ENGLISH

新世纪农业科学专业英语

生物技术英语

English Course for Biotechnology

李庆章/总主审　胡家英/总主编
贾洪波　孙兴参/主　编　赵晓东　王　巍/副主编

哈尔滨工程大学出版社
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内容简介

本书精选了有一定理论深度，并能深入浅出阐述该技术领域基础知识和科研成果的文章，有助于读者理解并增加了趣味性和可读性。

为了更好地学习科学知识和科技英语，每一单元我们精选了两篇，分为 Part A 和 Part B 两部分，每篇都作了详细的注释，Part A 给出了参考译文，并附有练习和思考题。本书适合大学本科学生作为专业英语教材使用，也可作为科技人员的参考阅读使用。

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总 序

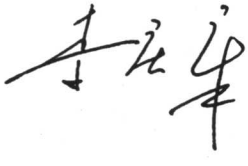
国家教育部1999年9月颁发的现行《大学英语教学大纲(修订本)》(以下简称《大纲》)规定:大学英语教学分为基础阶段(大学一、二年级)和应用提高阶段(大学三、四年级)。基础阶段的教学分为六级,或称大学英语一至六级(College English Bands 1 - 6,简称CEB1 - 6)。应用提高阶段的教学要求包括专业英语(Subject - Based English,简称SBE)和高级英语(Advanced English,简称AE)两部分。学生在完成基础阶段的学习任务即达到四级或六级后,都必须修读专业英语。已达到六级要求且学有余力的学生,除修读专业英语外,还可以选修高级英语课程。《大纲》不仅对专业英语的重要性,而且对专业英语的词汇和读、听、说、写、译的能力都做了明确说明。

按照《大纲》要求,本套教材在选材时,既注重专业英语的文体特征,又避免使用科普文章。本书教材的75%左右为专业基础内容,25%左右为专业前沿文献,一般从专业英语期刊中选取。主要因为学生在两年基础阶段的学习后,虽然专业基础知识已经建立,但对专业前沿内容尚知之不多。选取期刊上的内容,目的在于让学生深入了解专业英语文体特征和专业文献阅读方法,用英语来学习专业知识,同时也是向双语教学的过渡。

专业英语与公共英语中的日常英语和文学英语并无本质区别,只是文体(genre)不同。专业英语并无独立的语言系统,虽然专业英语中有大量的专业名词和术语,但是它的基本词汇都来自公共英语。除此之外,专业英语的语法有其自身特性和语法现象,但语法结构都仍遵循公共英语的一般规则,并无自己的独立语法。由此可见,公共英语是专业英语的基础,二者相互关联而具有显著的共通性。在编写这套教材时,我们采用专业教师和英语教师结合。专业教师负责文献取材,英语教师负责练习编排,文献翻译由专业教师和英语教师共同负责。既注重语言文字的流畅,又注重内容术语的准确。

本套教材是学生完成英语从基础学习过渡到实际应用的有效教材。通过教学,从英语文献阅读、英语资料翻译到英文摘要写作,系统科学地培养学生的英语应用能力,也为日后双语教学的逐步开展铺路搭桥。

是为之序。



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2007年2月

前言

近些年，生命科学发展迅速，尤其是生物技术的发展更是突飞猛进，出现了许多惊人的新成果。这些成果不仅引起了学术界的极大关注，而且也在很大程度上影响了人类的生活。这是一个激动人心的时代，不论是专攻生命科学的还是其它专业的学子，不论是专业研究人员，还是普通读者，都迫切希望掌握和了解这些最新成果和应用前景。由于英语是一门国际性交流语言，所以许多科技成果都要借助英语进行表述和交流。为此我们编选了这本《生物技术英语》以飨读者。

入选的文章不但突出了最新的成果和发展方向，同时也尽可能反映该技术领域的基础知识，使读者在掌握最新的科技突破的同时又巩固了基本知识。为了避免文章过于专业化，我们精选了有一定理论深度，并能深入浅出阐述该技术领域基础知识和科研成果的文章，有助于读者理解并增加了文章的趣味性和可读性。为了更好地学习科学知识和科技英语知识，每一专题文章我们选择了两篇(A，B 两篇，其中 A 篇给出了参考译文)，每篇都进行了详细的注释和说明，并附有练习和思考题。我们希望这本书能帮助广大读者更好地掌握生物技术知识，提高阅读科技英语文章的能力，拓宽知识面，加强对全球信息的了解，以适应科技时代的发展。

这本书是集体劳动的结晶，除了编委人员，还有很多人为此书的编写提供了帮助。在此特别感谢哈尔滨工程大学出版社和胡家英副院长，他(她)们为此书的出版提供了机会。东北农业大学李景鹏教授负责本书的主审工作，对他诚挚的帮助表示最深的谢意！

贾洪波

Preface

Life science, especially biotechnology, has developed rapidly in recent years. Great achievements have been made and these achievements not only draw attention from academic circle, but also make great effect on human beings' life. This is an encouraging age. People from all walks of life are eager to know the latest outcome and the potential applications of biotechnology. In order to meet the readers' need, we edit this Scientific English on Biotechnology. This book is intended to help the readers master the knowledge of biotechnology and improve the scientific English reading ability.

The articles chosen here highlight the up-to-date research and achievements and at the same time the basic knowledge of this field is also introduced. We hope in this way, the readers can not only know the breakthrough in this field, but also strengthen their basic knowledge. To avoid being too professional, the articles selected should explain deep theories with simple words and easily – understood examples. There are fourteen units in this books and each one has two articles. The two articles are chosen on one subject for a better understanding of both biological and English knowledge. All part A articles are translated and exercises are attached to each one.

This book is a product of group work. Except the editors, I must thank several people for their help. The publishers and Associate Professor Hu Jiaying provided the initial push to get the project under way. I am indebted to Professor Li Jingpeng at North East Agriculture University for reading the text and suggesting improvements. This book would never have been finished without their help.

Jia Hongbo

目录 Contents

Contents

Unit 1

Part A

A Basic Primer on Biotechnology

Michael D. Peel and David F. Betsch

1 Biotechnology Defined

Biotechnology can be broadly defined as "using living organisms or their products for commercial purposes". As such, biotechnology has been practiced by human society since the beginning of recorded history in such activities as baking bread、brewing alcoholic beverages or breeding food crops or domestic animals. A narrower and more specific definition of biotechnology is "the commercial application of living organisms or their products, which involves the deliberate manipulation of their DNA molecules". This definition implies a set of laboratory techniques developed within the last 20 years that have been responsible for the tremendous scientific and commercial interest in biotechnology, the founding of many new companies, and the redirection of research efforts and financial resources among established companies and universities. These laboratory techniques provide scientists with a spectacular vision of the design and function of living organisms, and provide technologists in many fields with the tools to implement exciting commercial applications.

2 Principles of Biology

Biotechnology and its use to modify the genetic makeup of living organisms has become a topic of heated discussion in recent years. Confusion is plentiful on the topic of biotechnology and genetically modified organisms (GMOs). The purpose of this section is to discuss genetic/biochemical processes at a basic level.

2.1 Genome

The complete set of genetic instructions for a living organism is contained in its genetic code, referred to as its genome. The genome for each organism differs by the number and size of chromosomes and the number of genes each contains. Each chromosome is composed of a single strand of deoxyribonucleic acid (DNA) and specialized protein molecules. (Figure 1A and Figure 1B). Coding regions called genes are along the DNA strand of each chromosome. Only specific regions of each chromosome code for genes. Alternate forms of genes in each organism account for the differences between individuals. Each DNA strand is composed of similar repeating units called nucleotides (Figure 1C). Four different nucleotide bases are present in DNA. They are adenine (A), thymine (T), cytosine (C), and guanine (G). The specific order of these bases in a gene coding region on the DNA strand specify exact genetic instructions.

Two DNA strands are held together by bonds between the bases; these constitute base pairs. Often the size of a genome is referred to by its number of base pairs. Each time a cell divides, the

full genome is replicated and each daughter cell receives an exact copy of the genetic code(Figure 1D). Each strand of DNA directs the synthesis of a complementary strand with free nucleotides matching up with their new complementary bases on each of the strands. Strict base pairing is adhered to; A will only pair with T, and C will only pair with G. Each daughter cell receives one old and one new DNA strand(Figure 1E).

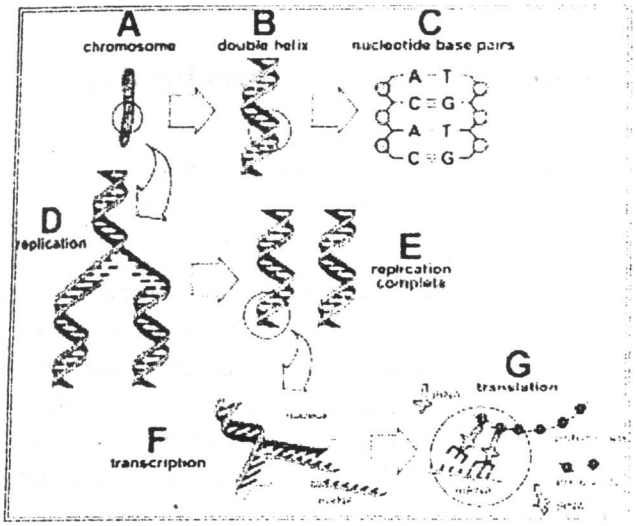

Figure 1 The basic structure and function of chromosomes and genes

2.2 Genes

The genes on each DNA strand contain the basic physical and functional units of heredity. A gene is a specific sequence of nucleotide bases, whose sequences carry the information required for constructing proteins. In turn, proteins regulate the expression of the genes and provide structural components and enzymes for biochemical reactions necessary for all living organisms. The protein-coding instructions from genes are transmitted indirectly through messenger ribonucleic acid (mRNA), a transient intermediary molecule similar to a single strand of DNA. For the information within a gene to be expressed, a complementary RNA strand is produced (by a process called transcription) from the DNA template in the nucleus(Figure 1F). This mRNA is moved from the nucleus to the cellular cytoplasm, where it serves as the template for protein synthesis. The cell's protein-synthesizing machinery then translates the genetic code, or codons, into a string of amino acids that will constitute the protein molecule (by a process called translation) encoded by the gene(Figure 1G). Following modification, the resulting protein can begin its function either as an enzyme, structural or regulatory protein.

Proteins are large, complex molecules made up of long chains of amino acid subunits. There are 20 different amino acids. Within a gene, each specific sequence of three DNA bases (codons) directs the cell's protein-synthesizing machinery to add a specific amino acid. For example, the base sequence ATG codes for the amino acid methionine (any biochemistry text will have a

complete list of amino acids and their corresponding codons). The genetic code is thus a series of codons that specify which amino acids are required to make the specific protein a gene codes for. The genetic code is the same for all living organisms.

Not all genes are expressed in all tissues. For example, the tassel and developing ears on a corn plant (Zea mays) produce pollen and embryos that will develop into seed. The differences between these two plant parts are ultimately controlled by gene expression. The differential expression of genes is controlled by its promoter. The expression of a few genes in plants are controlled by environmental factors such as sunlight, temperature, and day length. These three factors are important in triggering flowering in many plant species.

3 Using of biotechnology

Biotechnology includes a vast array of tools used in research and modification of biological systems. These include: genetic mapping, the process of identifying the location of a gene on a chromosome and elucidating the gene sequence; molecular based disease diagnosis, identifying specific alleles (alternate forms of a gene) of a gene which cause genetic diseases; gene therapy, replacing an absent or defective gene with a working one enabling normal body function; forensic science, solving crimes and identifying human remains not previously possible; and genetic transformation, movement of a gene or group of genes from one organism to another. This process is also called genetic engineering.

3.1 Genetic Transformation (genetic engineering)

Genetic transformation is the area of biotechnology that has created the greatest amount of stir and which will be the focus from this point on. Organisms with genetic material from another organism are often referred to as genetically modified organisms or GMOs. Since all crop and domesticated animal species have been genetically modified since the dawn of time, technically they are also GMOs. When referring to organisms with a gene from another species, transgenic is a more accurate description.

Many of the processes of biotechnology have been used for many years. Insulin from pigs and cows was historically used to treat diabetes and was beneficial to a many. However, there was not a consistent supply and some individuals developed adverse reactions to this type of insulin because their bodies recognized it as foreign and mounted an immune response. Human insulin produced through cloning and inserting human genes in bacteria resulted in insulin that did not cause an immune response. This was the first pharmaceutical produced through biotechnology and it has insured a consistent reliable source of human insulin.

Before a gene is transferred to another organism it must be identified, isolated and cloned. In the laboratory, the mRNA molecule from a gene being expressed can be isolated and used as a template to synthesize a complementary DNA (cDNA) strand. This isolated cDNA strand can then be cloned (duplicated) for transformation into another species. The cDNA strand can be used to locate the corresponding gene on a chromosome, or map it.

Transformation is typically accomplished by using either Agrobacterium tumefaciens or particle acceleration and the gene gun (Figure 2). Agrobacterium tumefaciens is a bacteria that

occurs in nature. It contains a small circular piece of DNA called a Ti plasmid (Ti for tumor inducing). When this bacterium infects certain woody plant species, the Ti plasmid enters cells of the host plant. Certain regions of the Ti plasmid insert themselves into the host cell's genome. This insertion occurs in a region of the DNA strand with a specific sequence. The host cell then expresses the gene from the bacteria, which induces massive cell growth and the resultant plant tumor the bacteria is named for (Figure 3). Biotechnology utilizes this natural transformation process by removing the bacterial genes from the region transferred to the host genome and substituting genes of interest (Figure 2A). Agrobacterium use for transformation is limited because it will only infect certain dicotyledonous species.

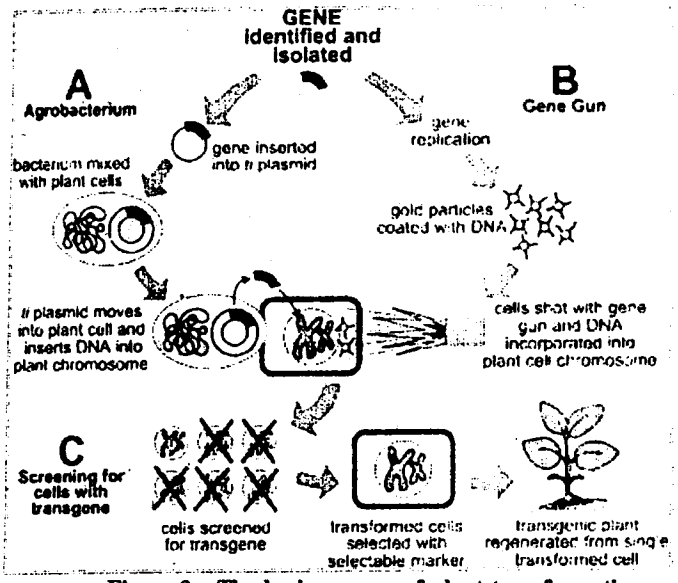

Figure 2 The basic process of plant transformation with Agrobacterium and the gene gun

The other transformation process involves coating gold particles with genes of interest. The gold particles are shot into single cells of the plant of interest with the gene gun. This is commonly referred to as particle acceleration. In a process not fully understood, the transgene(s) are incorporated into a DNA strand of the host genome (Figure 2B). This process is inefficient but does not have the host species limitation of Agrobacterium.

Both processes require the use of plant tissue culture. Individual cells of the plant to be transformed are cultured. These are then subjected to the transformation process. Non-transformed cells must be eliminated. This is done with selectable marker genes. In the case of the Roundup Ready gene, Roundup (glyphosate) is used directly as the selectable marker, since Roundup will kill non-transformed cells. When another trait of interest is being transformed in the crop, a selectable marker like antibiotic or herbicide resistance is used. The cells in culture are treated with the herbicide or an antibiotic. Only those cells that were transformed with the two genes will

survive. Whole plants are then regenerated from the single cells that survive.

Fig 3 Crown gall resulting when bacterial DNA is naturally transformed into the tree. (Used with permission from University of California Statewide IPM Project, J. K. Clark, photographer)

Following transformation and plant regeneration, the transgenic plants must be tested in the field to ensure that the transgene functions properly. Not all transgenic plants will express the trait or gene product properly. Once a transgenic plant that expresses the trait has been identified and is stable, then the trait can be bred using conventional plant breeding methods into cultivars with adaptation to the environmental conditions where the crop is produced.

3.2 Specific applications of genetic engineering

Specific applications of genetic engineering are abundant and increasing rapidly in number. Genetic engineering is being used in the production of pharmaceuticals, gene therapy, and the development of transgenic plants and animals.

3.2.1 Pharmaceuticals

Human drugs such as insulin for diabetics, growth hormone for individuals with pituitary dwarfism, and tissue plasminogen activator for heart attack victims, as well as animal drugs like the growth hormones, bovine or porcine somatotropin, are being produced by the fermentation of transgenic bacteria that have received the appropriate human, cow, or pig gene.

3.2.2 Gene Therapy

The first clinical gene therapy is underway to correct an enzyme deficiency called ADA in

children. Bone marrow cells are removed, defective DNA in bone marrow cells is supplemented with a copy of normal DNA, and the repaired cells are then returned to the patient's body.

3.2.3 Transgenic Plants

Transgenic plants that are more tolerant of herbicides, resistant to insect or viral pests, or express modified versions of fruit or flowers have been grown and tested in outdoor test plots since 1987. The genes for these traits have been delivered to the plants from other unrelated plants, bacteria, or viruses by genetic engineering techniques.

3.2.4 Transgenic Animals

Presently, most transgenic animals are designed to assist researchers in the diagnosis and treatment of human diseases. Several companies have designed and are testing transgenic mammals that produce important pharmaceuticals in the animal's milk. Products such as insulin, growth hormone, and tissue plasminogen activator that are currently produced by fermentation of transgenic bacteria may soon be obtained by milking transgenic cows, sheep, or goats.

4 Using Biotechnology in Diagnostic Applications

Since each living creature is unique, each has a unique DNA recipe. Individuals within any given species, breed, or hybrid line can usually be identified by minor differences in their DNA sequences -as few as one difference in a million letters can be detected! Using the techniques of DNA fingerprinting and PCR (polymerase chain reaction) scientists can diagnose viral, bacterial, or fungal infections, distinguish between closely related individuals, or map the locations of specific genes along the vast length of the DNA molecules in the cells.

4.1 Identifying Organisms

By using RFLP technology (restriction fragment length polymorphism), DNA fingerprints can be generated. Any individual organism can be uniquely identified by its DNA fingerprint. Consequently, this fingerprint can be used to determine family relationships in paternity litigation, match organ donors with recipients in transplant programs, connect suspects with DNA evidence left at the scene of a crime (in the form of hair or body fluids), or serve as a pedigree for seed or livestock breeds。

4.2 Identifying Genes

One important aspect of genetic engineering projects is to identify the DNA gene that controls a particular trait. In the same way that a visitor might use state, city, street, and house number to locate a friend's house, genetic engineers use genetic maps" to locate genes. The genetic maps are generated by statistical analyses, PCR, RFLP, DNA sequencing. Maps are being developed for humans, mice, swine, cattle, corn, wheat, and other plants or animals with commercial or research importance.

4.3 Diagnosing Infectious Diseases and Genetic Disorders

Diagnosis of infectious diseases is a profound application of new DNA technology. Tuberculosis, AIDS, papilloma virus, and many other infectious diseases, addition to the inherited disorders cystic fibrosis or sickle cell anemia, are diagnosed within hours by the PCR technique rather days or weeks by traditional methods. The greatly increased sensitivity and speed

of the PCR technique, as compared with traditional methods, allows earlier intervention and treatment. PCR assays will soon be available to diagnose diseases of crops and livestock.

Technical Terms

adenine [ˈædəniːn] *n.* 腺嘌呤
agrobacterium [ˌægrəubækˈtiəriəm] *n.* 根瘤农杆菌,根瘤土壤杆菌
antibiotic [ˈæntibaiˈɔtik] *n.* 抗生的;抗生素
bacteria [bækˈtiəriə] *n.* 细菌[微]
base pair *n.* 碱基对
bond [bɔnd] *n.* 结合;连接;接头;键
bone marrow *n.* 骨髓
chromosome [ˈkrəuməsəum] *n.* 染色体
cloning [ˈkləuniŋ] *n.* 克隆作成法;克隆化;纯株培养;建立无性繁殖系
codon [ˈkəudən] *n.* 密码(决定氨基酸结构的遗传符号);密码子
complementary DNA 互补 DNA;互补脱氧核糖核酸
cystic fibrosis 囊性纤维化
cytosine [ˈsaitəsiːn] *n.* 胞[核]嘧啶
diabetes [ˌdaiəˈbiːtiːz] *n.* 糖尿病
DNA *n.* 脱氧核糖核酸;去氧核糖核酸
DNA fingerprinting DNA 指纹技术
embryo [ˈembriəu] *n.* 胚;胚胎
fermentation [ˌfəmenˈteiʃən] *n.* 发酵作用;发酵[微]
forensic [fəˈrensik] *n.* 法医的;法医学
fungal infection *n.*【医】真菌感染
gene [dʒiːn] *n.* 基因
gene of interest 利益基因;有用基因
gene therapy *n.* 基因治疗
genetic code 遗传密码[分]
genetic engineering 遗传工程;基因工程[分]
genetic map 遗传学图
genome [ˈdʒiːnəum] *n.* 基因组
growth hormone 生长激素
guanine [ˈgwaːniːn] *n.* 鸟嘌呤
heart attack 心脏[梗塞]发作
herbicide [ˈhəːbisaid] *n.* 除莠剂;除草剂
immune response 免疫反应;免疫应答[免]
insulin [ˈinsjulin] *n.* 胰岛素
messenge ribouucleic acid 信使核糖核酸
nucleotide [ˈnjuːkliətaid] *n.* 核苷酸
paternity [pəˈtəːniti] *n.* 亲子关系
PCR-Polymerase chain reaction 聚合酶链反应
pedigree [ˈpedigriː] *n.* 血系;系谱;谱系
pharmaceutical [ˌfɑːməˈsjuːtikə] *adj.* 药学的;制药的
pituitary dwarfism 垂体性侏儒症
plasmid [ˈplæzmid] *n.* 质粒(胞质遗传体);
pollen [ˈpɔlin] *n.* 花粉
promoter [ˌprəˈməutə] *n.* 启动子(符号P);增强剂;增强子;促进剂;促催化剂
regeneration [riˌdʒenəˈreiʃən] *n.* 再生;
RFLP 限制性[内切酶]片段长度多态性;限制[酶切]片段长度多态性[分]
sequence [ˈsiːkwəns] *n.* 序列
selectable marker gene 可选择标记基因
sickle cell anemia 镰状细胞性贫血;镰状细胞贫血
somatotropin [ˌsəumətəuˈtrɔpin] *n.* 生长激素;垂体生长激素
tassel [ˈtæsəl] *n.* 雄(花)花穗(玉米)

template ['templeit] *n.* 模板;坐标板
thymine ['θaimi:n] *n.* 胸腺嘧啶
tissue plasminogen activator 组织纤维蛋白溶酶原激活物质
transgenic [ˌtræns'ʤenik] *adj.* 转基因的
transformation [ˌtrænsfə'meiʃən] *n.* 转化

Notes

1. Figure 1 The basic structure and function of chromosomes and genes
图一 染色体及基因的基本结构与功能
[分]double helix 双螺旋
Figure 2 The basic process of plant transformation with Agrobacterium and the gene gun
图二 用根瘤农杆菌和基因枪使植物转化的基本过程
Figure 3 Crown gall resulting when bacterial DNA is naturally transformed into the tree
图三 细菌 DNA 自然转化到树的基因组中形成冠瘿

Study Questions and Exercises

I. Answer the following questions according to the article.

1. How is biotechnology defined from the broad and narrow aspects?
2. What are the biological principles of biotechnology?
3. Illustrate the applications of biotechnology.
4. Why do people apply *biotechnology in producing human insulin*?
5. What have to be prepared before genetic transformation?
6. What are the currently used methods of genetic transformation?
7. Take the case of transgenetic plants to illustrate the transformation of genes.
8. Describe the specific applications of genetic engineering briefly.
9. *Explain the following terms*:
agrobacterium
chromosome
DNA
DNA fingerprinting
genetic code
genetic engineering
genetic map
gene
genome
PCR
plasmid

RFLP

sequence

transformation

Ⅱ. Choose an appropriate word or words from what we have learnt to fill in each of the following blanks. Change the word form where necessary.

1. Broadly speaking, Biotechnology can be defined as "using living organisms or their products for _____ purposes."
2. The genome for each organism differs by the _____ and _____ of chromosomes and the number of genes each contains.
3. Alternate forms of genes in each organism account for the _____ between individuals.
4. The number of amino acids that make up proteins are _____.
5. _____ is produced by moulds and bacteria, capable of destroying or preventing the growth of bacteria.
6. Human insulin produced through cloning and inserting human genes in bacteria doesn't cause an _____ response.
7. _____ is to replace an absent or defective gene with a working one enabling normal body function.
8. The differential expression of genes is controlled by their _____.
9. _____ is the manipulation of an organism's genetic endowment by introducing or eliminating specific genes through modern molecular biology techniques.
10. _____, _____, _____, _____, and _____ are used as tools of biotechnology in research and modification of biological systems.
11. Before a gene is transferred to another organism it must be _____, _____ and _____.
12. _____ is a map of the relative positions of genetic loci on a chromosome, determined on the basis of how often the loci are inherited together. Distance is measured in centimorgans (cM).
13. _____ is a lab technique that compares the patterns of bands on analogous DNA fragments from two or more separate individuals; this is done to find out how closely related they are to each another.
14. The genetic maps are generated by statistical analyses, _____, _____, and _____.