

Development of the **Cell Theory**....

The invention of the microscope just over 300 years ago opened our eyes to a whole new microscopic world, and we realized eventually that ALL life is made up of cells.

Over time, four big hypotheses were developed, that together make up the “Cell Theory”...(1858)

- all life is made up of one or more cells
- cells are the basic unit of life
- all cells come from pre existing cells
- in multicellular creatures, cells work together for the survival of all

ALL cells come from pre existing cells ?

Prior to the 1850's, people thought life could come from nonliving things (idea called spontaneous generation) aka “abiogenesis”.

The idea that life can only come from other life is called biogenesis.

Lets look at work carried out by a number of scientists involved with this longstanding debate....

Francesco Redi - 1668

One of the first controlled experiments ever documented.....places meat samples in jars, one covered, the other uncovered, maggots appear in the uncovered meat after several days. Concluded flies must access the meat and lay eggs in order for maggots to form, they do not form spontaneously !

John Needham - 1748

Boiled meat broth to sterilize it, then placed it into jars, seals some, leaving other jars open. Days later, all jars full of microorganisms.... supported abiogenesis.

Lazzaro Spallanzani -

Redoes Needham's work, only this time boils the broth longer and sterilizes the jars better. Microorganisms only grow in the open jars. Critics say he didn't allow air's "vital force" to access the sealed broth...necessary for life to form spontaneously.

Louis Pasteur (1822-1895) -

Ends the debate, proves biogenesis correct, abiogenesis wrong. Creates a long S - neck glass flask, into which he places meat broth and boils it. The s- shaped neck “trap” prevented microorganisms from reaching the broth, so it remained clear and unspoiled while also allowing air to get in.

Disproved the “vital force” theory, and proved that microorganisms come from other microorganisms, and food spoilage happens when microorganisms contaminate and multiply.

Pasteur’s experiment proved that microorganisms exist in air and water, they DO NOT spontaneously generate. Biogenesis became the widely accepted theory on the origin of life by the end of the 1800's.

Scientists began using newly refined microscopes (up to 2000 x magnification) to explore this new world of microorganisms. Significant contributions were made by....

Robert Hooke -

1665 publishes “Micrographia”, containing drawings of cork....shows little rooms he calls “cells”

Antony van Leeuwenhoek -

1666 designs his own high quality single lens microscopes, 6x better than anyone else

The first to observe moving “animalcules”

1683 discovers bacteria on teeth plaque

Matthias Schleiden -

1838.....all plants are made of cells

Theodor Schwann -

1839.....all animals are made of cells

Rudolf Virchow -

1858.....cells come from pre existing cells, and make up tissues, organs, systems, and then individuals

Structures In Cells..."Organelles" (page 23)

All living cells have to build and maintain structures that enable them to carry out basic life functions....

- get food and make energy
- make chemicals to maintain themselves
- chemical reactions
- get rid of waste
- reproduce
- keep genetic records of how to get this stuff done

Cells are classified into two giant groups...

Prokaryotic cells

Eukaryotic cells

PROKARYOTIC CELLS

(or prokaryotes)

*the largest group of unicellular organisms classified
and the oldest species ever discovered*

- pretty simple internal structure, with no real membrane bound organelles
- found everywhere (2B in 1g of good soil !), because they use a wide variety of foods and efficient but limited chemistry
- no true nucleus, their genetic material (a single loop of DNA) is spread throughout the cell (forms a “nucleoid” or “plasmid”...a darker region that isn't surrounded by a membrane)
- they are surrounded by a cell wall made of a unique substance called peptidoglycan and an outer protective slime layer called a capsule.
- some have thylakoids, a structure that allows them to carry out photosynthesis, and flagella for movement

Ex. Any member of Kingdoms Archea, Monera, and some of Protista

EUKARYOTIC CELLS

(or eukaryotes)

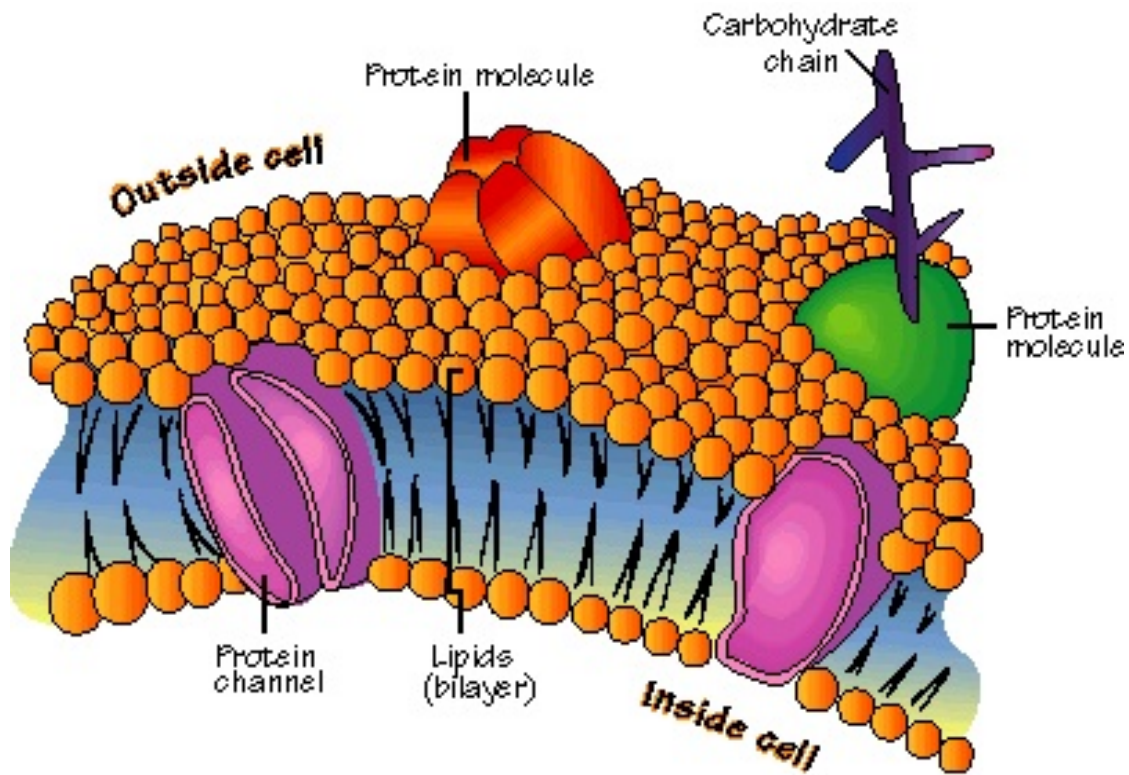
considered more highly evolved, they contain many smaller organs (organelles) inside, each surrounded by a membrane

- **organelles** carry out specific jobs inside a cell, could be specific chemical reactions, or building complicated molecules
- Each is surrounded by a membrane, separating some parts of the cell from others, so the chemistry inside isn't interfered with (ex. Lysosomes....bubble looking things that contain digestive enzymes....if let loose, would attack and destroy the cell)

Organelles typically found in cells...

Cell membrane.....

- separates inside from outside, controls what gets in and out
- defines the shape of the cell
- is somewhat flexible
- a double layer (**bilayer**) of fatty molecules with phosphates attached (**phospholipids**)
- large proteins embedded in it act as gates in and out
- molecules with specific shapes on the outside are used to recognize each other (**antigens**)



- cholesterol allows the cell membrane to stay together at higher temperatures, and still be fluid at lower temperatures, also serves to keep a lot of molecules outside unless they are specifically wanted by the cell.
- responsible for maintaining internal homeostasis...
 - it is selectively permeable
 - moves molecules in or out, or can collect certain molecules and keep them in the intracellular fluid (maintain a concentration gradient)

Liquid Environment :

Cytoplasm...

gel like liquid filling up the cell's interior, giving it its shape, and contains many dissolved substances

Supervision :

Nucleus...

largest solid organelle, the brain and instruction center of the cell...contains DNA (uncoiled...chromatin), which acts like a recipe book to tell the cell how to build and maintain everything it needs.

Nucleolus

Area containing a dense concentration of **chromatin** (uncoiled genetic material), helps the cell make "ribosomes"

Making large molecules :

Ribosomes

Make proteins from DNA instructions. These protein molecules may be partially finished inside another organelle, or stored inside the cell, or shipped outside using another organelle.

Endoplasmic reticulum

look like flat sacs or tunnels, make fat and protein molecules ready for shipment to other cells. Chemistry inside is kept separate from the rest of the cell.

2 kinds of E.R. : **smooth and rough** (the rough stuff has ribosomes stuck all over its surface) smooth stuff can pinch off (vesicle)and transport molecules to the membrane.

Golgi apparatus / Golgi body :

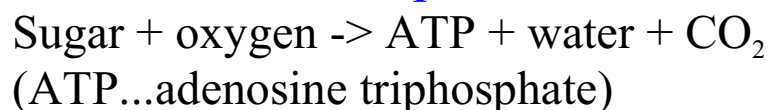
receives unfinished chemicals from the ER, and puts the finishing touches on fats and proteins, gets them ready for shipment around or out of the cell. Sections with finished molecules can pinch off (vesicle), move to the membrane, and secrete their product into the extracellular liquid.

Making Energy :

Mitochondria :

place where carbohydrates (sugars) are broken down (burned with oxygen) to make energy. Inner folds....cristae.. Survive for hours or days.

Process is called **cell respiration**....



They contain their own ribosomes, DNA, and reproduce themselves like simple bacteria.

Chloroplasts (plant cells only)...

Site of photosynthesis . Contains the green chemical chlorophyll that captures light and makes carbohydrates. Can also store starches, fats, and proteins. Have their own DNA and can reproduce themselves (symbiosis ?)

Temporary Storage :

lysosomes...

Container / bubble/ vesicle stores the cells digestive enzymes safely, moving them to the membrane and out

peroxisomes...

A type of vesicle in the cytoplasm that contains strong enzymes for breaking apart fats and alcohol.

centrosomes...

Organizes the cells skeleton (the microtubules) and makes sure stuff is divided evenly when the cell reproduces

vacuole....

Fluid filled sac that temporarily stores molecules until they are used

plastids (plants only)...

Storage of fats, proteins, and starches, with their own DNA and ribosomes. Reproduce themselves like simple bacteria.

Cell Shape :

cytoskeleton...(bundles of “microtubules”)

Provides the structure of the cell...holding organelles in place and holds stuff together....strands of protein that are made / broken within minutes. Evenly divides cell contents when the cell is copying itself and divides into two new daughter cells during mitosis (cell division).

cell wall (plant cells only).....

rigid cellulose structure surrounding plant cells.... provides the plant with support so it can stand upright

Cell Movement :

cilia / flagella....

structures made of bundles of centrioles that move cells through liquids.

Plant vs animal cells :

- shape
- large, central vacuole
- chloroplasts
- rigid cellulose wall

