生物学专业英语

ACADEMIC ENGLISH OF BIOLOGY

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内 容 提 要

本书是高等院校生物学专业英语基础教材,是编者结合多年教学实践并参考大量国内外英文生物学教科书的基础上编写而成的。全书共分 8 个单元,分别为生物学简介、细胞的结构与功能、遗传学、生命的起源与生物多样性、植物学、动物的结构与功能、生态学、科技英语写作范例。

本书可供农(林)学、医学、师范类高等院校及综合性大学生物类专业的学生、教师以及相关研究人员使用和参考。

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前　言

当今,生物学正以前所未有的深度和广度迅速发展,新知识、新技术不断涌现。从事与生物学相关方面的科技工作者必须时刻关注国际上的最新进展,因此学好英语,快速准确地获取新知识,与国外同行进行交流就显得非常重要。生物学专业英语正是在这一背景下为生物类专业的学生开设的一门专业基础课。课程设置的主要目的就是使学生掌握生物学专业词汇,熟悉生物学专业英语的基本表达方式,利用英语这个工具学习更多的生物学知识,并能够进行更广泛的学术交流。

本书一共分为8个单元,分别为生物学简介、细胞的结构与功能、遗传学、生命的起源与生物多样性、植物学、动物的结构与功能、生态学、科技英语写作范例。前7个单元在内容上基本涵盖了普通生物学的各个组成部分,最后1个单元为学生提供生物学英文论文的写作格式及写作指导。本书具有以下几个特点。

1.有较强的系统性和完整性,符合教学规律,使学习生物学知识和掌握生物学专业英语融为一体。

2.信息量大,既包含生物学基础知识和基本理论,也涉及相关的课外阅读材料和专业英语词汇。

3.各文章为了便于读者阅读和理解,每章后面附有生物学专业词汇及音标、惯用短语(Phrase)和疑难注释(Notes),并附有重点句子的讲解分析和参考译文。

4.在本书最后部分附有专业词汇的出处,以方便查阅和对照。

5.编者充分考虑了本书读者英语水平，在内容的编写上注重由浅入深、循序渐进、通俗易懂、生动有趣，在激发学生阅读兴趣、提高学生的英语阅读水平的同时，又掌握了生物学的知识。

本书是集体智慧的结晶，参与编写的人员主要是东北农业大学生命科学学院的中青年骨干教师，这些编者都具有博士学位，长期从事科学研究和一线教学，使全书的选材和内容质量得以保持在一个较高的起点。全书由哈尔滨医科大学基础医学院的雷蕾教授主审。

尽管我们在成书过程中十分审慎，但由于编写经验不足，难免会有不妥与错漏之处，敬请读者与各方专家在使用过程中提出宝贵意见，以便更正。

编　者

2005年5月于哈尔滨

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Introduction of Biology

1.1 SCIENCE AND THE SCIENTIFIC METHOD

You probably have the idea that biology has something to do with plants and animals. Most textbooks define biology as the science that deals with life. This definition seems clear until you begin to think about what the words science and life mean.

The word science is a noun derived from a Latin term (scientia) meaning knowledge or knowing. Humans have accumulated a vast amount of "knowledge" using, variety of methods, some by scientific methods and some by other methods.

Science is really distinguished by how knowledge, is acquired, rather than by the act of accumulating facts. Science is actually a process or way of arriving at a solution to a problem or understanding an event in nature that involves testing possible solutions. The process has become known as the scientific method. The scientific method is a way of gaining information (facts) about the world by forming possible solutions to questions followed by rigorous testing to determine if the proposed solutions are valid (valid = meaningful, convincing, sound, satisfactory, confirmed by others).

Scientists are in the business of distinguishing between situations that are merely correlated (happen together) and those that are correlated and show cause-and-effect relation-ships. When an event occurs as a direct result of a previous event, a cause-and-effect relationship exists. Many events are correlated but not all correlations show a cause-and-effect relationship. For example lightning and thunder are correlated and have a cause-and-effect relationship. However, the relationship between autumn and trees dropping their leaves is more difficult to sort out. Because autumn brings colder temperatures many people assume that the cold temperature is the cause of the leaves turning color and falling. The two events are correlated. However there is no cause-and-effect relationship. The cause of the change in trees is the shortening of days that occurs in the autumn. Experiments have shown the artificially shortening the length of days in a greenhouse will cause the trees to drop their leaves even though there is no change in temperature. Knowing that a cause-and-effect relationship exists enables us to make predictions about what will happen should that same set of circumstances occur in the future.

This approach can be used by scientists to solve a particular practical problem, such as how to improve milk production in cows or advance understanding of an important concept such as evolution that may have little immediate practical value. The scientific method requires a systematic search for information and a continual checking and rechecking to see if previous ideas are still supported by new information. If the new evidence is not supportive, scientists discard or change their original ideas. Scientific ideas undergo constant reevaluation, criticism, and modification.

The scientific method is not an inflexible series of steps that must be followed in order. However, the scientific method has several important identifiable components, including careful observation, the construction and testing of hypotheses, an openness to new information and ideas, and a willingness to submit one's ideas to the scrutiny of others[1].

1.1.1 Observation

Scientific inquiry often begins with an observation that an event has occurred repeatedly. An observation occurs when we use our senses (smell, sight, hearing, taste, touch) or an extension of our senses (microscope, tape recorder, X-ray machine, thermometer) to record an event. Observation is more than just taking note of something. You may hear a sound or see something without really observing. Scientists learn how to increase their level of awareness. Do you know what music is being played in a shopping mall? You hear it but you don't "observe" it. What color was the car that just drove past? You saw it but you didn't observe it. When scientists talk about their observations, they are referring to careful, thoughtful recognition of an event—not just casual notice.

The information gained by direct observation of the event is called *empirical evidence* (*empiric* = based on experience; from the Greek *empirikos* = experience). Empirical evidence is capable of being verified or disproved by further observation. If the event occurs only once or cannot be repeated in an artificial situation, it is impossible to use the scientific method to gain further information about the event and explain it.

1.1.2 Questioning and Exploration

As scientists gain more empirical evidence about an event they begin to develop questions about it. How does this happen? What causes it to occur? When will it take place again? Can I control the event to my benefit? The formation of the questions is not as simple as it might seem because the way the questions are asked will determine how you go about answering them. A question that is too broad or too complex may be impossible to answer; therefore a great deal of effort is put into asking the question in the right way. In some situations, this can be the most time-consuming part of the scientific method; asking the right question is critical to how you look for answers.

Let's say, for example, that you observed a cat catch, kill, and eat a mouse. You could ask several kinds of questions: ① Does the cat like the taste of the mouse? ② If given a choice between mice and canned cat food, which would a cat choose? ③ What motivates a cat to hunt? ④ Do cats hunt only when they are hungry?

Once a decision has been made about what question to ask, scientists explore other sources of knowledge to gain more information. Perhaps the question has already been answered by someone else or several possible answers have already been rejected. This avoids waste of time and energy in order to answer an already-answered question or explore solutions that have already been shown to be wrong. This process usually involves reading appropriate science publications, exploring information on the Internet, or contacting fellow scientists interested in the same field of study. Even if the particular question has not already been answered, scientific literature and other scientists can provide insights that may lead toward a solution. As a result of this activity a decision is made about whether to continue to explore the question. If the scientist is still intrigued by the question a formal hypothesis is formed and the process of inquiry continues at a different level.

1.1.3 The Formation and Testing of Hypotheses

A hypothesis is a statement that provides a possible answer to a question or an explanation for an observation. A good hypothesis is logical, accounts for all the relevant information currently available, allows one to predict future events relating to the question being asked, and is testable. Just as deciding which questions to ask is often difficult, the formation of a hypothesis requires much critical thought and mental exploration. If the hypothesis does not account for all the observed facts in the situation, doubt will be cast on the work and may eventually cast doubt on the validity of the scientist's work. If a hypothesis is not testable or is not supported by the evidence, the explanation will be only hearsay and no more useful than mere speculation.

Keep in mind that a hypothesis is a prediction based on observations and information gained from other knowledgeable sources. Scientists test a hypothesis to see if it is supported or is disproved. If you cannot disprove a hypothesis it increases your confidence that the hypothesis is probably correct, but it does not prove it. It could be that an alternative hypothesis you haven't thought of explains the situation or you have not made observations to indicate that your hypothesis is wrong. The test of a hypothesis can take several forms. It may simply involve the collection of pertinent information that already exists from a variety of sources. For example if you visited a cemetery and observed from reading the tombstones that an unusually large number of people of different ages died in the same year, you could hypothesize that there was an epidemic of disease or a natural disaster that caused the deaths. Consulting historical newspaper accounts would be a good way to test this hypothesis.

In other cases a hypothesis may be tested by simply making additional observations. For example, if you hypothesized that a certain species of bird used cavities in trees as places to build nests, you could observe several birds of the species and record the kinds of nests they built and where they built them.

Another common method for testing a hypothesis involves devising an experiment. An experiment is a re-creation of an event or occurrence in a way that enables a scientist to support or disprove a hypothesis. This can be difficult because a particular event may involve a great many separate happenings. For example, the production of songs by birds involves many activities of the nervous system and the muscular system and is stimulated by a wide variety of environmental factors. It might seem that developing an understanding of the factors involved in birdsong production is an impossible task. To help unclutter such situations, scientists have devised what is known as a controlled experiment. A controlled experiment allows scientists to compare two situations that are identical in all but one respect. The situation used as the basis of comparison is called the control group; the other situation is called the experimental group. The single factor that is allowed to be different in the experimental group but is controlled in the other group is called the variable.

The situation involving birdsong production would have to be broken down into a large number of simple questions, as previously mentioned. Each question would provide the basis on which experimentation could occur. Each experiment would provide information about a small part of the total process of birdsong production. For example, in order to test the hypothesis that male sex hormones are involved in stimulating male birds to sing, an experiment could be performed in which one group of male birds had their testes removed (the experimental group), whereas the control group was allowed to develop normally. After the experiment, the new data (facts) gathered would be analyzed. If there were no differences between the two groups, scientists could conclude that the variable evidently did not have a cause-and-effect relationship (i.e., was not responsible for the event). However, if there was a difference, it would be likely that the variable was responsible for the difference between the control and experimental groups. In the case of songbirds, removal of the testes does change their singing behavior.

Scientists are not likely to accept the results of a single experiment because it is possible a random event that had nothing to do with the experiment could have affected the results and caused people to think there was a cause-and-effect relationship when none existed[2]. For example, the operation necessary to remove the testes of male birds might cause illness or discomfort in some birds, resulting in less singing. A way to overcome this difficulty would be to subject all birds to the same surgery but to remove the testes of only half of them. (The control birds would still have their testes.) Only when there is just one variable and many replicates (copies) of the same experiment are conducted and the results are consistently the same are the results of the experiment considered convincing.

Furthermore, scientists often apply statistical tests to the results to help decide in an impartial manner if the results obtained are valid (meaningful, fit with other knowledge) and reliable (give the same results repeatedly) and show cause and effect, or if they are just the result of random events.

During experimentation, scientists learn new information and formulate new questions that can lead to even more experiments. One good experiment can result in 100 new questions and experiments. The discovery of the structure of the DNA molecule by Watson and Crick resulted in thousands of experiments and stimulated the development of the entire field of molecular biology. Similarly, the discovery of molecules that regulate the growth of plants resulted in much research about how the molecules work and which molecules might be used for agricultural purposes.

If the processes of questioning and experimentation continue, and evidence continually and consistently supports the original hypothesis and other closely related hypotheses, the scientific community will begin to see how these hypotheses and facts fit together into a broad pattern. When this happens, a theory has come into existence.

1.1.4 The Development of Theories and Laws

A theory is a widely accepted, plausible generalization about fundamental concepts in science. An example of a biological theory is the germ theory of disease. This theory states that certain diseases, called infectious diseases, are caused by microorganisms that are capable of being transmitted from one individual to another. As you can see, this is a very broad statement. It is the result of years of observation, questioning, experimentation, and analyzing data. Whereas a hypothesis provides a possible explanation for a specific question, a theory is a broad concept that shapes how scientists look at the world and how they frame their hypotheses. For example, when a new disease is encountered one of the first questions asked would be, "Is it caused by a microorganism?" There are fewer theories than hypotheses.

However, just because a theory exists does not mean that testing stops. In fact, many scientists see this as a challenge and exert even greater efforts to disprove the theory, and experimentation continues. Theories are rarely disproved. Some theories are considered so invulnerable that they are considered scientific laws. A scientific law is a uniform or constant fact of nature and is really just a way to highlight those theories considered fundamental and very unlikely to change. An example of a biological law is the biogenetic law, which states that all living things come from preexisting living things. You can see from this example that laws are even more general than theories. Therefore, there are relatively few scientific laws.

1.1.5 Communication

One central characteristic of the scientific method is the importance of communication. For the most part science is conducted out in the open under the critical eyes of others who are interested in the same kinds of questions. An important part of the communication process involves the publication of articles about one's research, thoughts, and opinions in scientific journals. The communication can occur at any point during the process of scientific discovery. People may ask questions about unusual observations. They may publish preliminary results of incomplete experiments. They may publish reports that summarize large bodies of material. And they often publish strongly held opinions that may not always be supportable with current data. This provides other scientists with all opportunity to criticize, make suggestions, or agrees. Scientists attend conferences where they can engage in dialog with colleagues. They also interact in informal ways by phone, e-mail, and the Internet.

The result is that most of science is subjected to examination by many minds as it is discovered, discussed, and refined.

1.1.6 Science, Nonscience, and Pseudoscience

Fundamental Attitudes in Science

As you can see from this discussion of the scientific method, a scientific approach to the world requires a certain way of thinking. There is an insistence on ample supporting evidence by numerous studies rather than easy acceptance of strongly stated opinions. Scientists must separate opinions from statements of fact. A scientist is a healthy skeptic.

Careful attention to detail is also important. Because scientists publish their findings and their colleagues examine their work, they have a strong desire to produce careful work that can be easily defended. This does not mean that scientists do not speculate and state opinions. When they do, however, they take great care to clearly distinguish fact from opinion.

There is also a strong ethic of honesty. Scientists are not saints, but the fact that science is conducted out in the open in front of one's peers tends to reduce the incidence of dishonesty. In addition, the scientific community strongly condemns and severely penalizes those who steal the ideas of others, perform shoddy science, or falsify data. Any of these infractions could lead to the loss of one's job and reputation.

From Experimentation to Application

The scientific method has helped us understand and control many aspects of our natural world. Some information is extremely important in understanding the structure and functioning of things in our world but at first glance appears to have little practical value. For example, understanding the life cycle of a star or how meteors travel through the universe may be important for people who are trying to answer questions about how the universe was formed, but it seems of little value to the average citizen. However, as our knowledge has increased, the time between first discovery to practical application has decreased significantly.

For example, scientists known as *genetic engineers* have altered the chemical code system of small organisms (microorganisms) so that they may produce many new drugs such as antibiotics, hormones, and enzymes. The case with which these complex chemicals are produced would not have been possible had it not been for the information gained from the basic, theoretical sciences of microbiology, molecular biology, and genetics[3]. Our understanding of how organisms genetically control the manufacture of proteins has led to the large-scale production of enzymes. Some of these chemicals can remove stains from clothing, deodorize, clean contact lenses, remove damaged skin from burn patients, and "stone wash" denim for clothing.

Another example is Louis Pasteur, a French chemist and microbiologist. Pasteur was interested in the theoretical problem of whether life could be generated from nonliving material. Much of his theoretical work led to practical applications in disease control. His theory that there are microorganisms that cause diseases and decay led to the development of vaccinations against rabies land the development of pasteurization for the preservation of foods.

Science and Nonscience

The differences between science and nonscience are often based on the assumptions and methods used to gather and organize information and, most important, the testing of these assumptions. The difference between a scientist and a nonscientist is that a scientist continually challenges and tests principles and assumptions to determine a cause-and-effect relationship, whereas, a nonscientist may not believe that this is important.

Once you understand the scientific method, you won't have any trouble identifying astronomy, chemistry, physics, and biology as sciences. But what about economics, sociology, anthropology, history, philosophy, and literature? All of these fields may make use of certain central ideas that are derived in a logical way, but they are also nonscientific in some ways. Some things are beyond science and cannot be approached using the scientific method. Art, literature, theology, and philosophy are rarely thought of as sciences. They are concerned with beauty, human emotion, and speculative thought rather than with facts and verifiable laws. On the other hand, physics, chemistry, geology, and biology are almost always considered sciences.

Music is an area of study in a middle ground where scientific approaches may be used to some extent. "Good" music is certainly unrelated to science, but the study of how the human larynx generates the sound of a song is based on scientific principles. Any serious student of music will study the anatomy of the human voice box and how the vocal cords vibrate to generate sound waves. Similarly, economists use mathematical models and established economic laws to make predictions about future economic conditions. However, the regular occurrence of unpredicted economic changes indicates that economics is far from scientific because the reliability of predictions is a central criterion of