高等院校环境类系列教材

科技英语

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前　言

本书是按照教育部《大学英语专业阅读阶段教学基本要求》编写而成，主要供理工科高等院校非英语专业的科技英语阅读阶段的教学使用，也可供其他类型高等院校进行专业英语阅读教学时采用。

本书旨在帮助学生开拓科普视野、熟悉科技文体、增加科技词汇量，进一步提高学生的阅读理解和综合分析能力，实现从大学基础英语阅读阶段到专业英语阅读阶段的过渡。科技英语具有丰富的词汇、独特的语法结构和专业上通用的表达方式，学习科技英语是对大学基础英语的补充和提高，也是学生开阔视野、直接了解世界范围内专业前沿知识和技术发展现状的必要途径。通过学习，了解掌握科技英语的表达方式和表达方法在英语中的具体体现，为高年级学生阅读专业英语文献和原著打下一个良好基础。

本书选材广泛，内容新颖，既侧重于专业性基础英语的学习，又兼顾了一些现代科技前沿的知识，内容涵盖了环境、化学、生物和新材料等方面的内容。课文难易适当，行文流畅，语言生动，结构严谨。课文后面配有专业性词汇、词组的解释和课文关键性句子的注解，便于学生自学。

本书共编入课文 16 篇，在使用本教材时，可根据教学时间和专业特点选取不同的内容。每课均附有与内容相关的阅读材料，可供学生

课余阅读练习用，不做教学要求。

参加本书编写工作的有洛阳理工学院的张少文（1～7篇）、周国强（8～9篇）、王强（10～16篇、附录），全书由张少文统一整理定稿。

本书在编写过程中借鉴了英美科技期刊和网站上的论文、部分兄弟院校及本校讲义中的许多有益内容。中国环境科学出版社为本书的出版给予了大力的支持，在此一并致谢。

由于编者经验和水平有限，书中不妥之处在所难免，敬请批评指正。

编　者

2008年2月

Contents

Unit 1

Air Fit to Breathe

Imagine that some extraordinarily powerful astronomical instrument were to be invented that allowed us to see the planets that must surely orbit around other stars, and to look at the composition of their atmospheres. Were we to come across one with an atmosphere like our own, we could scarcely conclude other than that here was a planet on which life had evolved. Not could evolve, but most definitely had. Our atmosphere is a beacon broadcasting our presence to any intelligent beings who might be able to see it.

The reason for this is that, unlike those of the other planets in the Solar system, Earth's atmosphere is in a state of extreme chemical disequilibrium①. It is in some sense comparable to a mixture of compounds in a vast beaker that is being maintained in a state far from equilibrium—indeed, rather like those chemical systems we encountered. What is holding the atmosphere away from chemical equilibrium? Ultimately it is the energy of the Sun, as well as heat from the Earth's interior. But the principal agent that converts this energy into chemical disequilibrium is life itself.

This is to say that it would be quite wrong to view our environment as one miraculously tuned to our needs. It is no coincidence that the atmosphere is suited to the organisms that dwell within and beneath it, for the evolution of life and the attainment of the atmosphere's present composition have not been independent processes.

About 4,600 million years ago, the newly formed Earth was a ball of molten magma which had been condensed, along with the Sun and the other planets, out of a primordial gaseous nebula. Within the body of this molten Earth, chemical elements began to separate out. Much of the planet consisted of iron, which sank (together with a smaller amount of nickel) to form a metal core, leaving behind a "scum" of molten rock which contained largely magnesium, silicon, oxygen, some remaining iron, aluminum, sodium, potassium and calcium. This chemical "differentiation" of the Earth is similar to the process that occurs in an iron smelter during extraction of iron from its ores.

About 3,900 million years ago, much of the planet's heat had been radiated out to space, and the surface was cool enough to solidify into a thin, rocky crust. Two processes now began to contribute to the formation of an atmosphere. The molten rock below the crust contained many dissolved gases, such as water, methane, carbon oxides, nitrogen and neon. These were released from the magma through volcanoes that punctured the solid crust, in a process called degassing. Meanwhile, stray bodies in the Solar System left over from the formation of the planets occasionally collided with the Earth, releasing considerable quantities of volatile gases. It has been suggested that as much as 85 per cent of the water presently on Earth was brought here by impacting extraterrestrial objects.

About 3,800 million years ago, the temperature at the Earth's surface fell below 100 degrees Celsius, at which point water vapor in the atmosphere could be condensed to liquid. It is hard to picture the rainstorm that ensued: imagine, if you can, the entire contents of the oceans falling from the skies in a deluge lasting for perhaps 100,000 years. With the appearance of the oceans, gases that dissolve to a significant extent in water, such as hydrogen chloride, sulfur dioxide and carbon dioxide, were extracted from the atmosphere into the water. Reactions with minerals would then have precipitated some of these compounds as insoluble salts, such as carbonates and sulfates②.

Light gases such as hydrogen, helium and neon, which were abundant in the solar nebula, are too light to be retained by the Earth's gravity, and so they simply rose through the atmosphere and evaporated away into space. Left behind in the early atmosphere were gases such as methane, water vapor, nitrous oxide (N_2O) and carbon monoxide (CO). It was under skies such as these, that life first appeared.

It is remarkable that the complex chemistry of life may have developed from its raw materials within the space of just 300 million years. Yet this is the implication of the discovery in 1983 by S.M.Awramik and colleagues of 3,500-million-year-old rocks in Western Australia that contained evidence of the fossilized forms of bacteria. These organisms appeared to be very similar to some of the very primitive species that still exist today, called blue-green algae or cyanobacteria.

But whereas most algae today obtain their energy by splitting water molecules through photosynthesis, the metabolism of the earliest organisms probably involved many cruder chemical reactions such as those utilized by archaebacteria, the most primitive form of life is still extant today③. Some of these organisms split apart organic molecules such as acetic acid, releasing energy and forming carbon dioxide and methane in the process. Others convert carbon dioxide to methane, or sulfate ions to hydrogen sulfide.

These resourceful bacteria were quite contently living under oxygen-free skies; in fact, oxygen was poisonous to them. But we must assume that one day a species of bacteria made the discovery that the stuff all around them–water–could itself provide a bountiful source of energy when split apart. This was a profoundly antisocial habit, because it yielded as a by-product the toxic gas oxygen. Lynn Margulis, a microbiologist from Harvard University, has described the appearance of photosynthesizing organisms as having heralded a "worldwide pollution crisis" of such magnitude that our present-day industrial emissions are as nothing in comparison. The evolution of life changed the atmosphere beyond recognition.

The time at which this crisis truly took a grip on the planet is open to some debate, but most researchers now place it at around 1,900 to 2,000 million years ago. Oxygen production eventually became overwhelming, presumably because the benefits of using photosynthesis as an energy source were so substantial that bacteria with this capability simply took over, until oxygen was bubbling forth from colonies of algae throughout the world. Inevitably, this polluting activity led to the extinction of many microbial populations, but at the same time mutant strains evolved that was resistant to the poison. Some of these showed still greater adaptability: rather than stoically tolerating the unhealthy new environment, they found a way to thrive in it. The metabolic pathways of these organisms developed so as to actually utilize the oxygen in the atmosphere. They learned to breathe the air of the new world.

These single-celled oxygen-breathing organisms, called protozoa, were the first animals. They made their appearance about 800 million years ago, when the concentration of oxygen in the atmosphere had reached about 5 per cent of its present-day value. Oxygen has probably been maintained at its present proportion of about one-fifth of the atmosphere more or less steadily during at least the past 300 million years, although before this there is evidence of substantial fluctuations: at one time as much as 35 per cent of the air may have been oxygen.

In the upper atmosphere, sunlight splits apart oxygen molecules into their two constituent atoms, and these undergo subsequent reactions with other O_2 molecules to form a new type of oxygen compound containing three atoms: ozone (O_3). This molecule absorbs ultraviolet light strongly, and so filters this part of the spectrum out of the sunlight impinging on the atmosphere. As ultraviolet light is damaging to organic matter, it was not until the ozone layer had formed, about 400 million years ago, that living creatures could entertain the notion of leaving the protecting blanket of seawater and venturing onto dry land.

Phrases and Expressions

1. astronomical	[æstrə'nɔmɪk(ə)l]	*adj.* 天文学的，庞大无法估计的
2. beacon	['bi:kən]	*n.* 灯塔，航标
3. magma	['mægmə]	*n.*（有机物或矿物的）稀糊状混合物；岩浆
4. primordial	[prai'mɔ:djəl]	*adj.* 原始的，最初的
5. nebula	['nebjulə]	*n.* 星云
6. scum	[skʌm]	*n.* 渣滓，糟粕
7. puncture	['pʌŋktʃə]	*n.* 刺穿，穿孔
8. extraterrestrial	[ˌekstrətə'restriəl]	*adj.* 宇宙的，地球大气圈外的
9. primitive	['primitiv]	*adj.* 初期的，原始的，原生的，基本的
10. algae	['ældʒi:]	*n.* 藻，藻类
11. cyanobacteria	[ˌsaiənəʊbæk'tiəriə]	*n.* 蓝藻细菌
12. archaebacteria	[ˌɑ:kibæk'tiəriə]	*n.* 原始细菌
13. stuff	[stʌf]	*n.* 原料，要素
14. microbiologist	[maikrəʊbai'ɔlədʒist]	*n.* 微生物学家
15. photosynthesize	[ˌfəutəu'sinθisaiz]	*vi.*（植物等）进行光合作用，实行光能合成 *vt.*（通过）光合（作用）产生
16. mutant	['mju:tənt]	*adj.* 变异的，突变的
17. strain	[strein]	*n.* 株，种，品系
18. protozoa	[prəutəu'zəuə]	*n.* 杀原生动物药；*n.* 原生动物
19. venture	['ventʃə]	*v.* 冒……的危险，冒昧，斗胆

Notes to the text

1. The reason for this is that, unlike those of the other planets in the Solar system, Earth's atmosphere is in a state of extreme chemical disequilibrium.

原因是这样的，和太阳系的其他星球不同，地球的大气层是处在一个极端的化学不平衡状态。

2. With the appearance of the oceans, gases that dissolve to a significant extent in

water, such as hydrogen chloride, sulfur dioxide and carbon dioxide, were extracted from the atmosphere into the water. Reactions with minerals would then have precipitated some of these compounds as insoluble salts, such as carbonates and sulfates.

随着海洋的出现，像氯化氢、二氧化硫、二氧化碳，这些来自于大气的气体大量地溶解于水中，与矿物质的反应会沉淀出一些如碳酸盐和硫酸盐形式的不溶盐。

3. But whereas most algae today obtain their energy by splitting water molecules through photosynthesis, the metabolism of the earliest organisms probably involved many cruder chemical reactions such as those utilized by archaebacteria, the most primitive form of life still extant today.

但是，多数藻类通过光合作用分解水分子获得能量，早期的生物体的新陈代谢可能涉及许多简单的化学反应，像今天仍存在的最简单的生命形式——原始细菌就利用了这些化学反应。

【Reading material】

Recycling the World

Today's air has an oxygen content of about 21 per cent; most of the remaining 79 per cent consists of the unreactive gas nitrogen. About 0.05 per cent is carbon dioxide, sufficient to support plant growth. This composition is regulated both by the sum of all lives on Earth—the biosphere—and by geological processes involving the land masses, the oceans and the planet's interior, which collectively comprise the geosphere. The biosphere encompasses all living things: the forests and grasslands, the microbes in soil and the communities of the seas: phytoplankton and zooplankton, microscopic marine plants and animals respectively. Photosynthesizers (which is to say, plants) strip water of its hydrogen atoms and use them to convert carbon dioxide to energy-rich carbohydrates, releasing oxygen gas in the process. Consumers (that is, animals) breathe in oxygen and use it to burn up ingested carbohydrates, converting carbon compounds back to carbon dioxide, which is released into the air again. This process, known as respiration, releases energy which the consumers generally store for later use in the form of the compound ATP. Without photosynthesizers to regenerate the oxygen used up by consumers, the atmosphere's oxygen content would slowly but steadily decline.

Much of the carbon "fixed" into organic matter by photosynthesizers is eventually released back into the atmosphere as carbon dioxide via respiration of consumers (primarily that of the microbes which decompose dead plant matter). But carbon is also cycled to and from the atmosphere via purely "inorganic" geochemical processes①. The reaction between atmospheric CO_2 and minerals (known as weathering) binds up the carbon in carbonate compounds, while transformation ("metamorphism") of carbonate-rich rocks, perhaps induced by the deformations caused by collision of tectonic plates, can release CO_2. Carbon dioxide dissolves in the oceans to form soluble species such as bicarbonate ions. And carbon-rich sediments on the seafloor—the remains of dead organisms from the upper waters-are dragged down into the Earth's interior when a tectonic plate plunges down under another at ocean trenches. The carbon is converted into new forms by the heat within the Earth's mantle, and is recycled into the atmosphere in the effluent of volcanoes which sit behind the ocean trench.

Nitrogen, too, is cycled to and from the atmosphere by processes involving the biosphere and geosphere. Certain kinds of bacteria transform the normally very unreactive nitrogen molecules to ammonia, whence it is converted into nitrogen-containing organic compounds such as amino acids. All organisms require amino acids; plants synthesize theirs directly, but animals obtain them from ingested matter-either plant tissue or that of other animals. The nitrogen in organic compounds is ultimately converted back to inorganic forms. Some may be incorporated into urea and then into ammonia again; some is "oxidized", to nitrite (NO_2^-) and nitrate (NO_3^-)ions. In a process known as denitrifiacation, bacteria strip nitrate ions of their oxygen atoms, releasing nitrogen gas back into the atmosphere.

These cyclic transformations of oxygen, carbon and nitrogen through the atmosphere, biosphere and geosphere are known as biogeochemical cycles②. A wonderful account of a carbon atom's journey through parts of this cycle can be found in Primo Levi's *The periodic Table.* When processes that remove elements from the atmosphere are balanced by those that replenish them, the atmosphere remains in a "steady state"—never achieving thermodynamic equilibrium, yet always staying the same.

We saw that the behavior of systems that are out of equilibrium can be hard to predict-in particular, they can undergo large changes in response to small disturbances.

We do not know how stable the present steady state of the atmosphere is, but we do know that there were times early in the planet's history when it was in entirely different steady state, with a different composition.

Phrases and Expressions

1. biosphere	['baiəsfiə] *n.* 生物圈，生命层
2. phytoplankton	[ˌfaitəu'plæŋktən] *n.* 浮游植物
3. zooplankton	[ˌzəuə'plæŋktən] *n.* 浮游动物
4. metamorphism	[ˌmetə'mɔːfizəm] *n.*（岩石）变质作用
5. tectonic plate	地壳构造板块
6. bicarbonate ion	重碳酸离子
7. sediment	['sedimənt] *n.* 沉积物
8. mantle	['mæntl] *n.* 地幔
9. biogeochemical cycles	生物地球化学循环

Notes to the text

1. But carbon is also cycled to and from the atmosphere via purely "inorganic" geochemical processes.

但是碳也会通过完全的“无机”地球化学过程和大气进行循环。

2. These cyclic transformations of oxygen, carbon and nitrogen through the atmosphere, biosphere and geosphere are known as biogeochemical cycles.

这些氧、碳、氮通过大气、生物圈、地球圈的循环统称为生物地球化学循环。

Unit 2

Chemical Equations and Formulas

Chemical equations and formulas are used by chemists as a kind of shorthand to indicate elements and compounds, and the kinds of reactions that take place between them. They are based on the chemical symbols of elements. These are the same throughout the world, forming a kind of international language of chemistry.

Each element has its own individual symbol. Many of these are the first letter of the English name of element. For example, H is hydrogen, O is oxygen and C is carbon. But there are more elements than letters of the alphabet, and so symbols of two letters must also be used①. For example, He is helium and Os is osmium. A few symbols do not come from the English names of the elements, but from the Latin names. Sodium, for example, is Na from its Latin name natrium.

The chemical symbol of an element may stand for the element in general. But in chemical formulas and equations, each symbol stands for one atom of an element. The chemical formula of an element or a compound represents the atoms that are joined together to form a molecule of the element or compound. Water is a compound of hydrogen (H) and oxygen (O). A molecule of water consists of two hydrogen atoms joined to an oxygen atom, and so the chemical formula of water is H_2O. The formula for hydrogen gas, an element which has two atoms in each molecule, is H_2. Similarly, Oxygen gas is O_2, but the variety of oxygen known as ozone has molecule made up of three oxygen atoms. Its formula is therefore O_3. Many elements have only one atom per molecule, and so their chemical formula is the same as their symbol. For example, Na represents one atom of sodium or one molecule of sodium.

Substances are given chemical formulas that represent the proportions of the atoms in the compound. For example, sodium chloride or common salt has the formula NaCl, one atom of sodium and one of chlorine.

Chemical equations represent the reactions that take place between substances. An equation indicates a reaction between molecules or atoms and this one reaction is many,

many times throughout the substances taking part. A chemical equation has two sides separated by an arrow pointing from left to right. The formulas on the left side represent the substances that are reacting together. The formulas on the right side represent the products that are formed. In this way, the arrow represents the direction of the reaction. Sometimes an equals sign (=) is used instead of a arrow, and the direction of the reaction is assumed to be from left to right②. But the most essential point about chemical equation is that they must balance. That is, the number of each kind of atom on each side of equation must be the same.

Water is made by reacting hydrogen gas and oxygen gas together. The simplest equation that represents this reaction would be:

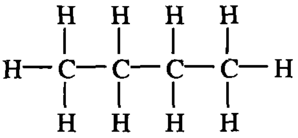
$$H_2 + O \longrightarrow H_2O$$

But this equation would not describe the reaction, because oxygen gas consists of molecules (O_2) and not free atoms (O). The equation must therefore be doubled on each side, giving:

$$2H_2 + O_2 \longrightarrow 2H_2O$$

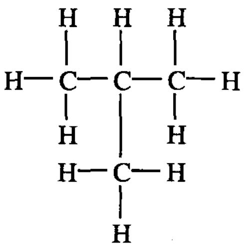
Sometimes two arrows pointing in opposite directions are used. This indicates a reversible reaction, which may go in either direction, depending on the condition③.

In organic chemistry, chemical formulas often show the arrangement of the atoms in the molecule. Two organic compounds may have the same numbers and kinds of atoms, but be completely different because the atoms are arranged differently. But equations in organic chemistry must balance just as they do in inorganic chemistry. One way of indicating the structure of molecules is to use a structural formula in which all the atoms are shown separately. Normal butane (C_4H_{10}) has a structural formula:



$$\begin{array}{ccccccccccc}
 & & H & & H & & H & & H & & \\
 & & | & & | & & | & & | & & \\
H & - & C & - & C & - & C & - & C & - & H \\
 & & | & & | & & | & & | & & \\
 & & H & & H & & H & & H & &
\end{array}$$

But this is rather clumsy, and a chemist would prefer to write $CH_3CH_2CH_2CH_3$, which adequately expresses the structure of normal butane. Butane also exists as an isomer, called isobutane④. This has the structural formula which a chemist would write $CH_3CH(CH_3)CH_3$.



Phrases and Expressions

1. chemical equation	化学反应式；化学方程式
2. chemical formula	化学式
3. natrium	['neitriəm] *n.* [拉丁文] 钠（sodium）
4. stand for	代表，代替；象征
5. in general	通常，一般；总的来说
6. sodium chloride	氯化钠
7. common salt	食盐（table salt）
8. an arrow pointing from left to right	从左到右的箭头
9. an equals sign	等号
10. free atom	单体原子；自由原子
11. structural formula	结构式
12. normal butane	正丁烷
13. isomer	['aisəumə] *n.* 异构体
14. isobutane	[ˌaisəu'bju:tein] *n.* [化]异丁烷

Notes to the text

1. But there are more elements than letters of the alphabet, and so symbols of two letters must also be used.

但元素的数目多于字母数，因此必须兼用由两个字母构成的符号。

2. Sometimes an equals sign (=) is used instead of an arrow, and the direction of the reaction is assumed to be from left to right.

有时用等号代替箭头，这时我们假定反应的方向是从左至右。

等号在英语中的正式名称为“sign of equality”，但数学公式的“=”往往读作“equals”，故“等号”又称作“equals sign”，而从严格的语法分析角度看，数学公式的“equals”既非形容词，又非名词，实际是动词，因而这里出现了一个以动词现在时单数第三人称形式作定语的特殊现象。