

CELLS: THE BASIC UNITS OF STRUCTURE

Discovering Cells

For the majority of human history we have not been able to see things that are on a small scale. In the late 16th century, that all changed with the invention of the **microscope**.

It wasn't until almost 100 years after the invention of the microscope that Robert Hooke discovered and named the cell by looking at a thin slice of cork.



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Anton van Leeuwenhoek discovered single celled organisms which he appropriately named animalcules.

Matthias Schleiden concluded that all plants were made up of cells and Theodor Schwann concluded that all animals were made up of cells. Both discoveries lead to the development of the cell theory.

The Cell Theory

The cell theory was developed in response to the discoveries of Schleiden and Schwann.

The cell theory declares that:

- Cells are produced from other living cells
- All living organisms are made up of cells, and that
- Cells are the basic building blocks of all living organisms.

Important Technologies

The **light microscope** not only makes things look larger, but it also shows the object in detail. Without good magnification and sharp resolution, the light microscope would have been useless.

Magnification is when an object is made to look bigger. **Resolution** is when an object is made to appear more clearly. An image that has sharp or high resolution is not blurry and details of the image are very clear. This is very important in scientific research.

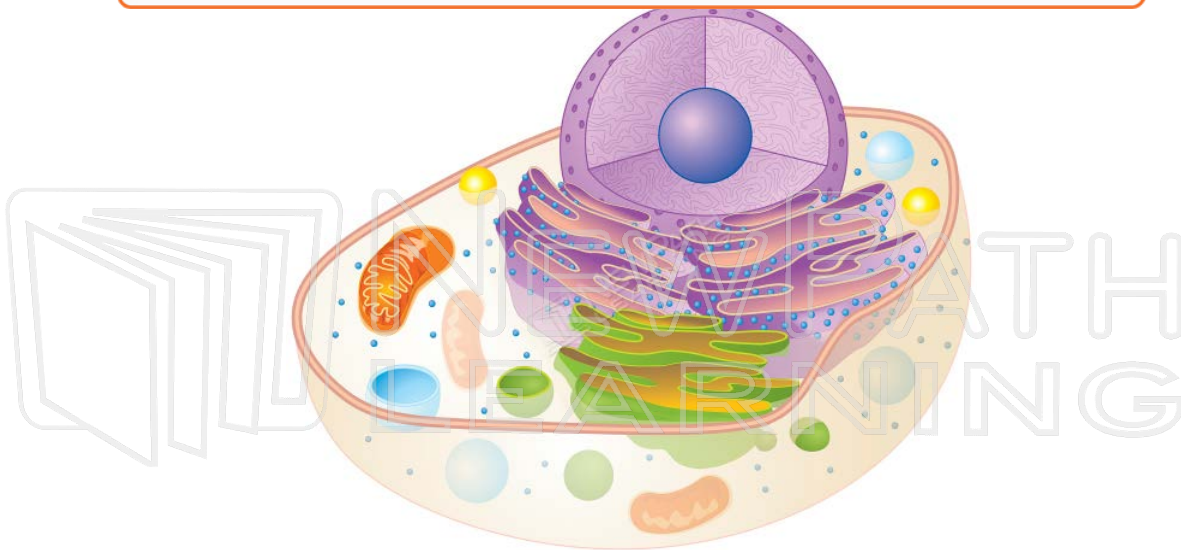
Electron Microscope

The electron microscope was first developed in the 1930's. An electron microscope uses a beam of incredibly small particles called electrons to create a very clear image.



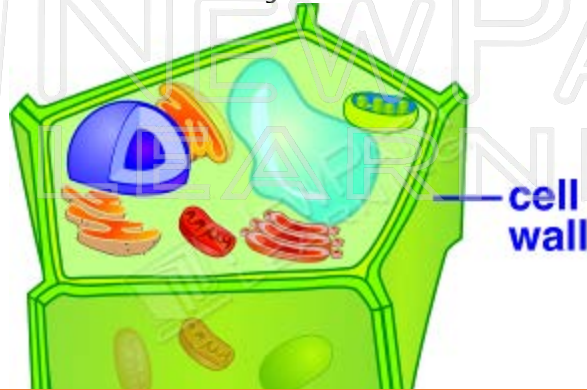
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The cell's organelles

The **cell wall** is a rigid outer layer of plant cells and certain other living organisms. Inside the cell wall is a layer called the **cell membrane**, which is the outer layer of all animal cells.



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The **cytoplasm** is a substance outside the nucleus where the cell's organelles are held. It is made almost entirely of water.

The organelles that are located in the cytoplasm are:

- The **chloroplast** captures energy from the sun and converts it into food and is only found in plant cells.
- The **endoplasmic reticulum** is the transport system that takes different materials around the cell.

- The **Golgi bodies** direct the different materials made in the cell to where they need to go.
- The **lysosomes** break down food molecules and old cell parts to be used for energy production.
- The **mitochondria** is a rod-like structure that produces most of the energy that is used by the cell.
- The **ribosome** is an organelle that produces proteins.
- The **vacuoles** are used for storing materials from the cell.

Plant and Animal Cell Differences

Plant and animal cells are very similar with cellular structures, but vary in two major aspects.

Plant cells contain **chloroplasts** that give the cells their green color. Chloroplasts are the organelles that capture energy from the sun and

convert it into energy that the cell can use. This process is called photosynthesis. This process has two main stages: light-dependent reactions and the Calvin cycle.

Light-dependent reactions occur in the thylakoid membranes of the chloroplasts. During these reactions, light energy is used to split water molecules into oxygen and hydrogen ions. The oxygen is released as a byproduct, and the hydrogen ions are used to create a proton gradient across the thylakoid membrane. This gradient is used to drive the synthesis of ATP, a molecule that stores energy for use in the Calvin cycle.

The Calvin cycle occurs in the stroma of the chloroplasts. During this cycle, carbon dioxide from the atmosphere enters the cell and is fixed into a three-carbon compound. This compound is then reduced to a three-carbon sugar, which can be used for energy or stored as starch. The Calvin cycle also produces a byproduct called NADPH, which is used in the light-dependent reactions.

Photosynthesis is a vital process for all living organisms. It provides the oxygen that we breathe and the food that we eat. Without photosynthesis, life on Earth would not be possible.

Plant cells also have a cell wall, which provides structural support and protection. Animal cells do not have a cell wall. Plant cells also have a large central vacuole, which helps maintain the cell's shape and turgor pressure. Animal cells do not have a large central vacuole.

Plant cells also have chloroplasts, which are organelles that capture light energy and convert it into chemical energy. Animal cells do not have chloroplasts. Plant cells also have a nucleus, which contains the cell's genetic material. Animal cells also have a nucleus.

Plant cells also have a cell membrane, which is a thin layer of phospholipids that surrounds the cell. Animal cells also have a cell membrane. Plant cells also have a Golgi apparatus, which is a stack of membrane-bound sacs that transport and process proteins. Animal cells also have a Golgi apparatus.

Plant cells also have a cytoskeleton, which is a network of protein fibers that provides structural support and helps with cell movement. Animal cells also have a cytoskeleton. Plant cells also have a cell plate, which is a structure that forms during cell division. Animal cells do not have a cell plate.

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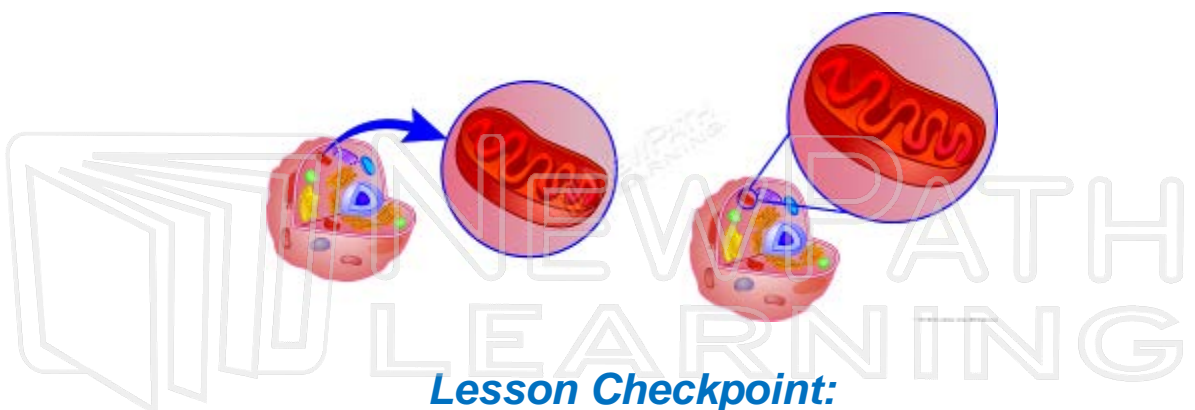
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Lesson Checkpoint:
What are the two key differences between plant and animal cells?