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SPECIAL ENGLISH FOR BIOTECHNOLOGY

生物技术专业英语

苏东海 主编

化学工业出版社

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本教材分为六章：生物技术基础入门、发酵工程、酶、细胞工程、基因工程、蛋白质工程。每章都包括阅读材料、词汇、练习和参考译文。入选的文章突出了最新成果和发展方向，同时也尽可能反映技术领域的基础知识，使读者在掌握了最新科技突破的同时又巩固了基本知识。为了扩大学生的专业阅读量，书后增加了阅读材料供学生和教师选用。

本书可作为生物技术、食品、生物制药等专业高职高专学生和应用型本科学生的专业英语教材或参考书。

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前 言

生物技术的发展日新月异，取得了许多惊人的新成果，各国投入巨资，组织力量追踪和攻关，以促进这一新兴高科技的快速发展。生物技术可以解决人类所面临的诸如粮食问题、健康问题、环境问题以及能源问题，对国计民生产生巨大而深远的影响。

在科技领域，英语的重要性日益突出，生物技术领域的期刊大多要求以英语发表，重要的国际会议都以英语为工作语言，涉及生物技术类的公司所需的资料大多也是英文。专业英语是学生完成基础英语学习后的一门继续课程，通过指导学生阅读有关专业英语文献，使他们进一步提高阅读和翻译科技资料的能力，并能以英语为工具获取专业所需的信息，针对高职院校生物技术类专业英语教科书较少的现状，化学工业出版社组织了部分高职院校的老师编写了本教材。教材编写过程中坚持以下原则:有利于学生通过专业知识学英语；涉及生物技术的领域较宽，以便于学生扩大专业词汇量；课文难度略高于科普读物。入选的文章突出了最新成果和发展方向，同时也尽可能反映技术领域的基础知识，使读者在掌握了最新科技突破的同时又巩固了基本知识。对每篇文章都进行详细的注释和说明，并附有练习。我们希望本书能够帮助广大读者更好地掌握生物技术知识，提高阅读科技英语的能力。

本书共分六章，由苏东海主编，具体分工如下：第一章由訾韦力编写；第二章由苏东海和张虎成编写；第三章由杨春华编写；第四章由田锦、张利民编写；第五章由史雅静、王宇编写；第六章由蒋丹、李颖编写。为了扩大学生的专业阅读量，书后增加了阅读材料供学生和教师选用，阅读材料由訾韦力编写。中国农业大学许文涛、中国食品发酵工业研究院鲁军审阅了全书。本书可作为食品生物技术、生物制药等专业高职高专学生和应用型本科生的专业英语教材或参考书。本书得到了北京市属高等学校人才强教计划项目[PHR(IHLB)]资助。

由于编者水平有限，书中难免有许多不足之处，敬请广大读者批评指正，以便再版时补充修正。

编者

2013 年 3 月

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Chapter One

A Basic Primer on Biotechnology

Reading Material

1. Biotechnology Definition

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 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.

(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. 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. 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 specifies 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. 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.

(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. 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 condons, into a string of amino acids that well constitute the protein molecule (by a process called translation) encoded by the gene. 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 (condons) 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 condons). The genetic code is thus a series of condons 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 is controlled by environmental factors such as sunlight, temperature, and day length. These three factors are important in triggering flowering in many plant species.

2. 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.

(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. 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. Biotechnology utilizes this natural transformation process by removing the bacterial genes from the region transferred to the host genome and substituting genes of interest. Agrobacterium use for transformation is limited because it will only infect certain dicotyledonous species.

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. 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.

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.

(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.

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.

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 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.

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.

3. 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.

(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. DNA 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.

(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.

(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.

Glossary

1. living organism	生物体
2. brewing	*n.* 酿造
3. molecule	*n.* 分子
4. genetically modified organisms (GMOs)	转基因生物
5. genome	*n.* 基因组，染色体组
6. chromosome	*n.* 同源染色体
7. deoxyribonucleic acid	脱氧核糖核酸
8. protein	*n.* 蛋白质
9. nucleotide	*n.* 核苷酸
10. adenine(A)	*n.* 腺嘌呤
11. thymine (T)	*n.* 胸腺嘧啶
12. cytosine (C)	*n.* 胞核嘧啶，氧氨嘧啶
13. guanine (G)	*n.* 鸟嘌呤(核酸的基本成分)
14. daughter cell	*n.* 子细胞
15. enzymes	*n.* 酶类，酵素；酶（enzyme 的复数）
16. messenger ribonucleic acid (mRNA)	*n.* 信使核糖核酸
17. intermediary	*n.* 中间人；调解人；媒介物
18. template	*n.* 样板；模板；标准
19. the cellular cytoplasm	细胞质
20. condon	密码子
21. amino acids	氨基酸类
22. methionine	*n.* 蛋氨酸，甲硫氨酸
23. tassel	*n.* 穗，缨，流苏
24. pollen	*n.* 花粉
25. embryo	*n.*〈生〉胚，胚胎
26. mapping	映射，绘制……的地图，计划
	等位基因
27. alleles	*adj.* 用于法庭的；法医的
28. forensic	*n.* 胰岛素
29. insulin	*n.* 1.〈医〉糖尿病；2. 多尿症
30. diabetes	*adj.* 制药的；配药的；卖药的
31. pharmaceutical	*n.* 药物

32. Agrobacterium tumefaciens	根瘤土壤杆菌
33. plasmid	*n.* 质粒，质体
34. plant tumor	植物瘤
35. dicotyledonous	*adj.* 双子叶的
36. glyphosate	*n.* 草甘膦
37. antibiotic or herbicide	抗生素或除草剂
38. cultivar	*n.* 栽培品种
39. pituitary dwarfism	垂体性侏儒症
40. plasminogen	*n.* 血纤维蛋白溶酶原,血浆酶原
41. bovine	*adj.* 牛的，关于牛的，迟钝的，笨拙的 *n.* 牛；牛科动物
42. porcine somatotropin	猪源生长激素
43. marrow	*n.* 骨髓；脊髓；髓
44. mammals	*n.* 哺乳动物
45. hybrid	*n.* 杂交生成的生物体，杂交植物(或动物)；
46. fungal	*adj.* 真菌的，由真菌引起的
47. polymorphism	*n.* 多型现象，多态性
48. paternity litigation	亲子鉴定
49. pedigree	*n.* 世系，家谱，系谱 *adj.* 纯种的
50. tuberculosis	*n.* 肺结核，结核病
51. papilloma virus	*n.* 乳突淋瘤病毒，刺瘤病毒
52. cystic fibrosis	*n.* 囊性纤维化（属遗传性胰腺病）
53. sickle cell	*n.* 镰状细胞，镰刀形红细胞
54. assays	*n.* 化验，试金，分析试验

Exercises

1. *Matching*

① living organism	(a) any of a large group of nitrogenous organic compounds that are essential constituents of living cells; consist of polymers of amino acids, essential in the diet of animals for growth and for repair of tissues
② enzyme	(b) using living organisms or their products for commercial purposes
③ genome	(c) a living thing that has (or can develop) the ability to act or function independently
④ protein	(d) the ordering of genes in a haploid set of chromosomes of a particular organism; the full DNA sequence of an organism
⑤ brewing	(e) any of several complex proteins that are produced by cells and act as catalysts in specific biochemical reactions
⑥ Biotechnology	(f) making (beer) by soaking, boiling, and fermentation

2. Fill in the blanks with the words or expressions given below, and change the form where necessary.

genome	genetic engineering	DNA fingerprinting
DNA gene	brewing	gene

① Biotechnology has been practiced by human society since the beginning of recorded history in such activities as baking bread/____________ alcoholic beverages or breeding food crops or domestic animals.

② The complete set of genetic instructions for a living organism is contained in its genetic code, referred to as its _____________.

③ A ______________is a specific sequence of nucleotide bases, whose sequences carry the information required for constructing proteins.

④ ______________is being used in the production of pharmaceuticals, gene therapy, and the development of transgenic plants and animals.

⑤ Using the techniques of ____________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.

⑥ One important aspect of genetic engineering projects is to identify the ____________that controls a particular trait.

Translation

生物技术基础入门

1. 生物技术的定义

从广义上说，生物技术可以定义为“为了商业目的而对生物体及其产品进行利用的行为或手段”。从这一定义来看，可以说有历史记载以来，人类社会就在实践活动中应用了生物技术，如烤面包、酿酒、种植庄稼或饲养家禽等。从狭义上说，对生物技术更科学的定义是“通过对生物体及其产品的 DNA 分子进行操作而达到商业应用目的的行为或手段”。在这一定义中体现了近 20 年发展起来的一系列实验室技术，这些技术不仅对生物技术领域中巨大的科技及商业利益，也对许多新的公司及大学的建立起着重要的作用。这些实验室技术不仅为科学家们提供了剖析生物体构造和功能的深入视野，也在许多领域为技术人员提供了实现商业应用的手段。

（1）基因组

生物体的遗传代码中包含了一整套的遗传信息，称作基因组。各生物体的基因组因染色体数目、大小以及每条染色体所含基因数的不同而不同。每条染色体是由一个单链脱氧核糖核酸（DNA）分子和数个特异化蛋白质分子组成的。每条染色体 DNA 的编码区，称为基因。每条染色体上只有特定的区域才能编码基因。不同生物体内基因的不同造就了个体之间的差异。每条 DNA 链是由称作核苷酸的近似重复单位组成，DNA 中含有四种不同的核苷酸碱基。

它们是腺嘌呤（A）、胸腺嘧啶（T）、胞嘧啶（C）及鸟嘌呤（G）。这些核苷酸碱基在 DNA 链上基因编码区的专门序列指定了精确的遗传指令信息。

碱基之间通过键将两条 DNA 链结合起来，构成碱基对。基因组的大小通常指碱基对的数量。每次细胞分裂时，整个基因组都会进行复制，每个子细胞会收到遗传代码的精确拷贝。每条单链 DNA 链与游离核苷酸结合，引导合成新的互补链。遵守严格的配对原则。腺嘌呤只与胸腺嘧啶配对，胞嘧啶只与鸟嘌呤配对。每个子细胞获得一条旧 DNA 链和一条新 DNA 链。

（2）基因

每一条 DNA 链上的基因包含遗传的基本生理及功能单位。基因是具有特定序列的核苷酸碱基，其序列携带合成蛋白质所需的信息。反过来，蛋白质调控基因表达，提供所有生物体生化反应中所需的结构成分及酶。来自基因的蛋白质编码指令间接通过信使核糖核酸（mRNA，一种类似于单链 DNA 的中介）传递。对于基因内要表达的信息，在核内会根据 DNA 模板生成互补的 RNA 链（这一过程称为转录）。mRNA 从细胞核转入细胞质中，作为蛋白合成的模板。细胞的蛋白质合成机制把基因代码（或密码子）翻译成相应的氨基酸序列，从而精确地构建由基因编码的蛋白质分子（这一过程称为翻译）。通过修饰，生成的蛋白质即以酶、结构蛋白或调节蛋白的形式发挥功能。

蛋白质是由氨基酸所组成的长链、复杂大分子，氨基酸的种类包括 20 种。在一个基因内，三个 DNA 碱基（密码子）所构成的不同特定序列可以引导细胞的蛋白质合成机制添加相应的特定氨基酸。例如，碱基序列 ATG 编码蛋氨酸（任何生物课本中都有氨基酸及其相应密码子的完整列表）。因此，遗传代码就是一系列密码子，它们指定了需要哪些氨基酸来构成一个由基因编码的特定蛋白质。遗传代码在所有生物体内都是通用的。

并非所有基因都可在任意组织中表达。比如，玉米（玉蜀黍属）植株上的穗和棒分别产生出玉米花粉和胚胎，进而生成种子。最终是由基因表达来控制这两个植物部分的差异。基因在不同组织中的不同表达是受启动子控制的。植物中的个别基因表达也受环境因素（如阳光、温度和日长）所控制。这三个因素在促使植物开花方面起着重要的作用。

2. 生物技术的应用

生物技术包括在生物系统研究与改造过程中所使用的大量技术手段。这些技术包括遗传图谱（鉴定染色体上某个基因的位置并阐明基因序列）、分子疾病诊断（鉴定引起遗传疾病的特定等位基因）、基因治疗（用正常功能的基因替代有缺失或缺陷的基因）、法医技术（破案和鉴定人体遗骸）和转基因（一个或一组基因从一个生物体转化到另一个生物体中的技术，也称作基因工程）。

（1）转基因（基因工程）

转基因曾在生物技术领域产生了巨大的轰动，今后也会继续成为研究热点。携带来自另一生物体遗传物质的生物通常称作转基因生物（GMO）。自古以来，所有粮食、家禽、家畜在遗传学上都已经发生了变化，所以从技术上可以称其为转基因生物。不过，将携带来自另一物种基因的生物体称作转基因生物才更为确切。

生物技术的应用已经有许多年的历史。例如，使用来自猪、牛的胰岛素治疗糖尿病和其它疾病。然而，这类胰岛素现在并没有得到继续应用，因为有些病人的身体会将这些胰岛素视为异物并产生免疫反应，从而产生副作用。人胰岛素是通过克隆技术并在细菌中嵌入人基

因而生产出的、不会产生免疫反应的胰岛素。这是通过生物技术生产的第一种药物，保证了持续、稳定的人胰岛素来源。

基因在经过鉴定、分离、克隆后才能转化到另一个生物体中。在实验室中，可以分离要表达的目的基因的 mRNA 分子，再将其用作合成互补 DNA 链（cDNA）的模板。分离的互补 DNA 链可以通过克隆（复制），转化到另一个物种中。可以用互补 DNA 链来定位染色体上的相应基因，或者绘制相应的遗传图谱。

一般通过使用根瘤土壤杆菌或者粒子加速及基因枪来完成转化。根瘤土壤杆菌是自然界中的一种细菌。它包含一个被称为肿瘤诱导质粒（Ti 质粒）的环状小 DNA。当这种细菌感染木本物种时，Ti 质粒就进入宿主植物细胞中。Ti 质粒的特定区域会嵌入到宿主细胞基因组中，这种嵌入发生在 DNA 链的特定序列区域。然后，宿主细胞会表达来自细菌的基因，诱导细胞及相应愈伤组织急剧增长。生物技术利用这一自然转化过程，在特定区域去除细菌要转入宿主的基因，植入目的基因。利用根瘤土壤杆菌进行转化是有局限的，因为它只能感染特定的双子叶植物。

另一种转化过程是用基因枪将涂有目的基因涂层的显微金颗粒射入目的植物的单细胞中，这就是通常所说的粒子加速。转化的基因会融入宿主基因组的一个 DNA 链中，不过具体过程尚不清楚。这一转化过程虽然也不完善，但没有根瘤土壤杆菌宿主物种的局限性。

上述两种转化过程都需要利用植物组织培养。首先对要转化的植物细胞进行培养，然后再进行基因转化。未转化的细胞必须清除出去。这是通过选择标记基因来完成的。以耐草甘膦基因为例，将草甘膦直接用作选择标记基因，因为它会杀死未转化细胞。如果有其它特征基因转化到作物中，还可使用抗生素或抗除草剂药之类的选择标记基因。培养细胞经过除草剂或抗生素处理后，只有转化了这两种基因的细胞才可以存活，这样即可从存活的单细胞中再生整个植株。

在基因转化与植株再生之后，需要对转基因植株进行田间试验来确定转基因是否成功。并非所有的转基因植株都能正确地表达基因特征或产物。一旦鉴别出稳定表达特征基因的转基因植株，就采用传统的植物育种方法，将特征植株培养成适应不同生长环境条件的栽培品系。

（2）基因工程的具体应用

基因工程不仅应用范围广，且数量与日俱增。基因工程目前在药物生产、基因治疗和转基因动、植物开发中均有应用。

① 药物

人类的药物如治疗糖尿病的胰岛素、治疗垂体性侏儒症的生长激素、治疗心脏病的组织纤溶酶原激活剂以及动物类药物（如生长激素，牛、猪促生长素等），一般通过已经植入人类、牛或猪源的某些基因的工程菌发酵来生产。

② 基因治疗

第一种接受临床基因治疗的疾病是矫正酶缺陷症，又称作儿童腺苷脱胺酶缺乏症。治疗中先移除骨髓细胞，骨髓细胞中的缺陷 DNA 用正常 DNA 的拷贝来补充，然后再造细胞移回病人体内。

③ 转基因植物

自 1987 年以来，人们开始在室外实验点种植和实验耐除草剂、耐昆虫或耐有毒害虫的转基因植物，以及经改良的水果或花卉。通过转基因工程技术，可以将其它无亲缘关系的植物、细菌或病毒特征基因转化到植物中。

④ 转基因动物

目前，大多数转基因动物用于协助研究者进行人类疾病的诊断与治疗。一些公司已经计

划并正在测试转基因哺乳类动物，以便利用动物的奶来生产重要的药物。目前利用转基因工程菌发酵生产出的产品，如胰岛素、生长激素和组织纤溶酶原激活剂，今后将会利用转基因牛、绵羊或山羊的奶来获得这些产品。

3. 生物技术在诊断中的应用

每个生物体都是独一无二的，因此对每个生物体所用的 DNA 诊断方法也不相同。一个物种、品种或杂交品系中的任何个体都可以通过 DNA 序列的小小差异鉴别区分开来，相当于 100 万个字母中只有 1 个字母不同也能鉴别出来。利用 DNA 指纹分析技术及聚合酶链反应（PCR），科学家们能够诊断出病毒性、细菌性或真菌性感染，区分联系紧密的个体，或在细胞中冗长的 DNA 分子序列中确定特定基因的位置。

（1）鉴别生物体

利用限制性片段长度多态性技术（RFLP），可以进行 DNA 指纹分析。指纹分析可以精确地鉴别任何生物体。因此，指纹分析技术可以用于确定亲子关系诉讼中的家庭关系，匹配移植中的捐赠者与接受者器官，根据遗留在犯罪现场的 DNA 证据（头发或血液）确定嫌疑犯，或者作为植物或畜禽育种的谱系鉴定方法。

（2）鉴别基因

遗传工程的一个重要应用是鉴别控制特定特征的 DNA 基因。比如，一位来访者会用州、城市、街道和房间号码来定位朋友的住址。同样，基因工程师可以利用遗传图谱定位特定的基因。遗传图谱是通过统计分析、PCR、RFLP 和 DNA 测序来建立的。目前人们已开始建立人、鼠、猪、牛、玉米、小麦和其它具有商业及研究价值的动植物图谱。

（3）诊断传染性疾病和遗传性疾病

诊断传染性疾病是 DNA 技术的最新深入应用。利用 PCR 技术，数小时内就可诊断肺结核、艾滋病、乳头状瘤及许多其它传染性疾病，此外还有囊性纤维化遗传性疾病或镰状细胞性贫血病，而传统方法却需要费时数日或数周。与传统方法相比，PCR 技术的检测灵敏度与速度大为提高，可以更早地实施疾病干预与治疗。PCR 检测技术也将很快应用于动植物的疾病诊断。

练习参考答案 *(Reference answers of exercises)*

1. *配对 (Matching)*

① —(c); ②—(e); ③—(d); ④—(a); ⑤—(f); ⑥—(b)

2. *用词或短语填空，根据需要变换形式 (Fill in the blanks with the words or expressions given below, and change the form where necessary)*

① brewing	② genome	③ gene
④ Genetic engineering	⑤ DNA fingerprinting	⑥ DNA gene