高等医学院校教材（英汉对照）

医学细胞生物学

Medical Cell Biology

主编 张春斌

人民卫生出版社

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前　言

自我校从2005年开展医学留学生全英语教学和基础医学双语教学工作以来，教材一直是困扰一线教师的问题，尤其是医学和生物学交叉学科。

因为教学体制的不同，中国的医学教育必须要在低年级开设《医学细胞生物学》、《生物化学》和《医学分子生物学》等课程。而国外的医学生已经系统学过生物学相关内容。寻找不到适合医学留学生全英语教学的教材成了以上课程教学的一个难题。

我们组织了多名有经验的一线教师编写《医学细胞生物学》英汉对照教材有三个目的。一是要满足外国留学生学习医学生物学相关知识的需要，符合中国医学的教学特点；二是由于此课程开设在一年级，可以帮助留学生学习专业汉语；三是可以作为中国医学专业学生的双语教材。

本书分十章，分别介绍了医学细胞生物学概论，细胞的基本结构和各种细胞器的功能，细胞的增殖、分化、衰老与死亡等生命现象。本书的每一个生物学名词都有详细的中英文解释，并且在书后列出，便于学生自学和学习时查找方便。内容深入浅出，并且涉及了该学科的最新进展。本书的另一个特点是为了避免知识的重复，尽量不涉及分子生物学的内容。

本书编写历时两年半，能够成功编写与学校国际交流中心、教材中心、教务处和基础医学院的大力支持是分不开的。编写过程中得到了孟祥才、徐晶和张爱晨等同志的帮助，特此致谢。最后感谢人民卫生出版社热情组织我们编写此书。

我们深感自己的知识水平和编写能力有限，本书肯定存在很多缺陷，敬请同道和读者给予批评指正。

张春斌

2008年3月于佳木斯

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Chapter 1

Introduction

Preface

What is popular in research today? Kinds of diseases: cancer, cardiovascular diseases, infectious diseases, AIDS and so on; Research fields: cell cycle control, cell apoptosis, cellular senescence, signal transduction, DNA damage and repair, proteomics, functional genomics.

Today we recognize that virtually all the organisms are made up of cells. A cell is the smallest unit of living matter. And a cell is the structural and functional unit of organs, ultimately, organisms (Figure 1-1). The cell is the foundation of reproduce, and the bridge of inheritance. The cell is the growing and developing basis of life.We are interested in the cell because it is a sort of "lowest common denominator" of life. Understanding the life of the cell can help us to understand life as a whole.

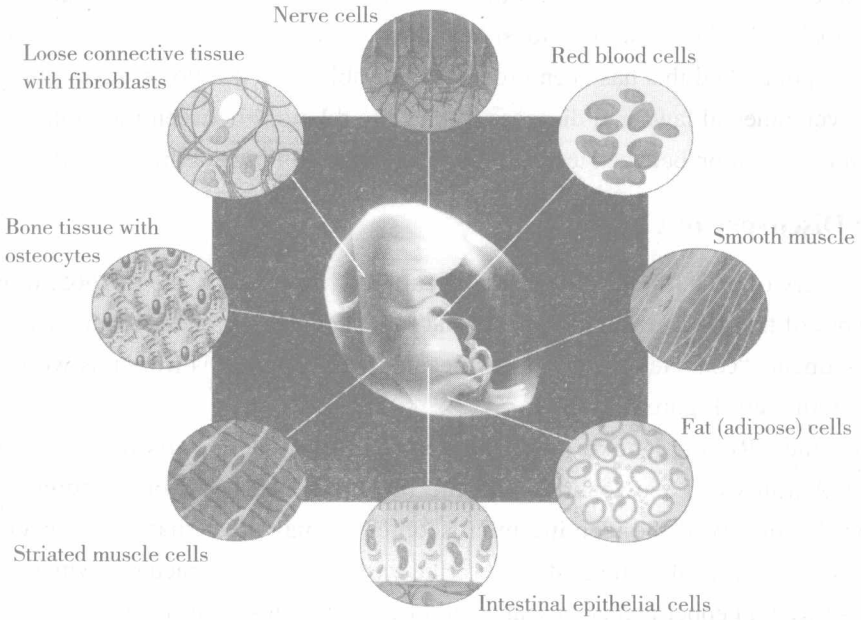


Figure 1-1 Cell is the basic unit of life

Cell biology is a branch of course of life science, which regard the cell as object, discover the disciplinarian of biologic development, differentiation, inheritance, variation, senescence and death, as well as the development, prevent and cure for human disease.

1. Teaching Objectives

Cell biology is one of the most important courses of current biology, and has been listed as a key curriculum of sciences by the Ministry of Education of China, and excellent curriculum of Sichuan University and Sichuan province. As the basic unit of structure and function for all organisms, cell is both the start and converge points of life science.

The teaching target of cell biology is to acquaint the students with the basic knowledge, concepts and fundamental theories, as well as the brief history and most advanced domain of the subject being taught. Furthermore, the students are to come under trainings on their thinking to master the skills of learning, so as to be capable of exploiting their talents on getting knowledge available and utilizing information.

2. Basic Teaching Characteristics

2.1 Cell biology is one of the country's first-class name brand courses, which is performed bilingually and employing the multimedia. The teaching effect in class is rather remarkable and the construction of the course is on the top internal.

2.2 Frequent updating not only an embodiment of basic knowledge, but also a reflection of preceding fields and hotspots of life sciences.

2.3 Taking the sentence of "education should face the modernization, face the world and face the future" as the guideline. According to the content system, internal connections as well as the principal and subordinate relationships of the subject, we established the route: learning block→unit→point. And this has been proved exercisable, which follows the teaching rules and scientific developmental laws and disposes well of the relations between traditional and modern contents, and the relation between teaching knowledge and training ability as well.

3. The Discovery of Cells

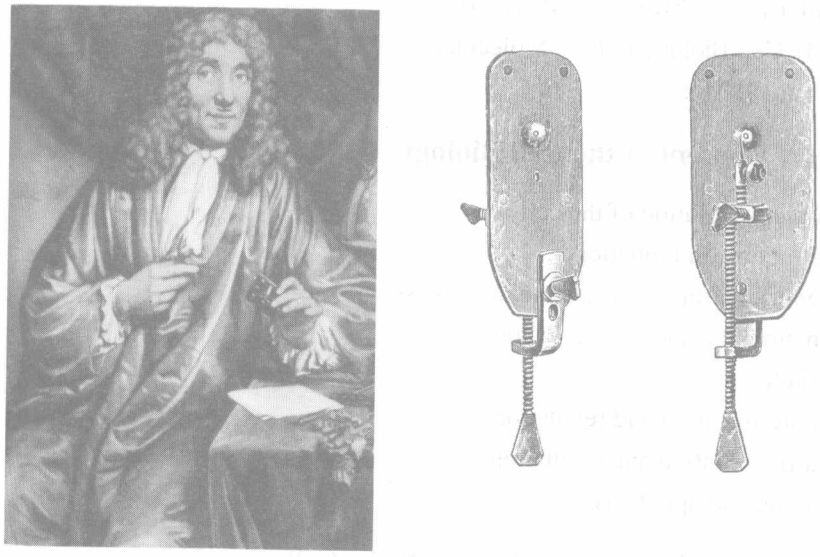
The discovery of cells followed from the invention of the microscope. In 1665, Robert Hooke saw a network of tiny boxlike compartments that reminded him of a honeycomb. He called these little compartments "cellulae", a Latin term meaning little room. It is from this word we get our present-day term-cell (Figure 1-2).

In actual fact, Robert Hooke had observed the empty cell walls of dead plant tissue. Meanwhile, Anton van Leeuwenhoek was the first to examine a drop of pond water under microscope. He observed the teeming microscopic "animalcules" that darted back and forth before his eyes. He was also the first to describe various forms of bacteria, which he obtained from water in which pepper had been soaked and from scrapings of his teeth (Figure1-3).

It wasn't until the 1830s that the widespread importance of cells was realized. In 1838,

(a) (b)

Figure 1-2 Robert Hooke and his microscope



(a) (b)

Figure 1-3 Anton van Leeuwenhoek and his microscope

Matthias Schleiden, a German lawyer turned botanist, concluded that: despite differences in the structure of various tissues, plants were made of cells and that the plant embryo arose from a single cell.

3.1 Cell theory has three basic tenets

3.1.1 All organisms are composed of one or more cells.

3.1.2 The cell is the basic unit of structure and function for all organisms.

3.1.3 All cells arise only from preexisting cells by division.

3.2 Why are cells the basic units of life

3.2.1 The cell is the structural unit of life, All organisms is made up of cells.

3.2.2 The cell is the functional unit of organisms. All metabolic activity is based on cells.

3.2.3 The cell is the foundation of reproduce, and the bridge of inheritance.

3.2.4 The cell is the growing and developing basis of life.

3.2.5 Cell (nucleus) is totipotent, which can create a new organism of the same type.

4. Development of Cell Biology (Figure 1-4)

4.1 The establishment of Cell theory

4.2 The classical period of cytology (1875—1900).

4.3 Experimental cytology (1900—1953): cytogenetics, cytophysiology, cytochemistry etc.

4.4 The subjects establishment and development of cell biology: Molecular Biology (1953), Cell Biology (1965), Molecular Cell Biology (in 1980s).

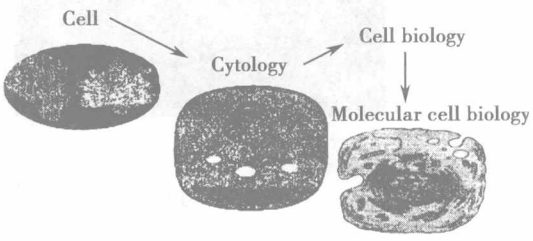


Figure 1-4 Development of cell biology

5. Primary Content of the Cell Biology

5.1 Origin and evolution of the cell

5.2 Cell structure and function

5.3 Nucleolus, chromosome and genic expression

5.4 Cell membrane and cell organelle

5.5 Cytoskeleton

5.6 Cell multiplication and regulation

5.7 Cell differentiation and regulation

5.8 Cell aging and apoptosis

6. Experimental Approaches for Studying Cells

Cell biology involves a range of techniques for examining cells function, regulating their own behavior, and interacting with their neighbors. Because molecular biology approaches are widely used in cell biology, a few essential techniques from that field are also included.

6.1 Techniques of microscope

6.2 Techniques of cytochemistry

6.3 Techniques of cell sorting and isolation

6.4 Cell engineering

6.5 Cell culture and fusion

6.6 Methods of molecular biology

7. Cell Biology and Medicine

Cell biology is a fundamental subject in modern life science.

7.1 Cell biology is one of important theoretical foundation of medicine

7.2 Cell biology and medicine develop together

(Zhang Chunbin Zhang Shuhong)

Chapter 2

The Summary of the Cell

Preface

A cell is the smallest unit of living matter. A cell is not only the structural unit, it is also the functional unit of organs. Some organisms are single-celled. Other organisms are complex assemblages of many cells of various kinds. We are interested in the cell because it is a sort of "lowest common denominator" of life. Understanding the life of the cell can help us to understand life as a whole. Thus, it is valuable to study life on the cellular level.

1. Cell Size, Shape and Substantial Basic

1.1 Cell size (Figure 2-1): Most cells are 1~10 microns in diameter. One micron is 10^{-6}meter,

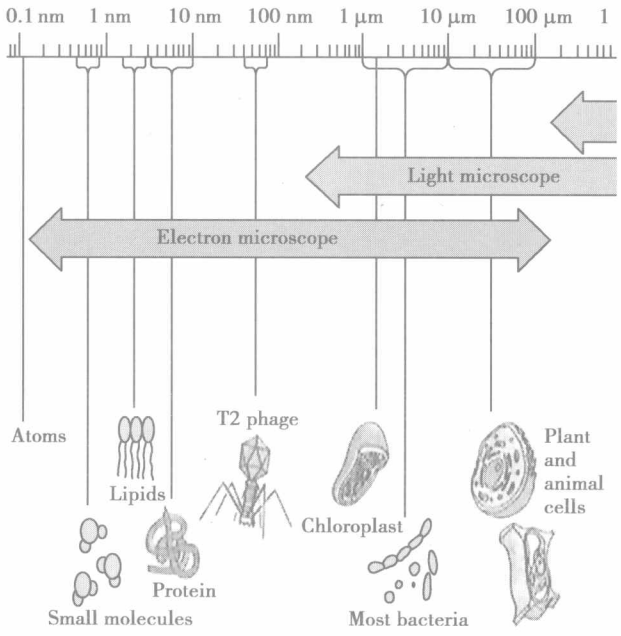


Figure 2-1 Size of biology cells

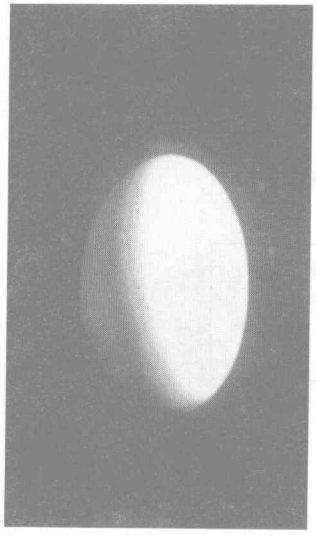


Figure 2-2 Ostrich egg

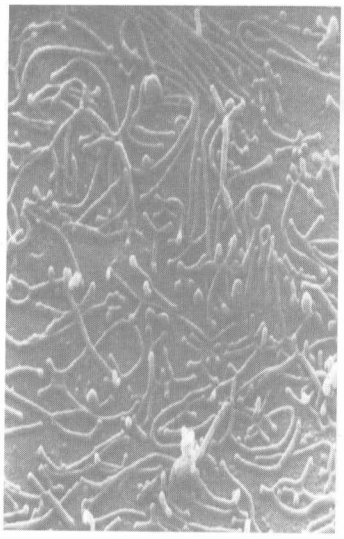


Figure 2-3 Mycoplasmas

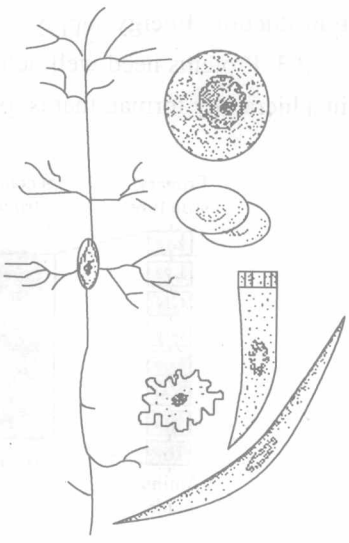


Figure 2-4 Shape of cell

or one millionth of a meter. So most cells are one thousandth to one hundredth of a millimeter in diameter. The largest cell is an ostrich egg, Most cells are much smaller than this (Figure 2-2). The smallest cells are less than one-half micron, or one two-thousandth of a millimeter across. Mycoplasmas are the simplest living cells, some have a diameter of about 0.1 microns and contain enough nucleic acid which may be the minimum number that a cell needs to survive (Figure 2-3). These measurements are rather difficult to visualize.

Perhaps comparing an average cell to a familiar object, a penny would be helpful. If a penny were enlarged to the size of a football field, a cell enlarged to the same degree, would be about the size of a penny.

1.2 cell shape is all kinds of because its constructer, function and environment is different: such as circular shape, ellipsoid, columnar, tetragon, pavement, trapezoid, even indeterminate (Figure 2-4).

1.3 All living creatures are made with a concentrated aqueous solution of chemicals. The simplest forms of life are solitary cells that propagate by dividing into two. we study them to learn, on the one hand how they are made from molecules and on the other, how the cooperate to make an organism as complex as human being. The cell chemical component include:

1.3.1 small molecules: amino, glucose, lipid etc.

1.3.2 biomacromolecule: protein, nucleic acid.

2. Protein

2.1 What are proteins: Proteins are nitrogen-containing macromolecules, composed of amino acids, linked together through peptide bonds.

2.2 What do proteins do: Catalytic activity; Metabolic and regulatory function; Transport and storage of materials; Coordinate motion and mechanical support; Immune protection; Signal

transduction; Energy supply.

2.3 Proteins need well defined structures to function properly. Their structures are organized in a hierarchy format, that is: primary, secondary, tertiary and quaternary structure (Figure 2-5).

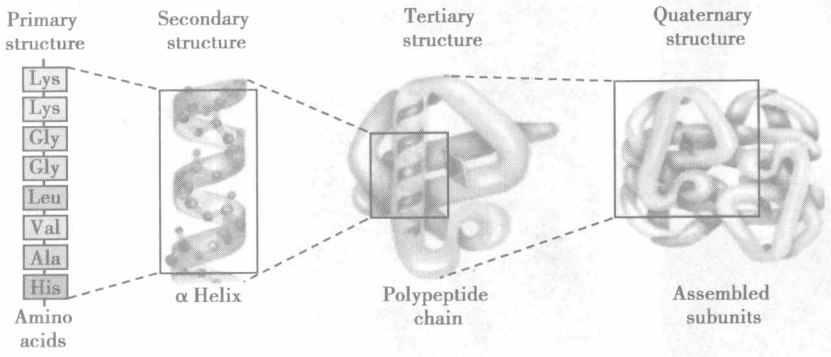


Figure 2-5 The structure of protein

2.4 Protein classification

2.4.1 Constituents : simple protein

conjugated protein: protein + prosthetic groups

2.4.2 Overall shape: Globular protein: long/short <10, soluble in water

Fibrous protein: long/short >10, insoluble in water

3. The Origin and Evolution of The Cell

3.1 Origin: Cell→Tissue→Organ→System→Multicellular individual→Population→Ecosystem (Figure 2-6). In the living world, the whole is more than the sum of its parts.

3.2 Evolution: All organisms, and all of the cells that constitute them, are believed to have

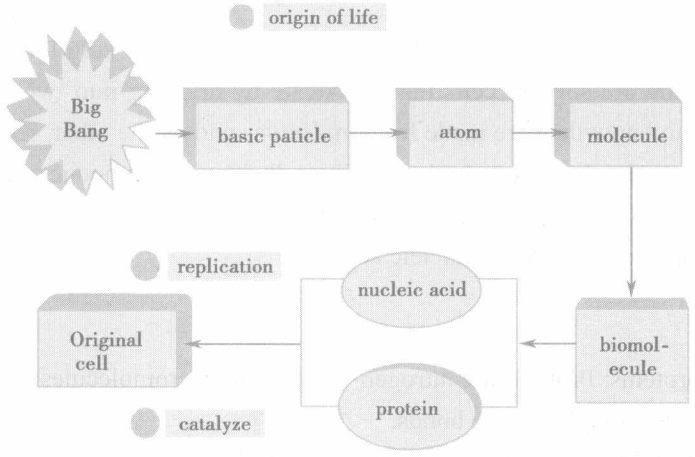


Figure 2-6 The origin of cell

descended from a common ancestor cell by evolution. evolution involves two essential processes: one is the occurrence of random variation in the genetic information passed from an individual to its descendants; the other is the selection of genetic information that help its possessors to survive and propagate.

Evolution is the central principle of biology, helping us to make sense of the bewildering variety in the living world. The interplay of events played out over billions of years, in the historical process called evolution, dictates the form and structure of the living world today.

The creative part of the evolutionary process is adaptation to rapidly changing environments and the conquest of new environmental niches. During this process, small alterations in cellular structures and functions are selected. Entirely new structures rarely are created; more often, old structures are adapted to new circumstances. More rapid change is possible by rearranging or multiplying previously evolved components rather than by waiting for a wholly new approach to emerge. The cellular organization of organisms plays a fundamental role in this process because it allows change to come about by small alterations in previously evolved cells, giving them new capabilities.

Clearly, there are difficulties in an evolutionary approach: the large gaps in our knowledge can be filled only by speculations that are likely to be wrong in many details.but there are enough evidence from fossils and from comparative studies of present-day organism and molecules to allow us to make intelligent guesses about the major stages in the evolution of life:

3.2.1 from molecules to the first cell

3.2.2 from prokaryotes to the eukaryotes

3.2.3 from single cells to the multicellular organisms

3.3 Comparison of procaryotic and eucaryotic organisms (Figure 2-9, Table 2-1)

Table 2-1 Comparison of procaryotic and eukaryotic cell

	Prokaryotic	Eucaryotic
Organisms	bacteria	fungi, plants and animals
Cell size	1~10 μm	10~100 μm
Metabolism	anaerobic or aerobic	aerobic
RNA and protein	synthesized in the same compartment	RNA synthesized in nucleus, protein synthesized in cytoplasm
Cell division	by binary fission	By mitosis or meiosis
DNA	Circular DNA in cytoplasm	Very long DNA containing many no coding regions
Cytoskeleton	No	have

3.3.1 Procaryotic cell: a small amount genetic information, be constituted of cyclic DNA, have no membrane organelle and nuclear envelop (Figure 2-7).

Mycoplasma: the simplest living cells, some have a diameter of about 0.1 microns and

contain enough nucleic acid which may be the minimum number that a cell needs to survive.

Bacteria: they are spherical or rod-shape cells, commonly several microns in linear dimension. In the electron microscope this cell interior appears as a more or less uniform matrix. Bacteria usually have flagella for their motion. Bacteria usually have fimbriae for their attachment to an appropriate surface. Given an energy source, most bacteria are able to synthesize any molecule they may need.

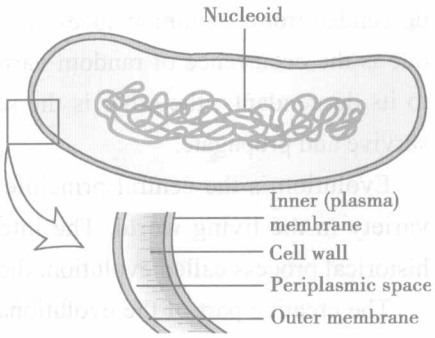


Figure 2-7 Procaryotic

3.3.2 Eukaryotic cell: An artist observed the eukaryotic cell and depicted the interior structure of a eukaryotic cell. Depicting a cell's interior is difficult because electron micrographs provide detailed pictures of only a thin slice of a cell, while the cell itself is a three-dimensional object with a very complex interior structure. Thus an artist can create a special sense of the cell's inner workings by using color and shading. In Figure 2-8, the artist rendered the organelles inside the cell as he imagined them rather than as a faithful reconstruction from electron micrographs. The blue object is the cell's nucleus with the DNA visible inside as a coil. In the rest of the cell is the cytoplasm, which contains many organelles, like the red, kidney-shaped mitochondria and the sectioned orange vesicles. The green stack of flattened vesicles near the nucleus is the Golgi apparatus, and the other flat vesicles represent the cell's endoplasmic reticulum. All of these cellular elements are described in later chapters.

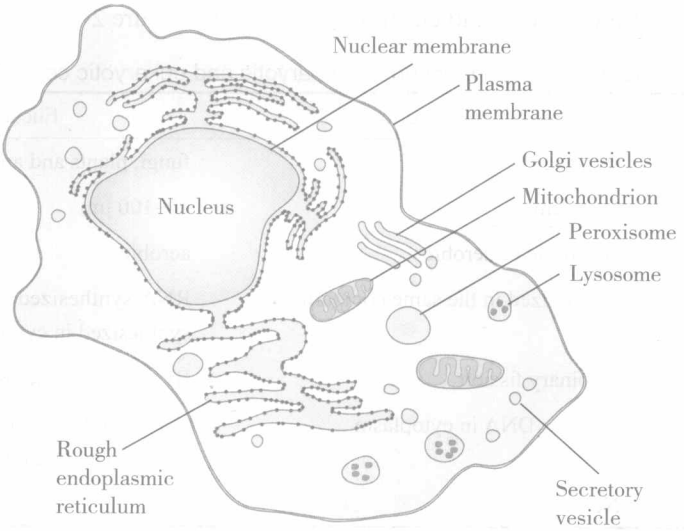


Figure 2-8 Eucaryotic

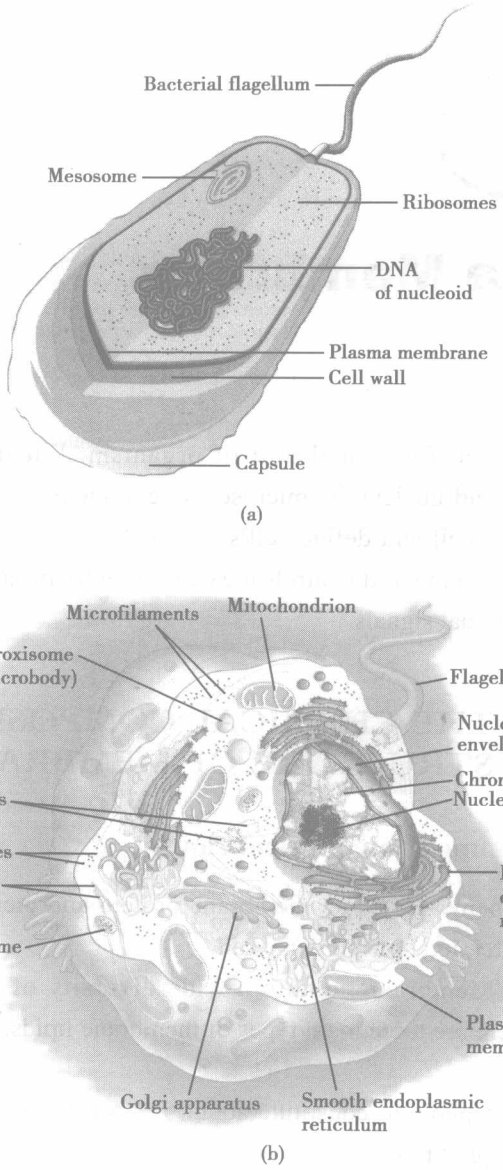


Figure 2-9 Comparison of procaryotic and eucaryotic structure

(Zhang Shuhong Luo Lan)

Chapter 3

The Plasma Membrane

Cell is the structural and functional unit of organism. Eukaryotic cell can be seen cytomembrane, cytoplasm and nucleus by microscope. cytomembrane is important ingredient of the cell. It enclose every cell and define cell's extent. It maintains the essential difference between its content and environment. It controls the entry of nutrients and exit of waste products. It also act as a sensor of external signals.

SECTION ONE THE CHEMICAL COMPOSITION AND STRUCTURE OF MEMBRANE

1. The Chemical Composition of Membrane

Membrane consist of membrane lipid, membrane protein and membrane carbohydrate. Of course, there are a little water, ion and inorganic salt.

1.1 Membrane lipid: Membrane contain a wide diversity of lipids, all of which are amphipathic molecule. There are three main types of membrane lipids: phospholipid, cholesterol and glycolipid.

1.1.1 Phospholipid: Phospholipid constitute about 50% of the most animal cytomembrane. There are two types of phospholipid.

1.1.1.1 Phosphoglyceride: Because most membrane phospholipids are built on a glycerol backbone, they are called phosphoglycerides. For example, phosphatidyl choline is a kind of phosphoglyceride (Figure 3-1).

1.1.1.2 Sphingolipids: Its content is less than phosphoglyceride, they are derivatives of sphingosine, an amino alcohol that contains a long hydrocarbon chain. Sphingolipids consist of sphingosine linked to a fatty acid by its amino group. This molecule is a ceramide.

If sphingosine substitute glycerol of phosphoglycerides, the molecule is sphingomyelin (Figure 3-2).

1.1.2 Glycolipid: All eucaryotic cell have glycolipid on their surface. Glycolipids are interesting membrane components. Relatively little is known about them. It constitute about 5%