Scientific English 

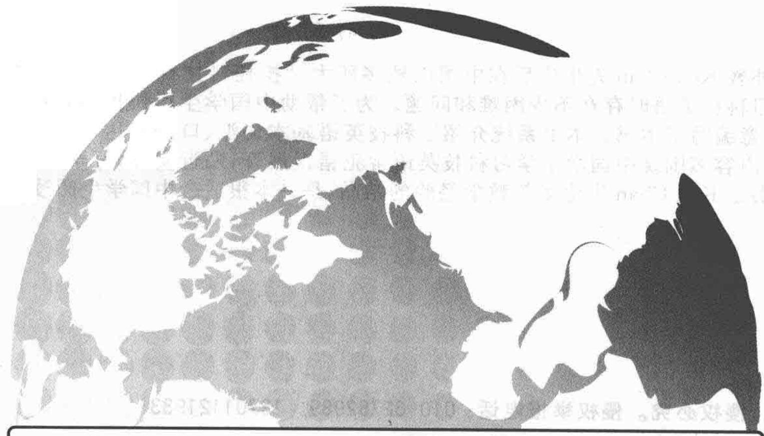
科技英语

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



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
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。

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

目　　录

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.

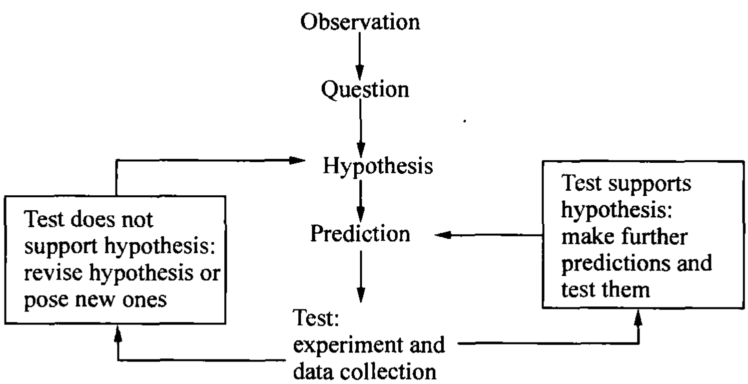


Figure 1-1 Steps in the scientific method.

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.

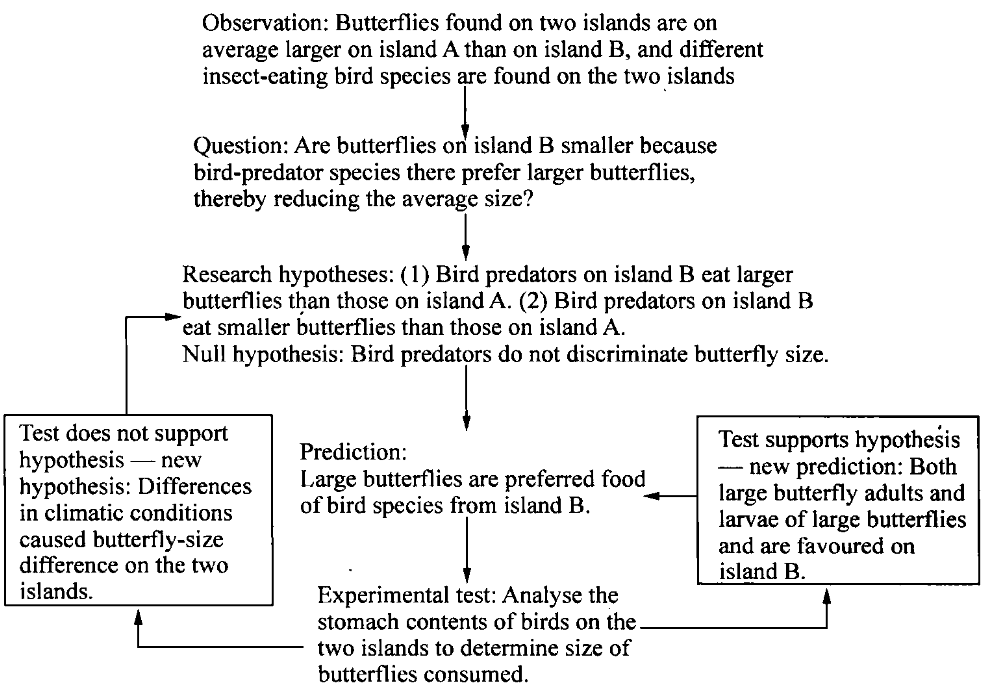


Figure 1-2 An example on the application of the scientific method.

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