3 在听的过程中如何区别事实与观点	(104)
5.5 在对话中的听力理解	(105)
5.6 习题	(106)
第6章 科技英语的阅读理解	(109)
6.1 如何看待词汇与阅读理解的关系	(109)
6.2 如何理解难句	(114)
6.3 在阅读过程中要做笔记及理顺笔记	(119)
6.4 如何提炼与记住阅读的主要内容	(124)
6.5 科学论文的格式及它在交流中的作用	(127)
6.5.1 科学论文的格式	(127)
6.5.2 在看科技论文时可以提出什么问题	(128)
6.6 要理解而不是死记硬背你阅读的内容	(135)
6.7 习题	(135)
第7章 科技英语的写作	(139)
7.1 写科学论文	(140)
7.1.1 写作前要了解科学论文的写作格式	(140)

7.1.2	不同类型的报告有不同的写作格式要求	(144)
7.1.3	如何开始写一篇论文	(145)
7.2	写作风格	(145)
7.3	中国学生的语法难点	(147)
7.4	人称代词及搭配的动词	(148)
7.5	单数主语和复数主语与搭配的动词	(150)
7.5.1	不要错用名词单、复数	(150)
7.5.2	一些名词只有单数或者复数	(152)
7.5.3	没有复数形式的名词可表示复数吗	(153)
7.5.4	集合名词是否可表示单、复数	(156)
7.5.5	如何在句子中使用单、复数的困惑	(158)
7.6	中国学生对“many”与“much”的误用	(159)
7.7	如何确定副词在句子中的位置	(160)
7.8	在写论文时如何确定用过去时还是现在时	(161)
7.9	要注意经常用错的单词	(164)
7.9.1	不要用太多复杂单词及不必要的短语	(164)
7.9.2	不要误用“the”	(166)
7.9.3	在没有反映顺序关系时不要用“respectively”	(170)
7.9.4	“such as”, “etc.” 与 “and so on” 的误用	(172)
7.9.5	“which” 和 “that” 的用法	(173)
7.10	如何处理双重否定句子	(175)
7.11	数目: 用数字表示还是用单词表示	(176)
7.12	如何使用标点符号	(178)
7.12.1	如何正确使用逗号分开句子	(178)
7.12.2	如何正确使用撇号(’)	(182)
7.12.3	中国学生经常不当使用大写字母	(183)
7.12.4	要明白在缩写词与测量单位中是否要使用标点符号	(185)
7.12.5	连字号(-)在写作中是很有用的	(190)
7.12.6	破折号的作用	(195)
7.12.7	不要误用或不用括号、冒号、分号、斜线	(196)
7.12.8	科技英语写作中标点符号与文字间空格的规则	(199)
7.13	关于句子结构的问题	(200)
7.13.1	如何写出简单的名子并使其组织在一起	(201)
7.13.2	不要在写作时总是先说明原因或目的	(204)
7.13.3	中国作者经常使用过长的句子	(205)
7.14	高级科技英语写作	(206)
7.14.1	如何写得简洁	(206)

7.14.2	如何使句子精确而不模棱两可	(215)
7.14.3	如何使句子更清楚	(220)
7.14.4	如何使句子或段落表达的意思更客观	(224)
7.14.5	一致性是科学的重要原则	(226)
7.15	剽窃是不能被接受的	(231)
7.15.1	什么是剽窃和为什么剽窃易被忽略	(231)
7.15.2	改写能有效避免剽窃	(232)
7.15.3	什么时候该引用而什么时候不需要引用	(233)
7.16	习题	(235)
习题答案		(242)
词汇表		(258)
名词索引		(265)

CHAPTER 1 INTRODUCTION

1.1 What is science

The word “science” is from a Latin verb meaning “to know”. When we speak of science, we speak of a way of understanding the world by describing and explaining natural phenomena, because this is the way of acquiring knowledge. To achieve this, the scientist makes initial observations and then follows a series of steps, known as the **scientific method** (Fig. 1-1), so that conclusions can be drawn on the observations made. This process allows knowledge to be gained in an organised way. All proper scientific research is carried out following the scientific method and scientific research articles are written with this method in mind. It is essential that any Chinese person aspiring to be a scientist is familiar with this method also. An appreciation of the process of the scientific method is valuable to the understanding of scientific academic English.

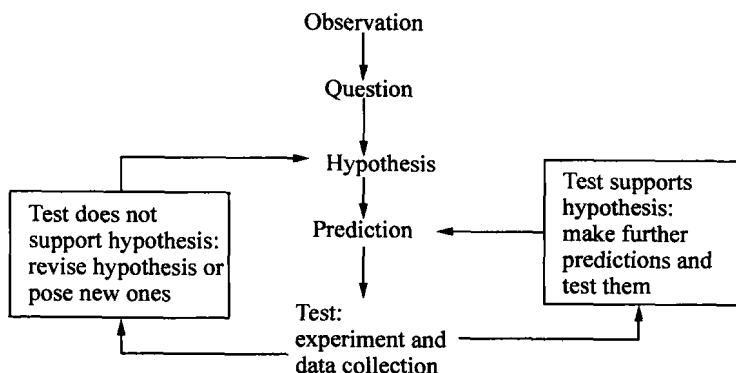


Figure 1-1 Steps in the scientific method.

1.1.1 The scientific method is essential to scientific English

The first step in the scientific method is to make **general observations**. You may then gain some idea about what you have observed, and you may have a **question** from which you could make a prediction on what the outcome might be. What you predict, however, may or may not be right. You must first test the different alternatives to your idea (or theory) so that your answer is not biased. However, an idea or a theory is usually not testable. For instance, you cannot test the theory of evolution itself, because evolution is a theory and not a tangible thing (that is, it cannot be touched and is not obviously visible). Therefore the question derived from your idea needs to be turned into a **hypothesis** that can be tested. For example, you can touch flowers and see their colours, and so you can collect their seeds and **test the hypothesis** that when seeds

of red and white pea flowers are crossed, the flowers of offspring have a certain ratio of pink, red, and white colour. You can easily count the seeds that produce the flower colours; therefore you can compare (i. e. test) them. The hypothesis, if supported by the results after testing, may be used as evidence to support the original idea. Thus if the ratio of red, white and pink flowers of offspring matches to that predicted, it can be taken as evidence for the theory of evolution, because evolution means change through generations.

Without hypothesis testing, ideas about nature (e. g. evolution and creation by God) are mere speculations which any person can make. You cannot base your conclusion or claims on intuition, unqualified speculation or emotion. Using these to explain something is not very convincing, and consequently would not be scientific. Science is therefore really about gathering evidence to explain natural phenomena.

There are actually two types of hypothesis when conducting an experiment: a **research hypothesis** and a **null hypothesis** (see example in Fig. 1-2). A research hypothesis is a statement that you think is true. But because science must be unbiased, testing what you think is true would be biased. The null hypothesis, which states that the test will show no difference in what is being compared (or no relationship between given variables), is an impartial or unbiased statement that is used for testing instead. If the test rejects the *null* hypothesis, i. e. the null hypothesis is shown to be incorrect, the data may be considered supportive of the *research* hypothesis. That is why the research hypothesis is also known as the **alternative hypothesis**. While there is only one null hypothesis for each test, there may be more than one alternative hypothesis.

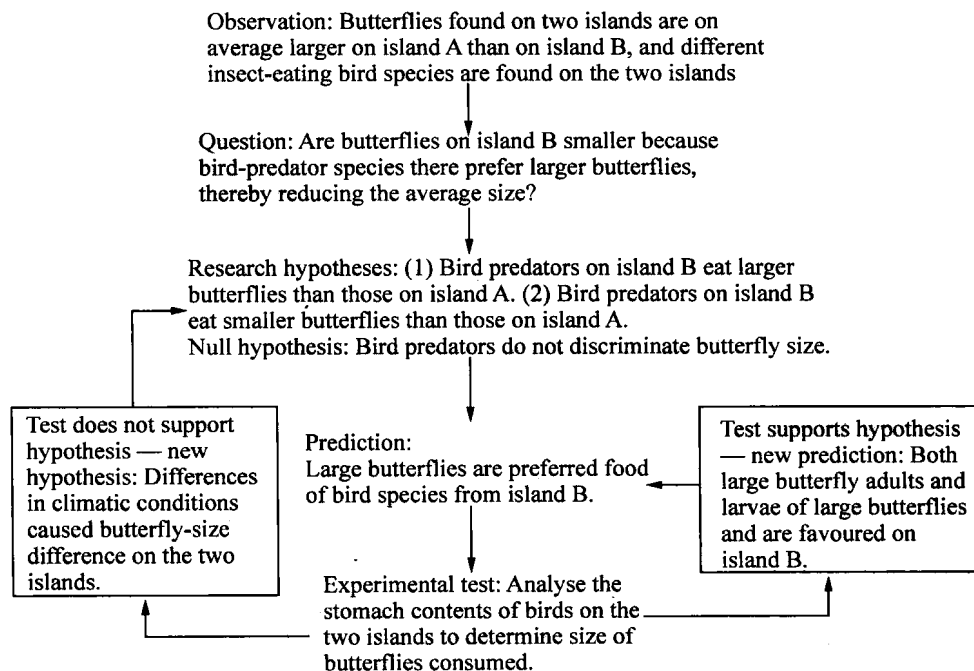


Figure 1-2 An example on the application of the scientific method.

The results you have obtained using the scientific method will only be considered valid if another researcher can duplicate your work and produce the same results through rigorous and repeated tests. Thus if an experiment is properly repeated again and again following the experimental methodology you have described, very similar results should be obtained. To allow the results to be reproducible by others, you must be able to provide a clear description of your work. Such procedural requirements of the scientific method result in a style and expression of information different from those expressed in non-scientific information (academic or not).

The study of science is not just memorising and reiterating a large amount of facts and theories; it is about experimentation using the scientific method. Experimentation, through the application of the scientific method, can make pursuit of knowledge enjoyable to the student. To the established scientist, there is nothing more satisfying than solving mysteries and delving into the complexity and fascination of nature.

1.1.2 Fields of science: is scientific English essential for you

Science is a large, multidisciplinary branch of knowledge comprising many fields of study. Within each science field, there occur many branches that science students may specialise. Below are some examples of sub-disciplines of the **natural sciences**:

- Biological sciences
 - molecular biology, genetics, evolutionary biology
 - microbiology, histology, cell biology
 - botany, zoology, entomology, parasitology, mycology, taxonomy
 - medicine, anatomy and physiology, neurophysiology, immunology
 - biochemistry, biotechnology
 - marine biology, freshwater biology
 - agriculture, agronomy, animal science, veterinary science
 - ecology, environmental science, conservation biology
 - bioinformatics
- Physical sciences
 - physics
 - mechanics, optics, acoustics, electromagnetism, nuclear physics, particle physics, quantum physics, fluids and plasmas, mechanics, solid-state physics, theoretical physics
 - chemistry
 - analytical chemistry, electrochemistry, materials science, biochemistry, organic chemistry, inorganic chemistry, spectroscopy, stereochemistry, industrial chemistry
 - astronomy, astrophysics, cosmology
- Earth sciences
 - geology, geography, hydrology, oceanography, soil science, limnology, meteorology, palaeontology, mineralogy, crystallography

Even within the sub-disciplines there are more specific areas of study. For example, ecology covers areas as population ecology, community ecology, ecosystem ecology, landscape ecology, environmental science, nature conservation, evolutionary biology, ecophysiology (or environmental physiology), behavioural ecology, etc. Medicine may include such areas as dentistry, pathology, cardiology, as well as immunology, microbiology, parasitology, anatomy and

physiology, etc.

Non-natural sciences include mathematics, health science, sports science, and many others. Mathematics itself does not require experimental test of own theories and hypotheses, but it is essential to science—it has an important role in the scientific method and in the expression of scientific models, such as in hypothesis testing and data analysis and in generation of mathematical models for prediction. Some subject areas attach “science” to their name because they want to be seen as rigorous that the science term implies. “Social sciences”, which study human behaviour and societies, and “political science”, which studies how people obtain or compete for power to use in governing a country, are examples of “sciences” based more on opinion and persuasion rather than following the scientific method. An extreme example is “creation science”, which has very little in common with the scientific method at all.

The science brand is often incorrectly used to mean “modernisation” or “high technology”. “Computer science” is an example. It is normally not considered a true science field for the same reason why “political science” is not considered a science field, although it does have a strong grounding in mathematics.

1.1.3 Pure/applied and academic/industrial sciences

There are other areas which may be considered as science at least in part. These include those which may fall under the category “science and technology” such as applied quantum mechanics, biotechnology, electrodynamics, food science, forensic science, nanotechnology, and thermodynamics. These areas may be viewed as **“applied science”** which is the seeking of information that is of immediate use and benefit. They include also the “industrial” or “commercial sciences” such as aeronautics, electronics, engineering (civil, chemical, electrical, mechanical, industrial, materials, etc.), environmental chemistry, image technology (e.g. cinematography, photography, television), industrial chemistry, mineral processing, synthetic chemistry, and telecommunications, among others. Certain branches of the natural sciences are also applied; examples are environmental science, agricultural science, areas of molecular biology and microbiology, as well as applied mathematics, and many others. Applied science is much more popular among postgraduates in China than pure science. A fundamental difference between the “industrial sciences” and the “academic sciences” such as the natural sciences is that study involving academic sciences is carried out for the sake of knowledge, whereas work in industrial sciences is solely for marketable products. A marked difference therefore exists between the two types of sciences—**academic sciences are hypothesis-driven, whereas industrial sciences are not**—experiments conducted in the academic science laboratory are based on hypotheses, but those in the industrial science laboratory only need to follow prescribed protocols.

In contrast to applied science, **“pure science”** pursues knowledge for the sake of knowledge and not just seeks information for short-term benefits only. Pure sciences are the more traditional research and learning areas such as zoology, botany, biochemistry, organic and inorganic chemistry, physical chemistry, calculus, algebra, theoretical physics, and others. Chinese research tends toward applied rather than pure, although the two may be mixed. Sometimes pure and applied sciences are not clear-cut (e.g. microbiology, soil science, meteorology).

This book is written specifically for Chinese students; researchers and academics that