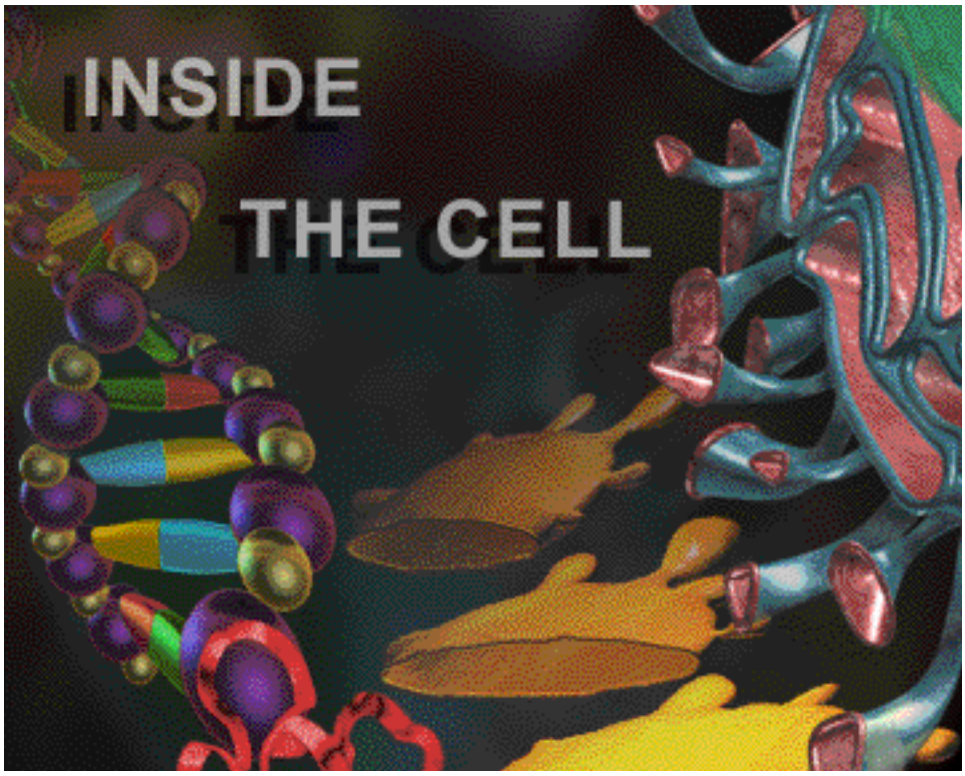
Interactive Biology Multimedia Courseware

Inside the Cell
Program Supplement



Inside the Cell
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Inside the Cell
PROGRAM SUPPLEMENT

The following subject areas are addressed throughout the Interactive Biology Multimedia Courseware program, *Inside the Cell*.

- An introduction to the cell, including the invention of the microscope
- Cell theory
- Essential organic compounds within a cell
- Definitions of prokaryotic and eukaryotic cells
- The parts of a eukaryotic cell
- Cell specialization and organization

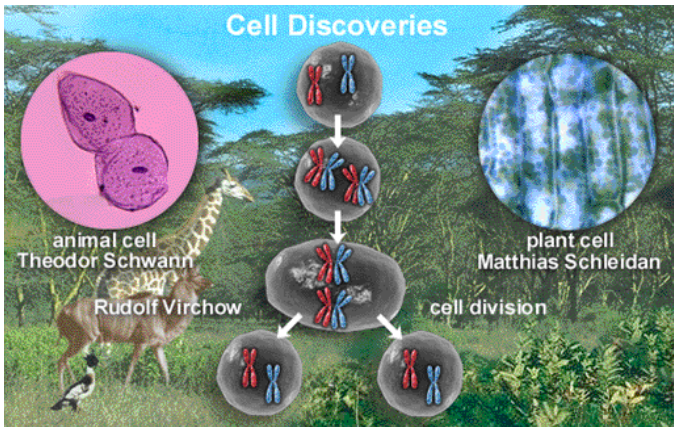
Study Guide #1
AN INTRODUCTION TO THE CELL

The cell is the smallest and most fundamental unit of life. All living things, or organisms, are made up of at least one cell. Some organisms, such as amoebas, are made up of *only* one cell and are therefore called **unicellular** organisms. On the other hand, **multicellular** organisms, such as humans, are composed of more than one cell.

Most cells are too small to be seen with the unaided eye, therefore, they were discovered only after the invention of the **microscope**. In the 1600's, Dutch naturalist **Anton van Leeuwenhoek** used simple magnifying instruments to create the first microscopes. Leeuwenhoek used glass grindings and polishing techniques to shape special glass lenses. Objects were magnified when viewed through these lenses. Leeuwenhoek was able to magnify the contents of pond water to see tiny **organisms**, or **microorganisms**, that were previously invisible to the unaided eye.

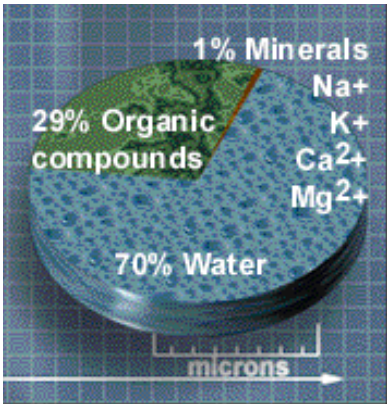
Soon after Leeuwenhoek's observation of microorganisms, an English physicist named **Robert Hooke** used a microscope to observe thin slices of cork, or dead wood. Hooke observed tiny honeycomb-like chambers in the cork material. These chambers were similar to the tiny rooms, or cells, of a monastery, so Hooke named them "**cells**." What he actually observed were the remains of once living wood cells.

Although there are microscopes that enable one to view things at the molecular level, most biologists utilize the modern **compound light microscope**. The compound light microscope can magnify specimens hundreds of times, allowing the user to see things at the cellular level. The word "compound" means that more than one lens is used to magnify the specimen. The word "light" means that the specimen is illuminated by a light source that passes through the specimen.



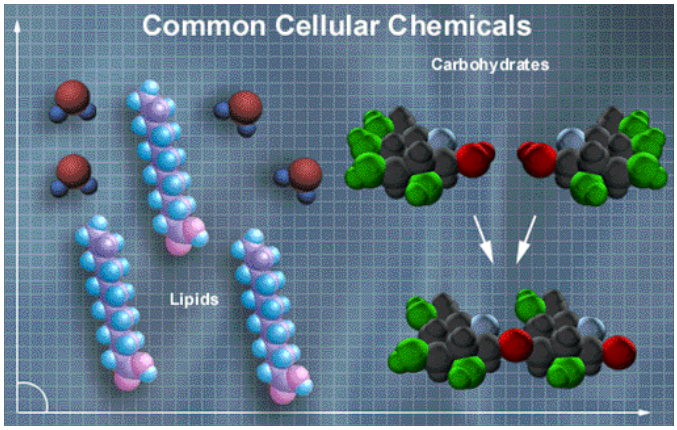
As microscope design improved beyond Leeuwenhoek's design, more detailed observations of organisms were made. Biologists began to use Hooke's word "cell" to describe the tiny fluid-filled compartments seen in all living organisms. An article published in the 1800's by German biologist, **Theodor Schwann**, concluded that all animals were made up of cells. Another nineteenth century German scientist, named **Matthias Schleidan**, concluded that all plants were made up of cells as well. Also during the 1800's, a German physician named **Rudolf Virchow** determined that animal and plant cells multiplied by a process called **cell division**.

The cell discoveries of the 1800's and the many studies that followed led to the development of the **cell theory**. The cell theory states that: (1) cells are the smallest working units of all living things, (2) all living things are composed of cells, and (3) all cells come from pre-existing cells by cell division.



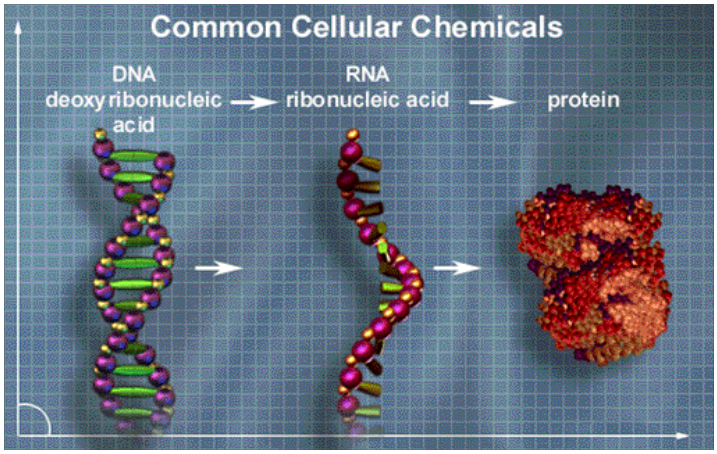
A typical cell consists of about 70 percent water, 29 percent organic compounds, and 1 percent minerals, such as sodium and potassium. Most cells have a few essential organic molecules in common. These include **lipids**, **carbohydrates**, and **macromolecules**. Macromolecules are large, organic molecules, such as **proteins**, **deoxyribonucleic acid** (DNA), and **ribonucleic acid** (RNA), that are made of many smaller chemical subunits.

Lipids are waxes, fats, and oils, and are mostly non-polar organic molecules. Non-polar molecules repel water molecules, which explains why oils and water do not mix. Carbohydrates, such as sugars and starches, are also organic molecules.

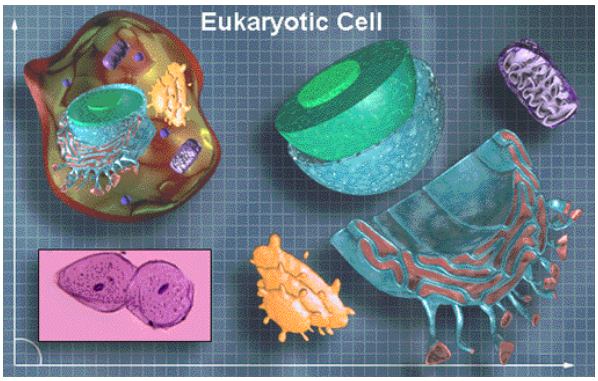


Proteins are macromolecules composed of **amino acids**. Amino acids assemble into proteins within the cell, where they become essential components of many cellular structures and chemical reactions. The sequence of amino acids within a protein is based on the genetic code of the macromolecule DNA, which is composed of a series of **nucleotides**. In order for DNA to form protein, another macromolecule called RNA, must read the genetic code and carry a message to the cell's **cytoplasm**. Within the cytoplasm, the message coded by RNA indicates the order in which amino acids link to form proteins.

All cells can be classified into two categories - **prokaryotic** cells and **eukaryotic** cells. Prokaryotic cells lack a **nucleus** and are usually smaller than eukaryotic cells. Single-celled **bacteria** are the only examples of organisms with prokaryotic cells. Eukaryotic cells, which contain a nucleus, are the cells that compose all other organisms.

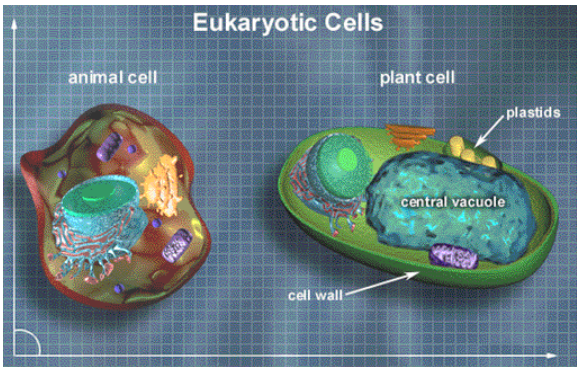


A eukaryotic cell is essentially a fluid-filled container. Located within eukaryotic cells are structures called **organelles**. Each type of organelle contains a unique composition of chemicals that allow it to perform a specific function.



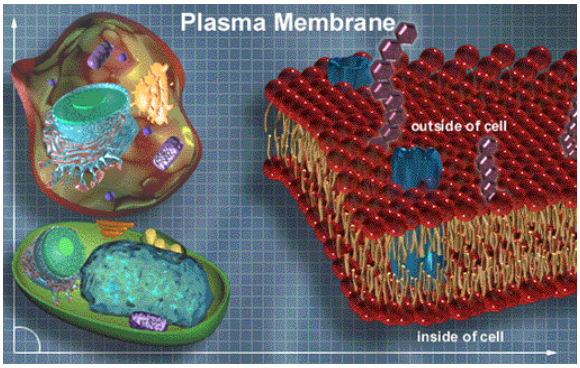
Plant cells and animal cells are all eukaryotic, and they have many common structures and organelles. Plant cells, however, have three additional structures that distinguish them from animal cells: a **cell wall**, a large **central vacuole**, and **plastids**.

The rigid cell wall gives plant cells their characteristic shape as well as provides structural support and protection. The cell wall contains the carbohydrate **cellulose**, which gives the cell its characteristic stiffness. Small openings in the cell wall allow gases and liquids to pass through the rigid barrier.



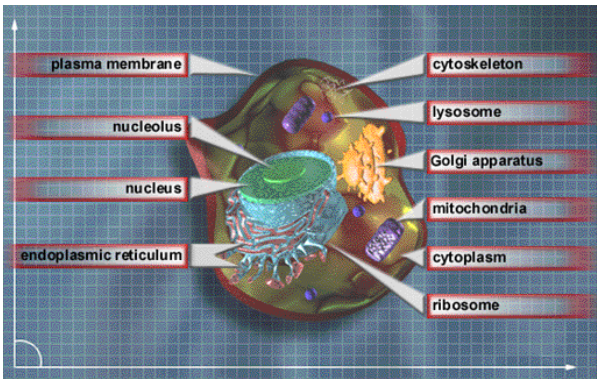
The central vacuole of a plant cell is a fluid-filled organelle. Often the central vacuole exerts outward pressure, providing internal support to the cell. Plastids vary in their function depending on the type of chemicals they contain. For example, plastids, which contain chlorophyll molecules, are involved in the process of **photosynthesis**. Photosynthesis is the process by which plants use energy from sunlight to convert water and carbon dioxide into carbohydrates.

Study Guide #2
PARTS OF A EUKARYOTIC CELL



All cells are surrounded by a cell membrane, which is also called a **plasma membrane**. In plants, the membrane is located just inside the cell wall. In animal cells, the membrane is the outer-most layer of the cell. The plasma membrane is comprised of proteins, carbohydrates, and special lipids called **phospholipids**. This composition makes the plasma membrane selective, allowing some molecules to pass through it while keeping others out.

The plasma membrane is actually made of two layers of phospholipid molecules. Each phospholipid in the bilayer has a non-polar region that repels water (tail) and a polar region (head) that which attracts water. The phospholipids in a membrane are arranged so that the non-polar tails are pointed toward one another and the polar heads are pointed away from each other. This arrangement creates a phospholipid bilayer. The phospholipid bilayer is fluid-like, allowing the individual phospholipids to move within the membrane.



In addition to phospholipids, the plasma membrane may also contain many different proteins and carbohydrates. These molecules can either occur within the phosopholipid bilayer or on its inner or outer surfaces. The fluidity of the phospholipid bilayer allows the proteins and carbohydrates to float about the plasma membrane. Proteins may function as channels that allow certain chemicals to enter or exit the cell or they may function as receivers of chemicals that trigger internal cellular changes. Carbohydrates are often involved in the chemical recognition of carbohydrates in other cell membranes.

Located within the cell is the **cytosol**, a gel-like substance that surrounds all the **organelles** and helps give cells their shape. The cytosol primarily consists of water, but it also contains dissolved chemicals, such as proteins and minerals. The term **cytoplasm** is often misused to describe the cytosol. Cytoplasm is a collective term describing the cytosol and all the organelles of a cell *except* the nucleus. The cytosol is *only* the fluid portion of the cytoplasm.

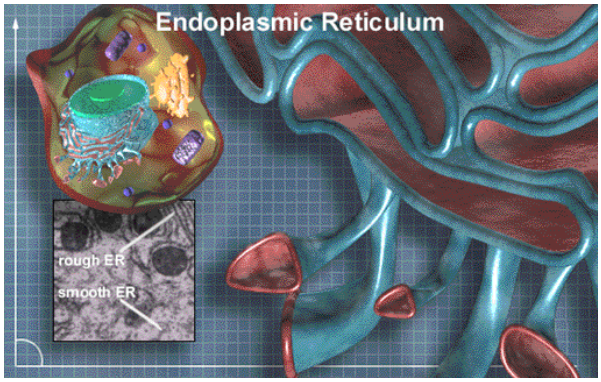
Within the cytoplasm, a web of small fibers, called the **cytoskeleton**, also supports and gives shape to cells. In some cells, cytoskeleton fibers may be modified for special

purposes, such as cellular mobility in **macrophages**, or contraction in muscle cells. These fibers also play special roles in cell division.

The nucleus, which contains nearly all of a cell's DNA, is usually the most distinguishable part of an animal cell. Since the DNA contains all of the necessary instructions for making a cell's proteins, the nucleus is often referred to as the "command center" of the cell. Within the nucleus, DNA is coiled around proteins, resulting in structures called **chromatin.**

A double membrane, called a **nuclear envelope**, surrounds the nucleus and functions to regulate the molecules that enter the nucleus. The nuclear envelope contains pores that regulate what substances may enter and exit the nucleus

Most nuclei contain one or two distinct dense regions known as **nucleoli**. The density of the nucleolus is due to the large amounts of ribosomal RNA being produced in it. Ribosomal RNA combines with small proteins within the nucleus. The combination forms two different ribosomal subunits, which once made, exit the nucleus through nuclear pores.



Once in the cytoplasm, the two ribosomal subunits join to become a complete **ribosome**. When RNA and amino acids come together on the ribosomes, protein synthesis occurs. Some ribosomes may be found free in the cytoplasm, where they assemble proteins that will reside in the cytoplasm, but most become bound to the **endoplasmic reticulum**.

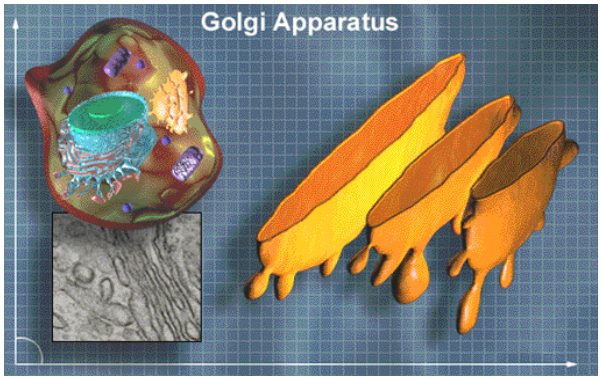
The endoplasmic reticulum (ER) is an intricate network of connected sacs and tubes covered with a bilayer membrane similar to the plasma membrane. The bilayer membrane of the ER is actually continuous with the outer-most bilayer membrane of the nuclear envelope. The space within the endoplasmic reticulum membrane is called the **lumen.**

The endoplasmic reticulum consists of the **rough ER** and the **smooth ER**. Ribosomes attach to the rough ER, thus giving it a bumpy or rough appearance. In contrast, the smooth ER lacks ribosomes. Ribosomes on the rough endoplasmic reticulum assemble proteins and deposit them into the lumen. Once in the lumen, proteins are sent to the smooth endoplasmic reticulum.

The smooth endoplasmic reticulum packages and deposits proteins into membrane-bound sacs called **vesicles**. Portions of the smooth endoplasmic reticulum membrane pinch off, thereby forming vesicles. From the smooth endoplasmic reticulum, vesicles travel to other organelles or to the plasma membrane of the cell, where the vesicle

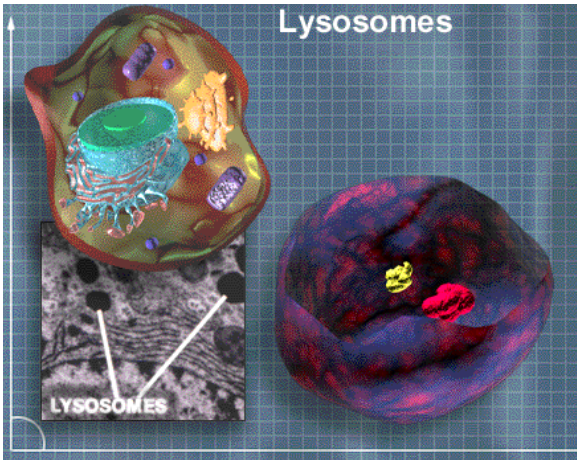
fuses with the membrane of the particular structure. Proteins within vesicles that travel to organelles are released into the organelle, whereas, proteins within vesicles that travel to the plasma membrane are released outside the cell by a process called **exocytosis.**

Proteins that are not fully functional by the time they leave the smooth endoplasmic reticulum travel to the **Golgi apparatus** where they become modified. The Golgi apparatus is an organelle consisting of a stack of membrane bound sacs, which resemble the endoplasmic reticulum. Unlike the endoplasmic reticulum, however, the sacs of the Golgi apparatus are not interconnected with one another or the nuclear envelope.



All of the functions of the Golgi apparatus are not yet understood. However, it is clear that **enzymes** located within each sac of the Golgi apparatus modify proteins. Enzymes modify proteins by adding or removing molecules as the proteins pass through the different sacs. Eventually, the final, functional protein is packaged into a vesicle and transported elsewhere.

Vesicles leaving the Golgi apparatus may travel to the cell's plasma membrane and a variety of organelles. However, some vesicles may remain in the cytoplasm where they exist as small organelles called **lysosomes**.



Lysosomes are membrane-bound vesicles that occur in various shapes and sizes within the cytoplasm. These organelles contain **digestive enzymes** (proteins) that break down or destroy large chemical particles, foreign material, or microorganisms such as bacteria. If released from the lysosome, digestive enzymes can destroy the entire cell.

Particles that require digestion by a lysosome are often taken into the cell by the process called **endocytosis**. Endocytosis is the cellular process of engulfing particles, foreign material, or microorganisms, and packaging them into vesicles. In order to break down the particles contained within the vesicle, the vesicle fuses with a lysosome. This creates a new vesicle wherein the digestive enzymes break down the foreign particles into smaller units. These smaller particles can then cross the lysosome's membrane and enter the cytoplasm, where they may be used by the cell.

In special instances, the lysosomes of a cell are programmed to all burst open at once to destroy the cell that contains them, thus giving lysosomes the name "suicide sacs". Programmed cell death is beneficial in some situations. For example, in early human development, webs of skin form between fingers and between toes of the fetus. Prior to birth, the skin cells of these webs are destroyed when the lysosomes burst open and release their digestive enzymes into the cytoplasm. If this does not occur, the child will be born with webbed hands and feet, a condition known as **cutaneous syndactyly**.

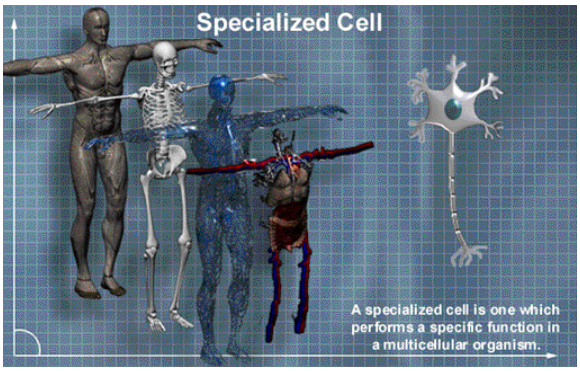
All living cells require energy. The **mitochondrion** is the organelle responsible for supplying energy, and is therefore referred to as the "power houses" of the cell. Mitochondria vary in number, size, shape, and location. Mitochondria are comprised of two separate phospholipid bilayer membranes, the smooth outer membrane and the folded or convoluted inner membrane. The folds of the inner membrane are known as **cristae**. The innermost compartment of a mitochondrion is called the **matrix**.

A mitochondrion's matrix is filled with proteins and enzymes specialized to transfer the energy from food to an energy-storing molecule called **adenosine triphosphate** (ATP). The ATP molecule has three phosphate groups attached to an adenosine molecule. The bonds between these phosphate groups store chemical energy. **Cell respiration** is the process of deriving energy from food and storing the energy in ATP molecules.

ATP can be thought of as the rechargeable batteries of a cell, cycling between ATP and ADP. ATP supplies energy when it transfers one of its phosphate groups to a chemical involved in a reaction. When ATP loses a phosphate group, it becomes **adenosine diphosphate** (ADP). ADP is converted back into ATP within the matrix of the mitochondria.

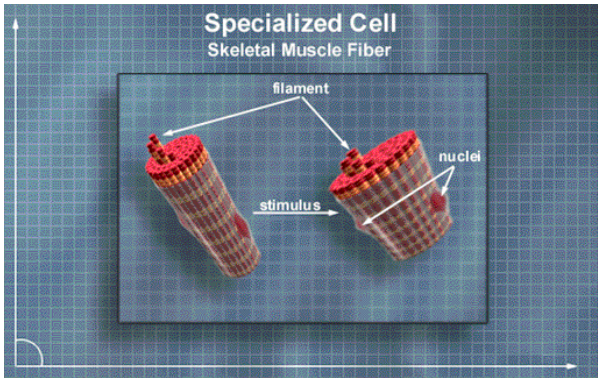
Study Guide #3
CELL SPECIALIZATION AND ORGANIZATION

The basic components of a eukaryotic cell were described in Study Guide #2, but not all cells of a multicellular organism are the same. Cells can differ in the type or number of organelles they possess. These differences allow some cells to carry out specific functions. A cell that performs a specific and unique function in a multicellular organism is said to be specialized. Examples of some **specialized cells** of humans include muscle fibers, nerve cells, and macrophages.



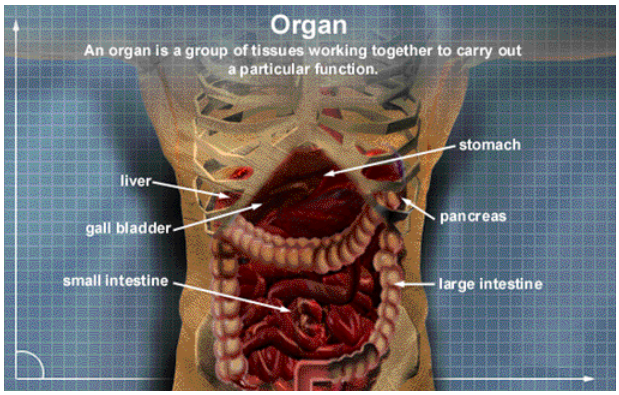
Macrophages are specialized cells formed in bone marrow that travel throughout the body via the bloodstream. The function of the macrophage is to protect the human body from invading organisms and other foreign material. Through **amoeboid movement**, the macrophage can leave the bloodstream to enter tissues that need protection against invaders. When a macrophage finds an invader, the macrophage engulfs the invader through endocytosis and packages it into a vesicle. Lysosomes within the macrophage cell fuse with the vesicle, releasing digestive enzymes that destroy the invader.

Another example of a specialized human cell is a skeletal muscle fiber, which is longer than the typical cell and contains many nuclei. The function of a muscle fiber is to perform muscle contraction. Muscle fibers contain **filaments** that, when they receive the proper stimulus, cause the muscle fiber to contract into a shorter and thicker cell.



No matter how specialized a cell may be, a single cell cannot accomplish muscle movement or all the functions your body performs daily. Groups of cells work together to perform a specific function. A group of cells working together to perform a specific function is called a **tissue**. An example of cells working together to perform a function is the muscle tissue in your arm. Your arm bends because the cells of muscle tissue work together to bend your arm.

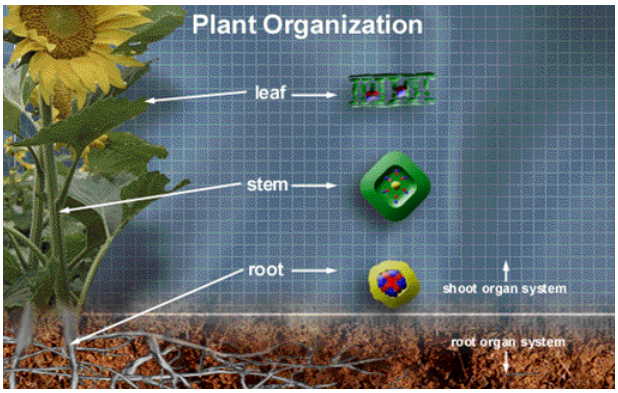
Some functions require that a group of tissues work together. A group of tissues working together to carry out a particular function is called an **organ**. Your stomach is an organ made up of different tissues working together to help breakdown and partially digest food. The outer tissue of the stomach causes the stomach walls to move, which churns the food. The inner tissue of the stomach secretes gastric juices that break down food to release nutrients.



In the previous example, a group of tissues worked together within an organ - the stomach - to partially digest food. However, many organs must manipulate food before cells of your body can use the food nutrients. A group of organs which work together to perform a particular function is known as an **organ system**. The human body has several organ systems. The digestion system, which is one of these, includes the stomach, the small intestine, the large intestine and other organs. These organs all act together as an organ system to completely digest the food you eat.

Plants also have organ systems, organs, and tissues. The organ systems of a plant are the root system and the shoot system. Individual roots, stems, and leaves are organs. Just as in animal cells, each of these organs is composed of different tissues, and each tissue is a collection of similar cells working together to perform a particular function.

In summary, there are four levels of organization within a multicellular organism: cells, tissues, organs, and organ systems. A cell is the smallest organizational unit of a living organism. A group of cells working together to perform a particular function makes up a tissue. A group of tissues working together is an organ, while a group of organs working together is an organ system. Finally, all the organ systems make up the living organism.



Inside the Cell
QUIZ PACK

The following quizzes are meant to assess student understanding of specific areas covered in the Interactive Multimedia Courseware program, *Inside the Cell*.

Quiz #1	An Introduction to the Cell
Quiz #2	Parts of a Eukaryotic Cell
Quiz #3	Cell Specialization and Organization

Quiz #1
AN INTRODUCTION TO THE CELL

1. All living things are made up of one or more cells.

   A. True
   B. False

2. The first microscope was created by the Dutch naturalist _____ in the 1600's.

   A. Charles Darwin
   B. Robert Hooke
   C. Theodor Schwaan
   D. Anton van Leeuwenhoek

3. _____ was the first person to use the term "cell."

   A. Charles Darwin
   B. Robert Hooke
   C. Theodor Schwaan
   D. Anton van Leeuwenhoek

4. The first person who concluded that all animals were made up of cells was _____.

   A. Charles Darwin
   B. Matthias Schleidan
   C. Theodor Schwaan
   D. Rudolf Virchow

5. The first person who concluded that all plants were made up of cells was _____.

   A. Charles Darwin
   B. Matthias Schleidan
   C. Theodor Schwaan
   D. Rudolf Virchow

6. The cell theory states all of the following *except* _____.

   A. cells are the smallest working units of all living things
   B. all living things are composed of cells
   C. all cells have an outer rigid cell wall
   D. all cells come from pre-existing cells by cell division

7. A typical cell consists of about _____ percent water.

   A. 70
   B. 29
   C. 1
   D. 40

8. Large, organic molecules that are made of many smaller units are called _____.

   A. micromolecules
   B. macromolecules
   C. complex molecules
   D. none of the above

9. Waxes, fats, and oils are all types of _____.

   A. carbohydrates
   B. lipids
   C. nucleic acids
   D. DNA

10. Sugars and starches are _____.

   A. carbohydrates
   B. macromolecules
   C. lipids
   D. A and B

11. _____ are the essential components of nearly all structures and chemical reactions of a cell.

    A. nucleic acids
    B. ribosomes
    C. proteins
    D. lysosomes

12. Amino acids are the building blocks of _____.

    A. fats
    B. carbohydrates
    C. nucleic acids
    D. proteins

13. Proteins are assembled according to instructions encoded in _____.

    A. amino acids
    B. carbohydrates
    C. DNA
    D. Ribosomes

14. Bacteria are examples of _____ cells.

    A. eukaryotic
    B. prokaryotic
    C. A and B
    D. none of the above

15. Plant cells and animal cells are all _____.

    A. eukaryotic
    B. prokaryotic
    C. A and B
    D. none of the above

16. All of the following characteristics distinguish a plant cell from an animal cell except _____.

    A. a cell wall
    B. a large, central vacuole
    C. plastids
    D. a nucleolus

17. The cell wall of a plant cell is mostly made up of _____.

    A. lipids
    B. cellulose
    C. nucleic acids
    D. cytosol

18. The _____ of a plant cell exerts pressure outward, providing internal support to the cell.

    A. central vacuole
    B. plastid
    C. cell wall
    D. nucleus

19. The process by which plants use energy from sunlight to convert water and carbon dioxide into carbohydrates is called _____.

    A. osmosis
    B. cell respiration
    C. photosynthesis
    D. mitosis

Quiz #2
PARTS OF A EUKARYOTIC CELL

1. All cells are surrounded by a cell membrane.

   A. True
   B. False

2. The plasma membrane of an animal cell includes all of the following *except* _____.

   A. lipids
   B. carbohydrates
   C. phospholipids
   D. cellulose

3. The plasma membrane is composed of two layers of _____.

   A. cellulose
   B. phospholipids
   C. DNA
   D. endoplasmic reticuli

4. The _____ of phospholipids repel water, while the _____ of phospholipids attract water.

   A. heads, tails
   B. necks, tails
   C. tails, heads
   D. arms, heads

5. Proteins and carbohydrates can float around in the plasma membrane.

   A. True
   B. False

6. The gelatinous fluid that surrounds all of the organelles within a cell is called _____.

   A. cytoplasm
   B. cellulose
   C. carbohydrate
   D. cytosol

7. Cytoplasm is _____.

   A. the gel-like fluid within a cell
   B. the cytosol and all of a cell's organelles except the nucleus
   C. water and dissolved chemical materials such as proteins and minerals
   D. the same as cytosol

8. The _____ helps give a cell its shape.

   A. DNA
   B. cytoskeleton
   C. cytosol
   D. B and C

9. A cell's nucleus contains _____.

   A. cytosol
   B. cytoplasm
   C. DNA
   D. cellulose

10. _____ is made up of DNA coiled around proteins.

   A. Chromatin
   B. A ribosome
   C. Endoplasmic reticuli
   D. Histone

11. The _____ of a eukaryotic cell is made up of two bilayer membranes that regulate the molecules entering the nucleus.

    A. plasma membrane
    B. cytoskeleton
    C. nuclear envelope
    D. nucleolus

12. Ribosomal RNA is made within the _____.

    A. nucleoli
    B. cytoplasm
    C. rough endoplasmic reticulum
    D. lysosomes

13. Proteins are made on _____.

    A. Vesicles
    B. Nuclei
    C. Nucleoli
    D. Ribosomes

14. The rough endoplasmic reticulum has no bound ribosomes.

    A. True
    B. False

15. The endoplasmic reticulum is connected to the nuclear envelope.

    A. True
    B. False

16. Within the _____ endoplasmic reticulum, proteins are packaged into membrane-bound sacs called _____.

    A. rough, vesicles
    B. smooth, Golgi apparatus
    C. smooth, vesicles
    D. rough, ribosomes

17. Proteins are modified within _____.

A. the nucleus
B. the endoplasmic reticulum
C. the Golgi apparatus
D. the mitochondria

18. _____ contain digestive enzymes that break down large chemical particles or foreign material such as bacteria.

A. Ribosomes
B. Mitochondria
C. Lysosomes
D. Plasma membranes

19. Endocytosis is _____.

A. the cellular process of engulfing particles, foreign material, or microorganisms, and packaging them into vesicles.
B. the process by which a cell exports proteins
C. the process of cell division
D. the process by which a cell modifies proteins

20. Lysosomes can destroy an entire cell.

A. True
B. False

21. _____ are the “power houses” of a cell.

A. Mitochondria
B. Ribosomes
C. Lysosomes
D. Vesicles

22. The inner-most compartment of a mitochondrion is called the _____.

A. lumen
B. cytosol
C. cristae
D. matrix

23. Mitochondria vary in number and size among cells.

A. True
B. False

24. _____ is the energy-storing molecule in cells.

A. Adenosine triphosphate (ATP)
B. Ribonucleic acid (RNA)
C. Deoxyribonucleic acid (DNA)
D. Trisodium phosphate (TSP)

Quiz #3
CELL SPECIALIZATION AND ORGANIZATION

1. All eukaryotic cells have the same type and number of organelles.

   A. True
   B. False

2. A specialized cell _____.

   A. is surrounded by an extra plasma membrane
   B. is a virus
   C. performs a specific and unique function
   D. B and C

3. _____ are formed in the bone marrow and are capable of amoeboid movement.

   A. Nerve cells
   B. Macrophages
   C. Muscle fibers
   D. Lysosomes

4. Macrophages _____.

   A. engulf and digest foreign invaders such as bacteria
   B. transmit nervous impulses
   C. help to contract muscles
   D. aid in digestion of food

5. A _____ is longer than most cells and contains many nuclei.

   A. nerve cell
   B. macrophage
   C. tissue
   D. skeletal muscle fiber

6. A group of similar cells working together to perform a particular function is called a(n) _____.

   A. organ
   B. organ system
   C. tissue
   D. muscle fiber

7. The stomach is an example of a(n)_____, or a group of tissues working together to perform a particular function.

   A. organ
   B. organ system
   C. muscle
   D. specialized cell

8. Digestion is carried out by a(n) _____.

   A. organ
   B. organ system
   C. muscle
   D. stomach

9. A leaf is an example of a plant organ.

   A. True
   B. False

10. The root system and the shoot system are the two _____ of plants.

    A. organs
    B. tissues
    C. organ systems
    D. specialized cells

Inside the Cell
COMPREHENSIVE EXAM

Directions: Answer the following questions as either true or false.

1. Mitochondria vary in number and size among cells.

   A. True
   B. False

2. All cells are surrounded by a cell membrane.

   A. True
   B. False

3. Lysosomes can destroy an entire cell.

   A. True
   B. False

4. The endoplasmic reticulum is connected to the Golgi apparatus.

   A. True
   B. False

5. The rough endoplasmic reticulum lacks bound ribosomes.

   A. True
   B. False

6. Proteins and carbohydrates can float in the plasma membrane.

   A. True
   B. False

7. All living things are made up of more than one cell.

   A. True
   B. False

8. All eukaryotic cells have the same type and number of organelles.

   A. True
   B. False

9. A leaf is an example of a plant organ.

   A. True
   B. False

Directions: Choose the correct answer to each multiple-choice question.

10. The plasma membrane of an animal cell includes all of the following *except* _____.

    A. lipids
    B. carbohydrates
    C. phospholipids
    D. cellulose

11. The plasma membrane in composed of two layers of _____.

    A. cellulose
    B. phospholipids
    C. DNA
    D. endoplasmic reticuli

12. The _____ of phospholipids repel water, while the _____ of phospholipids attract water.

    A. heads, tails
    B. necks, tails
    C. tails, heads
    D. arms, heads

13. The gelatinous fluid that surrounds all of the organelles within a cell is called _____.

A. cytoplasm
B. cellulose
C. carbohydrate
D. cytosol

14. Cytoplasm is _____.

A. the gel-like fluid within a cell
B. the cytosol and all of a cell's organelles except the nucleus
C. water and dissolved chemical materials such as proteins and minerals
D. the same as cytosol

15. The _____ helps give a cell its shape.

A. DNA
B. cytoskeleton
C. cytosol
D. B and C

16. A cell's nucleus contains _____.

A. cytosol
B. cytoplasm
C. DNA
D. cellulose

17. _____ is/are made up of DNA coiled around proteins.

A. Chromatin
B. Ribosomes
C. Endoplasmic reticuli
D. Histone

18. The _____ of a eukaryotic cell is made up of two bilayer membranes that regulate the molecules entering the nucleus.

A. plasma membrane
B. cytoskeleton
C. nuclear envelope
D. nucleolus

19. Ribosomal RNA is made within the _____.

A. nucleoli
B. cytoplasm
C. rough endoplasmic reticulum
D. lysosomes

20. _____ are responsible for the production of proteins.

A. Vesicles
B. Nuclei
C. Nucleoli
D. Ribosomes

21. Within the _____ endoplasmic reticulum, proteins are packaged into membrane-bound sacs called _____.

A. rough, vesicles
B. smooth, Golgi apparatus
C. smooth, vesicles
D. rough, ribosomes

22. Proteins are modified within _____.

A. the nucleus
B. the endoplasmic reticulum
C. the Golgi apparatus
D. the mitochondria

23. _____ contain digestive enzymes that break down large chemical particles or foreign material such as bacteria.

A. Ribosomes
B. Mitochondria
C. Lysosomes
D. Plasma membranes

24. Endocytosis is _____.

A. the cellular process of engulfing particles, foreign material, or microorganisms, and packaging them into vesicles.
B. the process by which a cell exports proteins
C. the process of cell division
D. the process by which a cell modifies proteins

25. _____ are the “power houses” of a cell.

A. Mitochondria
B. Ribosomes
C. Lysosomes
D. Vesicles

26. The inner-most compartment of a mitochondrion is called the _____.

A. lumen
B. cytosol
C. cristae
D. matrix

27. _____ is the energy-storing molecule in cells.

A. Adenosine triphosphate (ATP)
B. Ribonucleic acid (RNA)
C. Deoxyribonucleic acid (DNA)
D. Trisodium phosphate (TSP)

28. A specialized cell _____.

A. is surrounded by an extra plasma membrane
B. is a virus
C. performs a specific and unique function
D. B and C

29. _____ are formed in the bone marrow and are capable of amoeboid movement.

A. Nerve cells
B. Macrophages
C. Muscle fibers
D. Lysosomes

30. Macrophages _____.

A. engulf and digest foreign invaders such as bacteria
B. transmit nervous impulses
C. help to contract muscles
D. aid in digestion of food

31. A _____ is longer than most cells and contains many nuclei.

A. nerve cell
B. macrophage
C. tissue
D. skeletal muscle fiber

32. A group of similar cells working together to perform a particular function is called a(n) _____.

A. organ
B. organ system
C. tissue
D. muscle fiber

33. The stomach is an example of a(n)_____, or a group of tissues working together to perform a particular function.

A. organ
B. organ system
C. muscle
D. specialized cell

34. Digetion is carried out by a(n) _____.

A. organ
B. organ system
C. muscle
D. stomach

35. The root system and the shoot system are the two _____ of plants.

A. organs
B. tissues
C. organ systems
D. specialized cells

36. The first microscope was created by the Dutch naturalist _____ in the 1600's.

A. Charles Darwin
B. Robert Hooke
C. Theodor Schwaan
D. Anton van Leeuwenhoek

37. _____ was the first person to use the term "cell."

A. Charles Darwin
B. Robert Hooke
C. Theodor Schwaan
D. Anton van Leeuwenhoek

38. The first person to conclude that all animals were made up of cells was _____.

A. Charles Darwin
B. Matthias Schleidan
C. Theodor Schwaan
D. Rudolf Virchow

39. The first person to conclude that all plants were made up of cells was _____.

A. Charles Darwin
B. Matthias Schleidan
C. Theodor Schwaan
D. Rudolf Virchow

40. The cell theory states all of the following *except* _____.

A. cells are the smallest working units of all living things
B. all living things are composed of cells
C. all cells have an outer rigid cell wall
D. all cells come from pre-existing cells by cell division

41. A typical cell consists of about _____ percent water.

A. 70
B. 29
C. 1
D. 40

42. Large, organic molecules that are made of many smaller units are called_____.

A. micromolecules
B. macromolecules
C. complex molecules
D. none of the above

43. Waxes, fats, and oils are all types of _____.

A. carbohydrates
B. lipids
C. nucleic acids
D. DNA

44. Sugars and starches are _____.

A. carbohydrates
B. macromolecules
C. lipids
D. A and B

45. _____ are the essential components of nearly all structures and chemical reactions of a cell.

A. nucleic acids
B. ribosomes
C. proteins
D. lysosomes

46. Amino acids are the building blocks of _____.

A. fats
B. carbohydrates
C. nucleic acids
D. proteins

47. Proteins are assembled according to instructions encoded in _____.

A. amino acids
B. carbohydrates
C. DNA
D. Ribosomes

48. Bacteria are examples of _____ cells.

A. eukaryotic
B. prokaryotic
C. A and B
D. none of the above

49. Plant cells and animal cells are all _____.

A. eukaryotic
B. prokaryotic
C. A and B
D. none of the above

50. All of the following characteristics distinguish a plant cell from an animal cell except _____.

A. a cell wall
B. a large, central vacuole
C. plastids
D. a nucleolus

51. The cell wall of a plant cell is mostly made up of _____.

A. lipids
B. cellulose
C. nucleic acids
D. cytosol

52. The _____ of a plant cell exerts pressure outward, providing internal support to the cell.

A. central vacuole
B. plastid
C. cell wall
D. nucleus

53. The process by which plants use energy from sunlight to convert water and carbon dioxide into carbohydrates is called _____.

A. osmosis
B. cell respiration
C. photosynthesis
D. mitosis

Inside the Cell
ANSWER KEY

Quizzes

Quiz #1	Quiz #2	Quiz #3
1. A	1. A	1. B
2. D	2. D	2. C
3. B	3. B	3. B
4. C	4. C	4. A
5. B	5. A	5. D
6. C	6. D	6. C
7. A	7. B	7. A
8. B	8. D	8. B
9. B	9. C	9. A
10. D	10. A	10. C
11. C	11. C	
12. D	12. A	
13. C	13. D	
14. B	14. B	
15. A	15. A	
16. D	16. C	
17. B	17. C	
18. A	18. C	
19. A	19. A	
	20. A	
	21. A	
	22. D	
	23. A	
	24. A	

Inside The Cell
ANSWER KEY

Comprehensive Exam

1. A	17. A	33. A	49. A
2. A	18. C	34. B	50. D
3. A	19. A	35. C	51. B
4. B	20. D	36. D	52. A
5. B	21. C	37. B	53. C
6. A	22. C	38. C	
7. B	23. C	39. B	
8. B	24. A	40. C	
9. A	25. A	41. A	
10. D	26. D	42. B	
11. B	27. A	43. B	
12. C	28. C	44. D	
13. D	29. B	45. C	
14. B	30. A	46. D	
15. D	31. D	47. C	
16. C	32. C	48. B	

Inside the Cell
GLOSSARY

adenosine triphosphate (**ATP)**: an energy storing molecule consisting of an adenosine molecule and three phosphate groups used to transfer the chemical energy of food into cellular energy.

amino acids: molecules that are the building blocks of proteins.

amoeboid movement: movement seen in amoeba-like cells or organisms that involves active cytoplasmic rearrangement which 1) extends portions of a cell (or organism), 2) anchors those portions, and 3) pulls the rest of the cell (or organism) along.

bacteria: single celled, prokaryotic microorganisms.

carbohydrate: a category of naturally occurring molecules containing sugars and starches.

cell: The smallest organizational unit of living things.

cell division: the process whereby a cell replicates to become two similar cells.

cell respiration: a process that occurs in mitochondria that harvests cellular energy, in the form of ATP, from the energy stored in food

cell theory: the currently accepted viewpoint regarding the principles of the cell which states the following: 1) cells are the smallest working units of living things; 2) all living things are composed of cells; 3) all cells come from pre-existing cells by cell division.

cellulose: a structural carbohydrate that makes up the majority of the plant cell wall.

cell wall: a rigid structure in plant cells, which surrounds the plasma membrane, giving protection and support to the cell.

central vacuole: a fluid filled organelle in plant cells that, in part, functions to exert pressure against the cell wall, giving internal support to the cell.

chromatin: a complex of DNA found in the nucleus that is wrapped tightly around associated proteins.

compound light microscope: an instrument which utilizes the light bending capabilities of concave and convex glass lenses to enlarge objects.

cristae: the folds of a mitochondrion's inner membrane.

cutaneous syndactyly: a condition in which a child is born with webbed skin between fingers and between toes.

cytoplasm: the contents of the cell that reside between nuclear membrane and the plasma membrane, including the cytosol.

cytoskeleton: a web of very small fibers found throughout the cytoplasm, providing structural support to the cell.

cytosol: the gel-like fluid surrounding the organelles within a cell.

deoxyribonucleic acid (**DNA**): a macromolecule consisting of nucleotides which contains the genetic information for making the proteins necessary for the cell to function properly.

digestive enzymes: special proteins packaged within lysosomes that are specifically designed to break up particles, cells, microorganisms, or foreign material.

endocytosis: the cellular process of engulfing particles, other cells, microorganisms, or foreign material such as bacteria, and packaging them into vesicles.

endoplasmic reticulum: an organelle composed of connected sacs, forming an intricate network; functions to package proteins and send those proteins elsewhere in the cell.

enzyme: a special protein which increases the rate or likelihood of chemical reactions occurring.

exocytosis: the process of depositing a vesicle's contents outside the cell.

eukaryote: any organism made of cells that contain a membrane bound nucleus and organelles.

filaments: long strands of proteins found in skeletal muscle fibers that allow the muscle to contract and relax.

gastric juices: a mucusy liquid of digestive chemicals secreted by the stomach in order to break down food.

golgi apparatus: an organelle composed of separate membrane bound sacs closely packed together; functions to modify proteins from the endoplasmic reticulum before sending them elsewhere in the cell.

Hooke, **Robert** - (1635 - 1703): an English physicist known in the scientific community as the first scientist to use the term "cell".

lipid: waxy, fatty, or oily organic molecules which are mostly non-polar.

lumen: the innermost space of certain organelles such as the endoplasmic reticulum and Golgi apparatus.

lysosomes: membrane bound vesicles, produced by the Golgi apparatus, that contain special digestive enzymes; functions to fuse with other vesicles, breaking down the matter contained inside.

macromolecules: large, organic molecules that are comprised of many smaller subunits.

macrophage: a specialized cell which is formed in the bone marrow, travels throughout the bloodstream, and is capable of both ameboid movement and phagocytosis.

matrix: the innermost space of a mitochondrion.

microorganisms: organisms that can only be seen with the aid of a magnifying device, such as the microscope.

microscope: an instrument that utilizes the light bending capabilities of convex and concave glass lenses to magnify objects which cannot be seen by the unaided eye.

mitochondrion, **mitochondria** (pl.): a double membrane bound organelle that varies in size, shape, and number per cell; functions to supply energy for cellular processes and is therefore known as the "power house" of the cell.

multicellular: made up of more than one cell.

neuron cell: a specialized cell which conducts electrical impulses throughout the body. Also known as nerve cells.

nuclear envelope: the double membrane that surrounds the nucleus and contains many nuclear pores; functions to regulate what substances enter and exit the nucleus.

nuclear pores: complex channels within the nuclear envelope that allow substances to enter and exit the nucleus.

nucleolus: a dense region within the nucleus where ribosomal RNA is produced.

nucleotide: a molecule which links with other nucleotides to form nucleic acids such as deoxyribonucleic acid (DNA) and ribonucleic acid (RNA).

nucleus, **nuclei** (pl.): usually the largest and most noticeable double membrane bound organelle; functions to house most of the genetic information of an organism.

organ: a group of tissues working together to carry out a particular function.

organelle: a small structure within a cell that is membrane bound and contains a fluid different in composition than the cytosol.

organism: anything that is alive.

organ system: a group of organs which work together to perform a particular function.

phospholipid: a special lipid found in all cellular membranes that contains both a polar and a non-polar region.

photosynthesis: the process by which plants convert energy from the sun into carbohydrates.

plasma membrane: a bilayer of phospholipids, proteins, and carbohydrates which forms the outermost layer of animal cells and the layer just inside the cell wall of plant cells; functions to contain the cell's contents as well as regulate what substances enter and exit the cell.

plastid: a membrane bound organelle found in certain eukaryotes, most notably plants; functions include food production and storage.

polar: possessing the chemical property of being attracted to electrically charged chemicals such as water.

prokaryotes: single-cell bacteria that do not have their genetic information contained within a nuclear membrane.

protein: a type of macromolecule that is made of many amino acids linked in a specific sequence.

ribosomal RNA: the type of RNA that is produced in the nucleolus and used as part of a ribosome.

ribosome: a small cellular particle, made of two subunits of RNA and proteins, that is often attached to the endoplasmic reticulum; functions as the site where protein production takes place.

ribonucleic acid (RNA): a macromolecule of nucleotides whose structure is determined by the DNA from which it is produced; functions to use the genetic information of DNA to produced proteins.

Schleidan, **Matthias** - (1804 - 1881): a German scientist who concluded that all plants were composed of cells.

Schwann, **Theodor** - (1810 - 1882): a German biologist who concluded that all animals were composed of cells.

specialized cell: a cell that performs a specific and unique function in a multicellular organism.

tissue: a group of similar cells working together to perform a specific function.

unicellular: made of only one cell.

van Leeuwenhoek, **Anton** - (1632 - 1723): A Dutch naturalist known in the scientific community as one of the first microscope makers.

Vesicle: any small, membrane bound organelle used to transport or store cellular material.

Virchow, Rudolf - (1821 - 1902): a German physician credited with proposing that all cells are produced from pre-existing cells through cell division.