分子生物学专业英语

ACADEMIC ENGLISH OF MOLECULAR BIOLOGY

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内 容 提 要

本书是高等院校生命科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教科书与科技文献编写而成的。全书共分3部分，第1部分为分子生物学基本阅读；第2部分为扩展阅读；第3部分为科技英语写作范例与指导。

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

与发展迅速的生命科学相关的新知识、新技术，乃至新生的边缘及交叉学科不断涌现，高水平生命科学文献一般都用英文撰写，国际会议的工作语言也均为英语。因此，要求从事相关工作的科研、教学人员及相关专业的学生在掌握普通英语的同时，应具有阅读专业文献及用英语获取专业知识和信息的能力，并能够与国内外同行进行交流。

在这一背景下，各大专院校的生命科学专业普遍在本科生及研究生中开设专业英语课程，以培养和提高学生的专业英语水平。但是，目前国内生物学专业英语教材普遍存在广而不精的问题，致使很多授课教师采取印发阅读材料的形式进行教学。为此，我们筹划编写了《分子生物学专业英语》一书，以方便广大师生的教学活动及课外阅读。

本书分为 3 部分，第 1 部分为基础阅读，介绍分子生物学的基本概念与原理，主要内容有 DNA、染色体、DNA 复制、DNA 修复、转录、基因表达的调控、操纵子、蛋白质的运输、细胞凋亡、信号转导、肿瘤发生、免疫的多样性和核酸的杂交等；第 2 部分为阅读材料，是基础阅读的扩展，内容涉及分子生物学领域的研究热点与前沿，主要内容有 RNA 、蛋白质的合成、真核基因调控、细胞周期、PCR、功能基因组学、蛋白质组学、生物钟、艾滋病、疯牛病、基因治疗和基因食品等；第 3 部分为分子生物学研究性论文写作指南。

本书具有以下几个特点：

1.有较强的系统性和完整性。本书涵盖了分子生物学的各个部分并与分子生物学的授课体系相符合，使学习分子生物学知识和掌握专业英语融为一体。

2.信息量大而新,既包含分子生物学基础知识和基本理论,也涉及该学科发展的前沿内容。

3.为了使读者便于阅读和理解,在课文后面附有专业词汇及音标,惯用短语(Phrase)和疑难注释(Notes)部分。

4.最后部分附有专业词汇索引,以方便查阅和对照。

5.在内容的编排上注重由浅入深、循序渐进、通俗易懂、生动有趣,在激发学生阅读兴趣,提高学生英语阅读水平的同时,又使学生掌握了生物学知识。

本书是由哈尔滨工业大学生命科学与工程系、大连海事大学环境系统生物学研究所、东北大学计算机科学与技术系、哈尔滨市第一一二中学联合编纂的,参与编写的人员主要是中青年骨干教师,他们多数具有博士学位,每人负责编写的部分都是其在科研和教学中熟悉的领域,从而使得全书的选材和内容质量得以保持在一个较高的起点。基础阅读部分由程震龙、刘明、赫杰编写,阅读材料部分由王洋、李岩松、程振宇、关双红编写,胡玉刚、成瑜、张向东、李光协助进行了材料收集、整理与校对工作。全书由大连海事大学环境系统生物学研究所孙野青教授审定。

由于编写经验不足,尽管我们在成书过程中十分审慎,但仍难免会有不妥与疏漏之处,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10月

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Basic Reading for Molecular Biology

1.1 SMALL MOLECULES

1.1.1 Sugars are Food Molecules of the Cell

The simplest sugars—the monosaccharides—are compounds with the general formula $(CH_2O)_n$, where "n" is an integer from 3 through 7. **Glucose,** for example, has the formula $C_6H_{12}O_6$. Sugars can exist in either a ring or an open-chain form. In their open-chain form sugars contain a number of hydroxyl groups and either one aldehyde ($>C=O$) or one ketone ($_{H}{>}C=O$) group. The aldehyde or ketone group plays a special role. First, it can react with a hydroxyl group in the same molecule to convert the molecule into a ring; in the ring form the carbon of the original aldehyde or ketone group can be recognized as the only one that is bonded to two oxygens. Second, once the ring is formed, this carbon can become further linked to one of the carbons bearing a hydroxyl group on another sugar molecule, creating a disaccharide. The addition of more monosaccharides in the same way results in oligosaccharides of increasing length (trisaccharides, tetrasaccharides, and so on) up to very large polysaccharide molecules with thousands of monosaccharide units. Because each monosaccharide has several free hydroxyl groups that can form a link to another monosaccharide (or to some other compound), the number of possible polysaccharide structures is extremely large. Even a simple disaccharide consisting of two glucose residues can exist in eleven different varieties, while three different hexoses ($C_6H_{12}O_6$) can join together to make several thousand different trisaccharides. It is very difficult to determine the structure of any particular polysaccharide because one needs to determine the sites of linkage between each sugar unit and its neighbors. With present methods, for instance, it takes longer to determine the arrangement of half a dozen linked sugars (those in a glycoprotein, for example) than to determine the nucleotide sequence of a DNA molecule containing many thousands of nucleotides (where each unit is joined to the next in exactly the same way)[1].

Glucose is the principal food compound of many cells. A series of oxidative reactions leads from this hexose to various smaller sugar derivatives and eventually to CO_2 and H_2O. The net result can be written

$$C_6H_{12}O_6 + 6O_2 \xrightarrow{E} 6CO_2 + 6H_2O + \text{energy}$$

In the course of glucose breakdown, energy and "reducing power," both of which are essential in biosynthetic reactions, are salvaged and stored, mainly in the form of ATP in the case of energy and NADH for reducing power.

Simple polysaccharides composed only of glucose residues—principally **glycogen** in animal cells and **starch** in plant cells—are used to store energy for future use. But sugars have functions in addition to the production and storage of energy. Important extracellular structural materials (such as cellulose) are composed of simple polysaccharides, and smaller but more complex chains of sugar molecules are often covalently linked to proteins in **glycoproteins** and to lipids in **glycolipids**.

1.1.2 Fatty Acids are Components of Cell Membranes

A fatty acid molecule, such as palmitic acid, has two distinct regions: a long hydrocarbon chain, which is hydrophobic (water insoluble) and not very reactive chemically, and a carboxylic acid group, which is ionized in solution (COO^-), extremely hydrophilic (water soluble), and readily reacts with a hydroxyl or an amino group on a second molecule to form esters and amides. In fact, almost all of the fatty acid molecules in a cell are covalently linked to other molecules by their carboxylic acid group. The many different fatty acids found in cells differ in the length of their hydrocarbon chains and the number and position of the carbon-carbon double bonds they contain.

Fatty acids are a valuable source of food since they can be broken down to produce more than twice as much usable energy, weight for weight, as glucose[2]. They are stored in the cytoplasm of many cells in the form of droplets of **triglyceride** molecules, which consist of three fatty acid chains, each joined to a glycerol molecule; these molecules are the animal fats familiar from everyday experience. When required to provide energy, the fatty acid chains can be released from triglycerides and broken down into two-carbon units. These two-carbon units, present as the acetyl group in a water-soluble molecule called **acetyl CoA**, are then further degraded in various energy-yielding reactions, which we will describe below.

But the most important function of fatty acids is in the construction of cell membranes. These thin, impermeable sheets that enclose all cells and surround their internal organelles are composed largely of phospholipids, which are small molecules that resemble triglycerides in that they are constructed mostly from fatty acids and glycerol. In phospholipids, however, the glycerol is joined to two rather than three fatty acid chains. The remaining site on the glycerol is coupled to a negatively charged phosphate group, which is in turn attached to another small hydrophilic compound, such as **ethanolamine**, **choline**, or **serine**.

Each phospholipid molecule, therefore, has a hydrophobic tail—composed of the two fatty acid chains—and a hydrophilic polar head group, where the phosphate is located. A small amount of phospholipid will spread over the surface of water to form a **monolayer** of phospholipid molecules; in this thin film, the hydrophobic tail regions pack together very closely facing the air and the hydrophilic head groups are in contact with the water. Two such films can combine tail to tail in water to make a phospholipid sandwich, or lipid bilayer, an extremely important assembly that is the structural basis of all cell membranes

1.1.3 Amino Acids are the Subunits of Proteins

The common amino acids are chemically varied, but they all contain a carboxylic acid group and an amino group, both linked to a single carbon atom. They serve as subunits in the synthesis of proteins, which are long linear polymers of amino acids joined head to tail by a **peptide bond** between the carboxylic acid group of one amino acid and the amino group of the next. Although there are many different possible amino acids, only 20 are common in proteins, each with a different **side chain** attached to the alpha-carbon atom. The same 20 amino acids occur over and over again in all proteins, including those made by bacteria, plants, and animals. Although the choice of these particular 20 amino acids probably occurred by chance in the course of evolution, the chemical versatility they provide is vitally important. For example, 5 of the 20 amino acids have side chains that can carry a charge, whereas tie others are uncharged but reactive in specific ways. As we shall see, the properties of the amino acid side chains, in aggregate, determine the properties of the proteins they constitute and underlie all of the diverse and sophisticated functions of proteins.

1.1.4 Nucleotides are the Subunits of DNA and RNA

In nucleotides one of several different nitrogen-containing ring compounds (often referred to as bases because they can becombined with H^+ *in acidic solutions*) is linked to a five-carbon sugar (either **ribose** or **deoxyribose**) that carries a phosphate group. There is a strong family resemblance between the different nitrogen-containing rings found in nucleotides. **Cytosine** (C), **thymine** (T), and **uracil** (U) are called pyrimidine compounds because they are all simple derivatives of a six-membered pyrimidine ring; **guanine** (G) and **adenine** (A) are purine compounds, with a second five-membered ring fused to the six-membered ring. Each nucleotide is named by reference to the unique base that it contains.

Nucleotides can act as carriers of chemical energy. The triphosphate ester of adenine, ATP, above all others, participates in the transfer of energy in hundreds of individual cellular reactions. Its terminal phosphate is added using energy from the oxidation of foodstuffs, and this phosphate can be split off readily by hydrolysis to release energy that drives energetically unfavorable biosynthetic reactions elsewhere in the cell. As we discuss later, other nucleotide derivatives serve as carriers for the transfer of particular chemical groups, such as hydrogen atoms or sugar residues, from one molecule to another. And a cyclic phosphate-containing adenine derivative, cyclic **AMP**, serves as a universal signaling molecule within cells.

The special significance of nucleotides is in the storage of biological information. Nucleotides serve as building blocks for the construction of nucleic acids, long polymers in which nucleotide subunits are covalently linked by the formation of a phosphate ester between the 3'-hydroxyl group on the sugar **residue** of one nucleotide and the 5'-phosphate group on the next nucleotide. There are two main types of nucleic acids, differing in the type of sugar that forms their polymeric backbone. Those based on the sugar ribose are known as ribonucleic acids, or RNA, and contain the four bases A, U, G, and C. Those based on deoxyribose (in which the hydroxyl at the 2' position of ribose is replaced by a hydrogen) are known as deoxyribonucleic acids, or DNA, and contain the four bases A, T, G, and C. The sequence of bases in a DNA or RNA polymer represents the genetic information of the living cell. The ability of the bases from different nucleic acid molecules to recognize each other by noncovalent interactions (called base-pairing)—G with C, and A with either T (in DNA) or U (in RNA)—underlies all of heredity and evolution.

Vocabulary

monosaccharide	[ˌmɔnəu'sækəraid]	*n*.[生化]单糖
formula	['fɔ:mjulə]	*n*.公式，规则
glucose	['glu:kəus]	*n*.葡萄糖
hydroxyl	[hai'drɔksil]	*n*.羟基
aldehyde	['ældihaid]	*n*.[化]醛
ketone	['ki:təun]	*n*.[化]酮
disaccharid	[dai'sækəraid]	*n*.二糖
oligosaccharide	[ˌɔligəu'sækəraid]	*n*.低聚糖,寡糖
trisaccharide	[trai'sækəraid]	*n*.三糖
tetrasaccharide	[ˌtetrə'sækəraid]	*n*.四糖
polysaccharide	[pɔli'sækəraid]	*n*.多糖,多聚糖
hexose	['heksəus]	*n*.己糖
glycoprotein	[ˌglaikəu'prəuti:n]	*n*.糖蛋白
oxidative	['ɔksideitiv]	*a*.氧化的
derivative	[di'rivətiv]	*a*.引出的，系出的

		n. 派生的事物
biosynthetic	[ˌbaiəusin'θetic]	*a*. 生物合成的
salvage	['sælvidʒ]	*n*. *vt*. 抢救，打捞，营救
glycogen	['glaikəudʒen]	*n*. 糖原
starch	[stɑːtʃ]	*n*. 淀粉
extracellular	[ˌekstrə'seljulə]	*a*. 细胞外的
cellulose	['seljuləus]	*n*. 纤维素
covalently	[kəu'veiləntli]	*adv*. 共价地
glycolipid	[ˌglaikə'lipid]	*n*. 糖脂
hydrocarbon	['haidrəu'kɑːbən]	*n*. 碳氢化合物
hydrophobic	[ˌhaidrəu'fəubik]	*a*. 疏水的
carboxylic	[ˌkɑːbɔk'silik]	*a*. 羧基的
hydrophilic	[ˌhaidrəu'filik]	*a*. 亲水的
ester	['estə]	*n*. 酯
amide	['æmaid]	*n*. 氨基化合物
triglyceride	[trai'glisəˌraid]	*n*. 甘油三酯
glycerol	['glisəˌrɔl]	*n*. 甘油，丙三醇
acetyl	['æsitil]	*n*. 乙酰基
impermeable	[im'pəːmjəbl]	*a*. 不能渗透的，不渗透性的
phospholipid	[ˌfɔsfəu'lipid]	*n*. 磷脂
ethanolamine	[ˌeθənæl'æmiːn]	*n*. 乙醇胺
choline	['kəuliːn]	*n*. 胆碱
serine	['seriːn]	*n*. 丝氨酸
phosphate	['fɔsfeit]	*n*. 磷酸盐
monolayer	['mɔnəu'leiə]	*n*. 单层
bilayer	[ˌbai'leiə]	*n*. 双分子层
polymer	['pɔlimə]	*n*. 聚合体
versatility	[ˌvəːsə'tiləti]	*n*. 多功能性

aggregate	[ˈæɡriɡeit]	*n*.合计，总计，集合体 *a*.合计的，集合的，聚合的 *v*.聚集，集合，合计
nucleotide	[ˈnjuːkliətaid]	*n*.核苷
base	[beis]	*n*.碱基
ribose	[ˈraibəus]	*n*.核糖
deoxyribose	[diːˌɔksiˈraibəus]	*n*.脱氧核糖
cytosine	[ˈsaitəsiːn]	*n*.胞嘧啶
thymine	[ˈθaimiːn]	*n*.胸腺嘧啶
uracil	[ˈjuərəsil]	*n*.尿嘧啶
pyrimidine	[ˌpaiˈrimidiːn]	*n*.嘧啶
guanine	[ˈɡwɑːniːn]	*n*.鸟嘌呤
adenine	[ˈædəniːn]	*n*.腺嘌呤
purine	[ˈpjuəriːn]	*n*.嘌呤
triphosphate	[traiˈfɔsfeit]	*n*.三磷酸盐
oxidation	[ɔksiˈdeiʃən]	*n*.氧化
hydrolysis	[haiˈdrɔlisis]	*n*.水解
cyclic	[ˈsaiklik]	*a*.轮转的，循环的
noncovalent	[ˈnɔnkəuˈveilənt]	*a*.非共价的

Phrases

reducing power 消色力，还原能力

fatty acid 脂肪酸

palmitic acid 棕榈酸

acetyl CoA 乙酰辅酶 A

amino acid 氨基酸

peptide bond 肽键

nucleic acid 核酸

Notes

1. it takes longer to determine ... than to determine ...,字面意思为:确定几个连在一起的糖的组合比测定几千个碱基的 DNA 序列更费时。意指糖结合时组合的多样性。
2. Fatty acids are a valuable source of food ... more than twice as much usable energy, weight for weight, as glucose.这句话的意思是:脂肪酸作为食物的优势是其包含比较多的能量,等质量的情况下产生的能量是葡萄糖的两倍。

1.2 GENES ARE DNA

The hereditary nature of every living organism is defined by its **genome**, which consists of a long sequence of **nucleic acid** that provides the **information** needed to construct the organism. We use the term "information" because the genome does not itself perform any active role in building the organism; rather it is the sequence of the individual subunits (bases) of the nucleic acid that determines hereditary features. By a complex series of interactions, this sequence is used to produce all the proteins of the organism in the appropriate time and place. The proteins either form part of the structure of the organism, or have the capacity to build the structures or to perform the metabolic reactions necessary for life.

The genome contains the complete set of hereditary information for any organism. Physically the genome may be divided into a number of different nucleic acid molecules. Functionally it may be divided into **genes**. Each gene is a sequence within the nucleic acid that represents a single protein. Each of the discrete nucleic acid molecules comprising the genome may contain a large number of genes. Genomes for living organisms may contain as few as <500 genes (for a mycoplasma, a type of bacterium) to as many as >40 000 for Man.

The basic behavior of the gene was defined by Mendel more than a century ago. Summarized in his two laws, the gene was recognized as a