

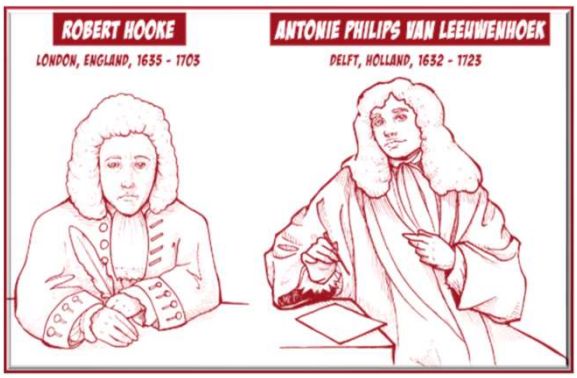
Cells are the basic building blocks of all living things. The human body is composed of trillions of cells. If you could peek inside of any cell in your body, you'd find it is a remarkable hub of activity. Whether you are awake or sleeping, energy is being transformed inside your cells, changing forms as molecules undergo the connected chemical reactions that keep you alive and functional. Cells are constantly carrying out thousands of chemical reactions needed to keep the cell and your body as a whole alive and healthy. These chemical reactions are often linked together in chains or pathways. All of the chemical reactions that take place inside of a cell are collectively called the cell's metabolism.

Welcome to the first lesson. Here we talk about the cell and the concept of metabolism. It lays the groundwork for an understanding of respiration and perfusion.

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Discovery of Cells

- Robert Hooke – 1665
  - ✓ Observed a piece of bottle cork
  - ✓ Named the "rooms" as cells
- Anton Van Leeuwenhoek
  - ✓ Noted cells exhibited motility
  - ✓ Concluded cell were "alive"
  - ✓ Entities were named animalcules
- Robert Brown – Scottish botanist
  - ✓ First insights into cell structure



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The Discovery of cells is one of the remarkable advancements in the field of science. It helps us know that all organisms are made up of cells, and these cells help in carrying out various life processes. The structure and functions of cells helped us to understand life in a better way.

Robert Hooke discovered the cell in 1665. He observed a piece of bottle cork under a compound microscope and noticed minuscule structures that reminded him of small rooms. Consequently, he named these "rooms" as cells. However, his compound microscope had limited magnification, and hence, he could not see any details in the structure. Owing to this limitation, Hooke concluded that these were non-living entities.

Later, Anton Van Leeuwenhoek observed cells under another compound microscope with higher magnification. This time, he had noted that the cells exhibited some form of movement. As a result, Leeuwenhoek concluded that these microscopic entities were "alive." Eventually, after a host of other observations, these entities were named animalcules.

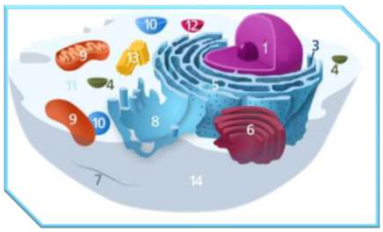
In 1883, Robert Brown, a Scottish botanist, provided the very first insights into the

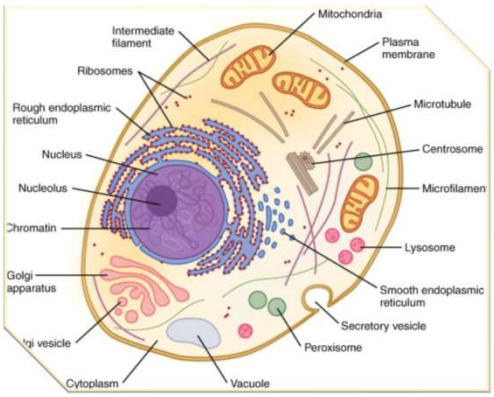
cell structure. He was able to describe the nucleus present in the cells of orchids.

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CELL STRUCTURE

- Three main parts:
  - ✓ The cell membrane
  - ✓ Nucleus
  - ✓ Cytoplasm





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There are hundreds of different types of cells in the human body, which vary in shape and size. All cells have three main parts: the cell membrane, the nucleus, and, between the two, the cytoplasm.

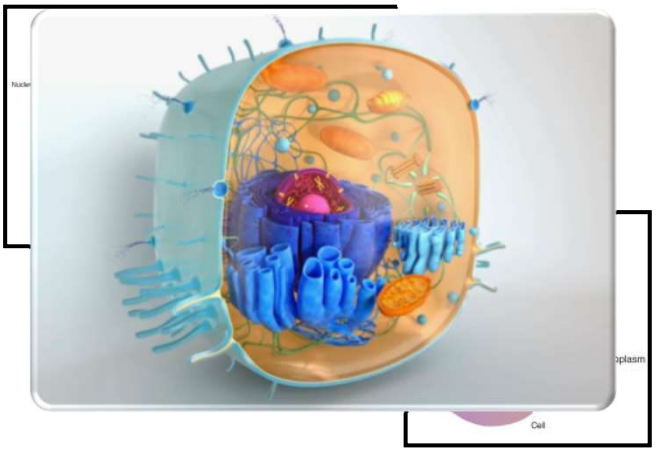
The image on the left is a 3-D representation of a simple human cell. The top half of the cell volume was removed. Number 1 shows the nucleus, numbers 3 to 13 show different organelles immersed in the cytosol, and number 14 on the surface of the cell shows the plasma membrane.

The image on the right is a typical example of a cell containing the primary organelles and internal structures.

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CELL STRUCTURE (CONT.)

- Cell membrane – Regulates what can pass in and out of the cell
- Cytoplasm – Contains structures that consume and transform energy
- Nucleus – Controls cell division and reproduction
- Mitochondria – Provide cell with energy
- Cytoplasmic organelles – Little organs suspended in the cytoplasm

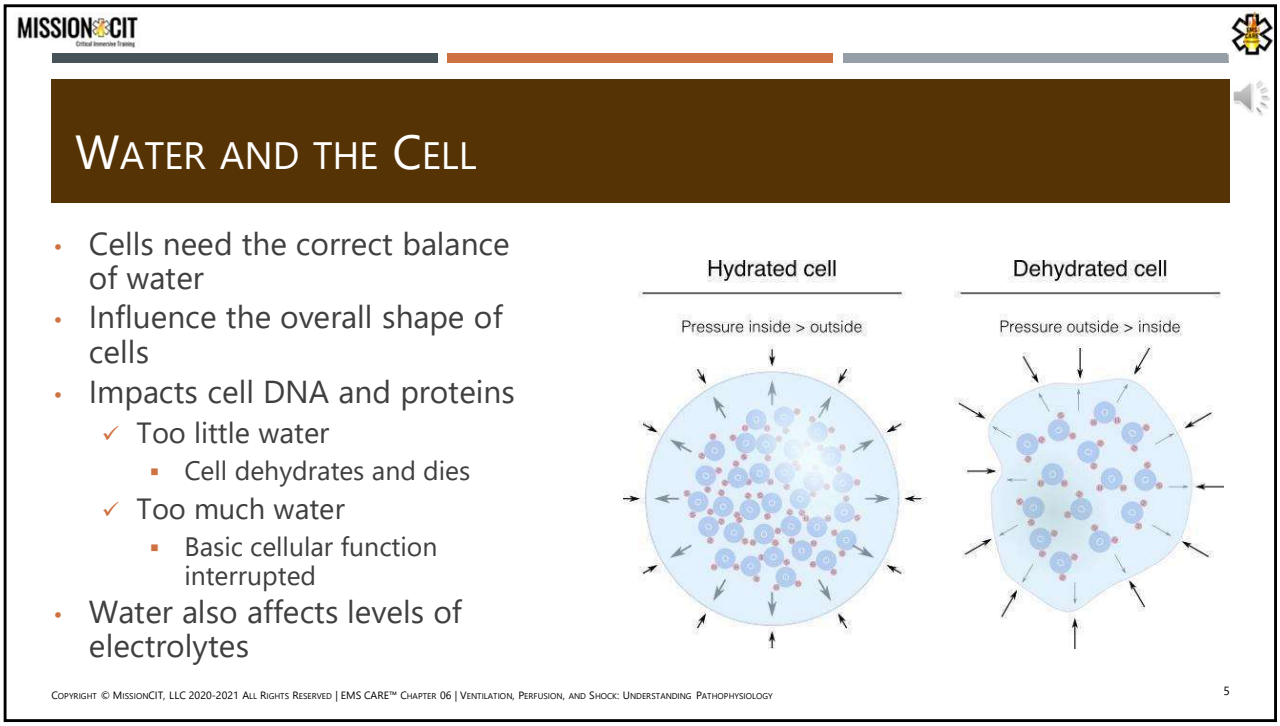


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Now, let us briefly discuss the parts of the cell:

1. The plasma membrane (often called the cell membrane) is a thin flexible barrier that separates the inside of the cell from the environment outside the cell and regulates what can pass in and out of the cell.
2. The cytoplasm contains structures that consume and transform energy and perform the cell's functions, and finally
3. The nucleus contains the cell's genetic material and the structures that control cell division and reproduction.

Mitochondria are tiny structures inside every cell that provide the cell with energy. Cytoplasmic organelles are "little organs" that are suspended in the cytoplasm of the cell. Each type of organelle has a definite structure and a specific role in the function of the cell.



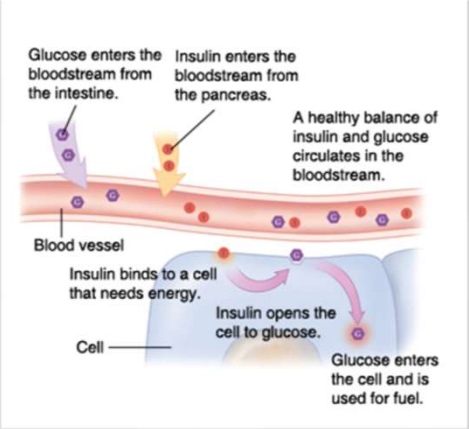
Cells require the correct balance of water. Visually, water fills cells to help maintain shape and structure. The water inside many cells (including those that make up the human body) creates pressure that opposes external forces, similar to putting air in a balloon. Water also contributes to the formation of membranes surrounding cells. In addition to influencing the overall shape of cells, water also impacts some fundamental components of every cell, such as DNA and proteins.

With too little water; the cell dehydrates and dies. With too much water; basic cellular function is interrupted.

Water also affects the levels of electrolytes by Impacting electrical functions.

Glucose and the Cell

- Building blocks for energy
- Supply of insulin must match the body's glucose requirement
- Cellular respiration – Process in which cells in the body, get energy from glucose
- ATP – A small molecule that give cells a way to store energy

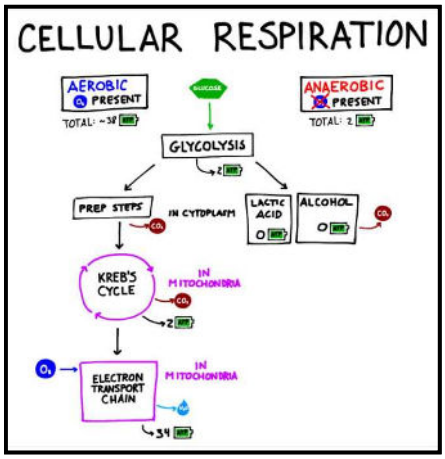


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Glucose is the building block for energy. Note that the supply of insulin must match the body's glucose requirement. Most of the cells in your body, get energy from glucose in a process called cellular respiration. During this process, a glucose molecule is broken down gradually, in many small steps. Breaking down glucose releases energy, which is captured by the cell in the form of adenosine triphosphate, or ATP. ATP is a small molecule that gives cells a convenient way to store energy briefly. Once it's made, ATP can be used by other cell reactions as an energy source.

Aerobic and Anaerobic Respiration

- Aerobic metabolism system uses oxygen
- Anaerobic metabolism system does not
- Both systems occur simultaneously
- Dominance of system depends on amount of muscle oxygen



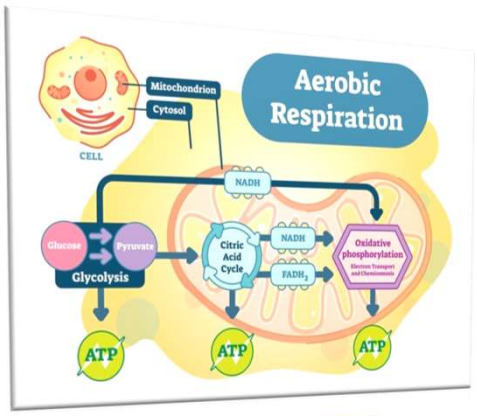
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The body is dependent upon two processes to create energy, aerobic and anaerobic metabolism. Simplified, the aerobic metabolic system uses oxygen, while the anaerobic system does not; however, oxygen plays a vital role in allowing the body to function under both systems.

Both the aerobic and anaerobic systems occur simultaneously; there is no switching from one to the other. Whether the aerobic or the anaerobic system is dominant depends on the amount of muscle oxygen available. The term muscle oxygen refers to the balance between the supply and demand of oxygen in the muscle.

Aerobic Respiration

- Aerobic metabolism
  - ✓ Fuels energy needed for long duration activity
  - ✓ Function uses Krebs Cycle
  - ✓ Relies on circulatory system to transport oxygen before it creates ATP



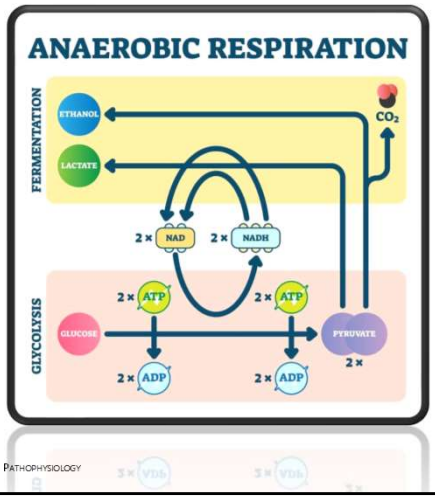
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Aerobic metabolism fuels most of the energy needed for long-duration activities. The aerobic metabolic system functions using the Krebs Cycle, a complex series of chemical reactions that use oxygen to convert nutrients (carbohydrates, fats, and protein) to carbon dioxide and adenosine triphosphate (ATP), an energy-rich compound.

Aerobic metabolism relies on the circulatory system to transport oxygen to the working muscles before it creates ATP.

Anaerobic Respiration

- Anaerobic metabolism
  - ✓ Occurs when oxygen demands of muscle tissue exceed the capacity of circulation
  - ✓ If oxygen debt becomes too high, muscle cannot function
  - ✓ Muscle recovers with oxygen-rich blood



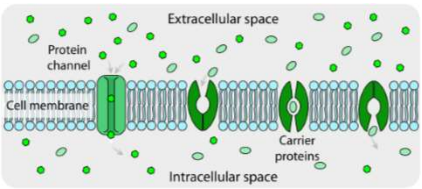
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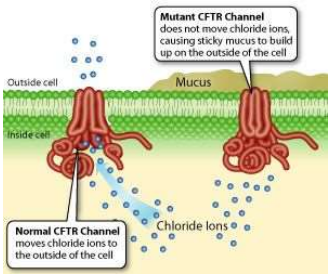
Anaerobic metabolism, on the other hand, occurs during short bursts of high-intensity exercise, when the oxygen demands of muscle tissue exceed the capacity of the circulation to supply, creating oxygen debt. If the oxygen debt becomes too high, the muscle is no longer able to function. The only way to recover the muscle is to provide it with oxygen-rich blood to oxygenate the excess lactic acid. This is usually achieved during a recovery period in a workout.

Many people confuse the concepts of blood lactate and lactic acid. Lactate is produced as a byproduct of the energy system but is completely harmless; in fact, it is used as fuel by the heart and muscles. Even at rest, the body produces lactate, though quantities increase with exercise. Lactic acid, however, is a byproduct of lactate buildup and causes acidosis to increase in the system.

The Vulnerability of Cells, Organs, and Organ Systems

- Diseases alter the permeability of membrane
- Ineffective cell membrane can allow substances into the cell
- These substances can interfere with the regulation of water





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Many diseases alter the permeability of the cell membrane. An ineffective cell membrane can allow substances into the cell that should not be there. These substances can interfere with the regulation of water.

Cell Membrane Video

- Cell membrane provides protection for a cell
- Provides fixed environment within
- Functions:
  - ✓ Transport nutrients into the cell
  - ✓ Transport toxic substances out of the cell
  - ✓ Proteins on it interact with other cells



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The last part of this lesson is a 3-D video of the Cell Membrane. The plasma membrane, or the cell membrane, protects a cell. It also provides a fixed environment inside the cell, and that membrane has several different functions. One is to transport nutrients into the cell and also to transport toxic substances out of the cell. Another is that the membrane of the cell, which would be the plasma membrane, will have proteins on it that interact with other cells.

On this note, we complete the first lesson, and Justin will take you through the next that will talk about the Cardiopulmonary System.