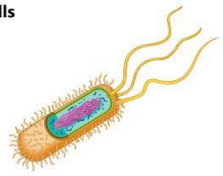
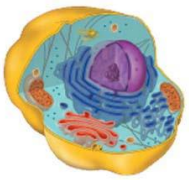
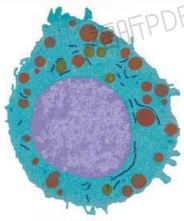
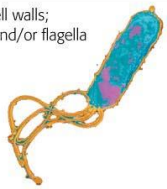
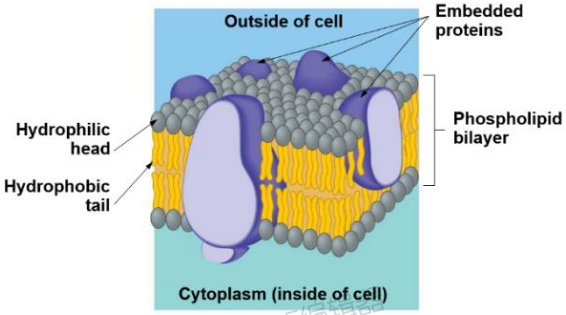
Chapter 4. A tour of the cell

- **Two major categories of cells:** prokaryotic cells, eukaryotic cells

Table 4.1 Comparing Prokaryotic and Eukaryotic Cells

Prokaryotic cells	Eukaryotic cells
	
Plasma membrane of identical structure	
Cytoplasm occupies entire interior of cell	Cytoplasm occupies the region between the nucleus and the plasma membrane
Single circular chromosome in nucleoid region	One or more linear chromosomes in nucleus 
Both have ribosomes, but structure differs slightly	
First evolved approximately 3.5 billion years ago	First evolved approximately 2.1 billion years ago
Smaller, simpler	Larger, more complex
No membrane-bound organelles	Membrane-bound organelles (for example, nucleus, ER)
Most are surrounded by cell walls; some have capsules, pili, and/or flagella 	Plant cells surrounded by cell walls; animal cells surrounded by extracellular matrix

- **Organelles:** membrane-enclosed structures that perform specific functions.
- **Membrane structure**

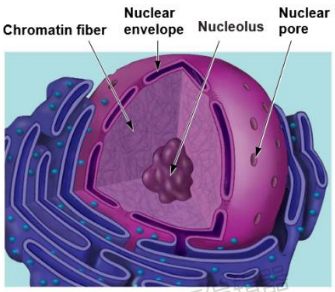


流动镶嵌

Fluid mosaic: fluid because the molecules can move freely past one another and mosaic because of the diversity of proteins that float like icebergs in the phospholipid sea.

- **Genetic control of the cell:** the nucleus（细胞核）, ribosomes

1) The nucleus: an envelope consisting of two membranes encloses the nucleus. Within the nucleus, DNA and proteins make up chromatin fibers; each very long fiber is a single chromosome. The nucleus also contains the nucleolus, which produces components of ribosomes.



2) Ribosomes: produce proteins in the cytoplasm using messages produced by the DNA.

- **The endomembrane system:** manufacturing and distributing cellular products

The Endoplasmic Reticulum(ER) 内质网	✧ Consists of membrane-enclosed tubes and sacs within the cytoplasm. ✧ Two type of ER: rough ER, smooth ER 1) rough ER named because of the ribosomes attached to its surface, makes membrane and secretory proteins; 2) the function of smooth ER: lipid synthesis, detoxification
The Golgi Apparatus 高尔基体	✧ Consists of a stack of membrane plates. ✧ Receives, refines, stores certain ER products and packages them in transport vesicles targeted for other organelles or export from the cell.
Lysosomes 溶酶体	✧ A membrane-enclosed sac of digestive enzymes found in animal cells, developed from vesicles that bud off from the Golgi apparatus. ✧ Contain digestive enzymes, aid digestion and recycling within the cell. ✧ Functions: 1) nourish the cell; 2) destroy harmful bacteria; 3) continually renew the cell; 4) sculpting functions in embryonic development ✧ Typical disease: Tay-Sachs disease
Vacuoles 液泡	✧ Large sacs made of membrane that bud off from the ER or Golgi apparatus. ✧ Functions: 1) Food vacuole; 2) Contractile vacuoles; 3) Central vacuoles that store organic nutrients.

- **The cytoskeleton:** cell shape and movement

Maintaining cell shape	✧ Cytoskeleton fibers: 1) microtubules; 2) intermediate filaments; 3) microfilaments.
Cilia and flagella	✧ Aid in movement. ✧ They are made primarily of microtubules; ✧ Differences: 1) Cilia: short, numerous, move the cell via coordinated beating. 纤毛 2) Flagella: long, often occur singly, propel a cell with whiplike movement. 鞭毛

Chapter 5. The Working Cell

Chapter 6. Cellular Respiration: Obtaining Energy from Food

- **Membrane Function**

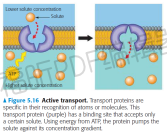
  Proteins embedded in the plasma membrane perform a wide variety of functions, including regulating transport, anchoring to other cells or substances, promoting enzymatic reactions, and recognizing other cells.

  - **Passive Transport**: Diffusion across Membranes（no energy needed）
    - ✧ **Diffusion** is the movement of molecules spreading out evenly into the available space, from a region where the molecules are more concentrated to a region where they are less concentrated
    - ✧ Substances that do not cross membranes spontaneously—or otherwise cross very slowly—can be transported via proteins that act as corridors—— **facilitated diffusion**

      examples of facilitated diffusion: Glucose Transporter in small intestine;
      Ion Channels in neurons and muscle;
      Aquaporins(水通道蛋白)
    - ✧ **Osmosis** (滲透)
      - ✧ The diffusion of water across a selectively permeable membrane is **osmosis**.

      The control of water balance is called **osmoregulation(渗透压调节)**

  - **Active Transport:** The Pumping of Molecules across Membranes
    - ✧ **Active transport** requires that a cell expend energy (ATP) to move molecules across a membra
    - ✧ **Active transport re**quires transport proteins



  - **Exocytosis and Endocytosis: Traffic of Large Molecules**

    Exocytosis is the secretion of large molecules within vesicles. **Endocytosis** is the import of large substances via vesicles into the cell.

- **Producers and Consumers**

  Autotrophs (producers) make organic molecules from inorganic nutrients via photosynthesis.
  Heterotrophs (consumers) must consume organic material and obtain energy via cellular respiration.

- **Cellular Respiration: Aerobic** (需氧的) **Harvest of Food Energy**
  - **Cellular Respiration**: aerobic harvesting of chemical energy from organic fuel molecules.
  - **An Overview of Cellular Respiration**

    The overall equation of cellular respiration simplifies a great many chemical steps into one formula:

    $C_6H_{12}O_6 + 6\,O_2 \rightarrow 6\,CO_2 + 6\,H_2O$ + approx. 32 ATP
  - **The Three Stages of Cellular Respiration**
    - ✧ **Stage 1: Glycolysis** (糖酵解)
      1. A six-carbon glucose molecule is split in half to form two molecules of pyruvic acid (丙酮酸).
      2. The three-carbon molecules then donate high-energy electrons to NAD+, forming NADH.
      3. Generate four ATP molecules directly when enzymes transfer phosphate groups from fuel molecules to ADP.

Figure 6.5 Glycolysis. In glycolysis, a team of enzymes splits glucose, eventually forming two molecules of pyruvic acid. After investing 2 ATP at the start, glycolysis generates 4 ATP directly. More energy will be harvested later from high-energy electrons used to form NADH and from the two molecules of pyruvic acid.