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# Review Facts About Living Things



## What Are the Main Characteristics of organisms?

1. Made of CELLS
2. Require ENERGY (food)
3. REPRODUCE (species)
4. Maintain HOMEOSTASIS
5. ORGANIZED
6. RESPOND to environment
7. GROW and DEVELOP
8. EXCHANGE materials with surroundings (water, wastes, gases)



## LEVELS OF ORGANIZATION

Nonliving Levels:

1. ATOM (element)
2. MOLECULE (compounds like carbohydrates & proteins)
3. ORGANELLES (nucleus, ER, Golgi …)

## LEVELS OF ORGANIZATION

Living Levels:

1. CELL (makes up ALL organisms)
2. TISSUE (cells working together
3. ORGAN (heart, brain, stomach …)
4. ORGAN SYSTEMS (respiratory, circulatory …)
5. ORGANISM



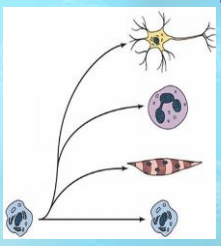

## LEVELS OF ORGANIZATION

Living Levels continued:

1. POPULATION (one species in an area)
2. COMMUNITY (several populations in an area
3. ECOSYSTEM (forest, prairie …)




## History of Cells & the Cell Theory

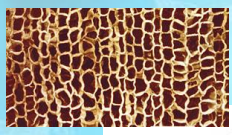


Cell Specialization




## First to View Cells

- In 1665, Robert Hooke used a microscope to examine a thin slice of cork (dead plant cell walls)
- What he saw looked like small boxes



## CELL THEORY

- All living things are made of cells
- Cells are the basic unit of structure and function in an organism (basic unit of life)
- Cells come from the reproduction of existing cells (cell division)




## Cell Size and Types

- Cells, the basic units of organisms, can only be observed under microscope
- Three Basic types of cells include:

Animal Cell

Plant Cell

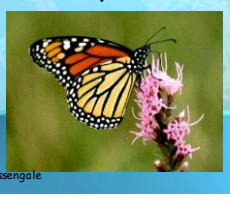
Bacterial Cell




## Number of Cells

Although ALL living things are made of cells, organisms may be:

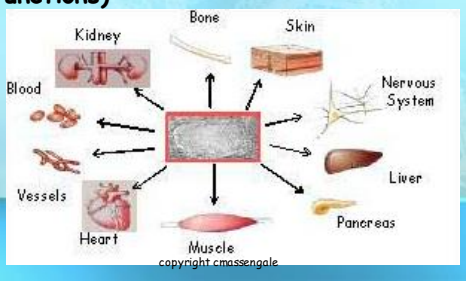
- *Unicellular* – composed of one cell
- *Multicellular*- composed of many cells that may organize into tissues, etc.





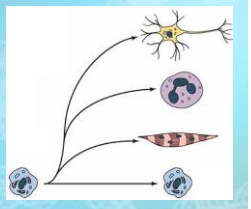

## Multicellular Organisms

- Cells in multicellular organisms often specialize (take on different shapes & functions)



## Cell Specialization

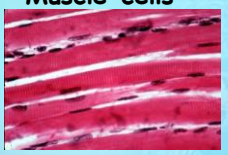
- Cells in a multi-cellular organism become specialized by turning different genes on and off
- This is known as DIFFERENTIATION





## Specialized Animal Cells

Muscle cells



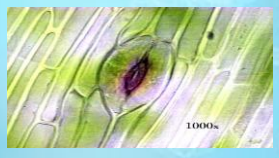
Red blood cells

Cheek cells



## Specialized Plant cells

Guard Cells



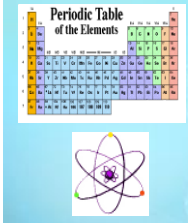

Pollen

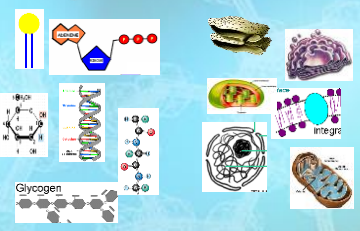


## Organization Levels of Life

*Atoms to Organisms*

## Nonliving Levels

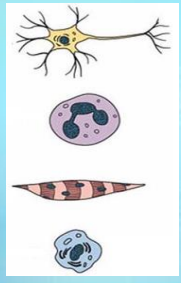


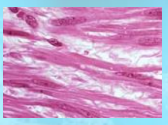




ATOMS → MOLECULES → ORGANELLES



## Living Levels

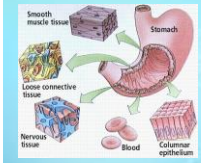


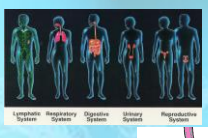


CELLS – life starts here → TISSUES – Similar cells working together



## More Living Levels



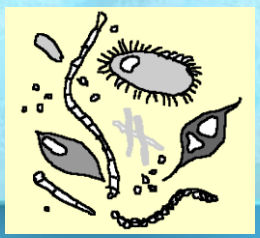
ORGANS → ORGAN SYSTEMS → ORGANISM

Different tissues working together

Different organs working together

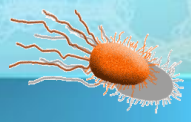


## Simple or Complex Cells



## Prokaryotes – The first Cells

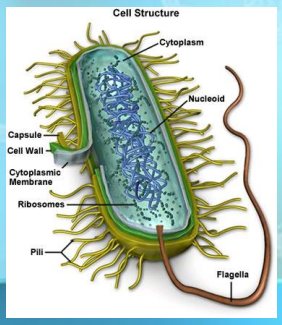
- Cells that lack a nucleus or membrane-bound organelles
- Includes bacteria
- Simplest type of cell
- Single, circular chromosome





## Prokaryotes

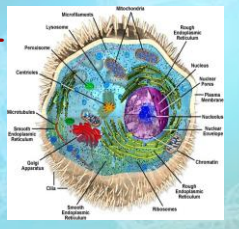
- Nucleoid region (center) contains the DNA
- Surrounded by cell membrane & cell wall (peptidoglycan)
- Contain ribosomes (no membrane) in their cytoplasm to make proteins






## Eukaryotes

- Cells that HAVE a nucleus and membrane-bound organelles
- Includes fungi, plants, and animals
- More complex type of cells

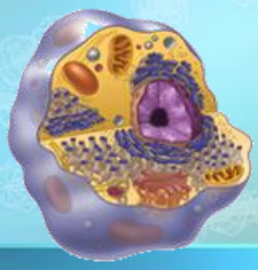




## Eukaryotic Cell

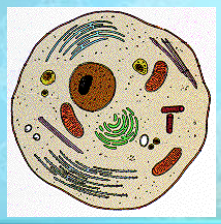
Contain 3 basic cell structures:

- Nucleus
- Cell Membrane
- Cytoplasm with organelles



## Two Main Types of Eukaryotic Cells

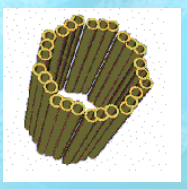
Plant Cell



Animal Cell



## Organelles



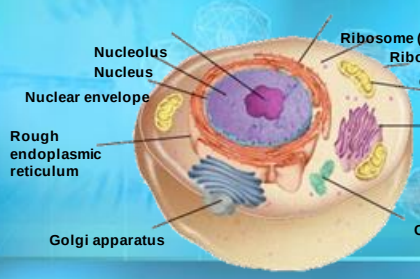


## Organelles

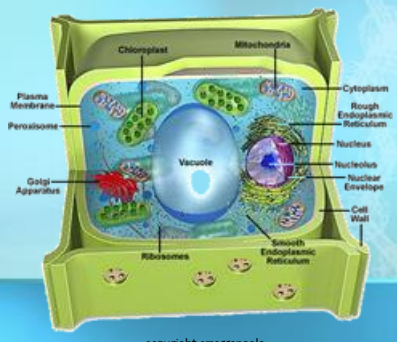
- Very small (Microscopic)
- Perform various functions for a cell
- Found in the cytoplasm
- May or may not be membrane-bound



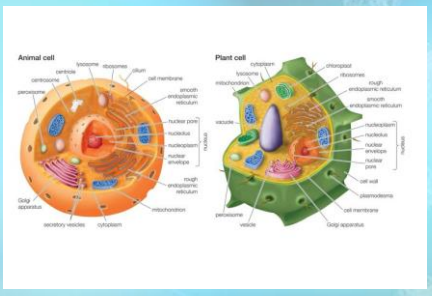
## Animal Cell Organelles



## Plant Cell Organelles



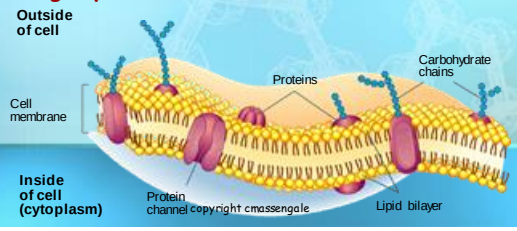





## Cell or Plasma Membrane

- Composed of double layer of phospholipids and proteins
- Surrounds outside of ALL cells
- Controls what enters or leaves the cell
- Living layer






Membrane proteins are proteins that interact with, or are part of, biological membranes

They include
- integral membrane
- peripheral membrane proteins

The integral membrane proteins are classified as

- Transmembrane (cell marker) proteins that span across the membrane
- integral monotopic proteins that are attached to only one side of the membrane.



Membrane proteins are a common type of proteins along with soluble

- globular proteins (Water soluble)
- fibrous proteins (Water insoluble)
- disordered proteins



Why Important???

- Membrane receptor proteins relay signals between the cell's internal and external environments.
- Transport proteins move molecules and ions across the membrane. They can be categorized according to the Transporter Classification database.
- Membrane enzymes may have many activities, such as oxidoreductase, transferase or hydrolase

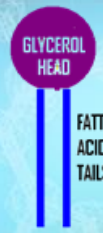


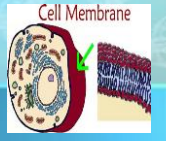
Why Important???

- They are targets of over 50% of all modern medicinal drugs.
- It is estimated that 20–30% of all genes in most genomes encode membrane proteins

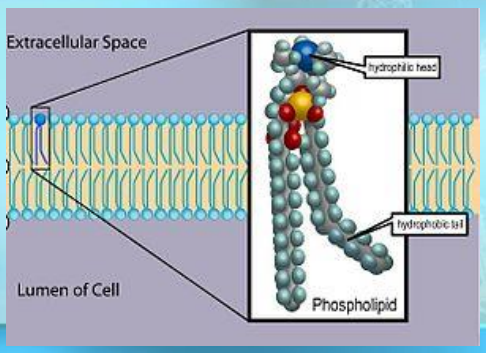
## Phospholipids

- Heads contain glycerol & phosphate and are hydrophilic (attract water)
- Tails are made of fatty acids and are hydrophobic (repel water)
- Make up a bilayer where tails point inward toward each other
- Can move laterally to allow small molecules ($O_2$, $CO_2$, & $H_2O$ to enter)

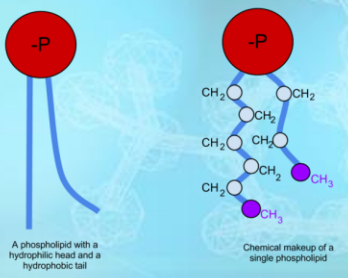




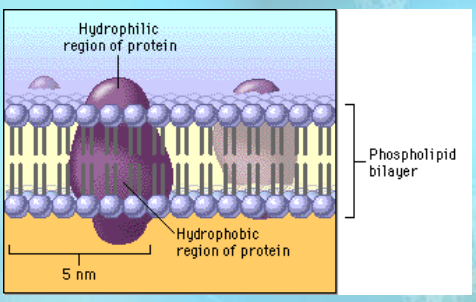








## The Cell Membrane is Fluid




Molecules in cell membranes are constantly moving and changing

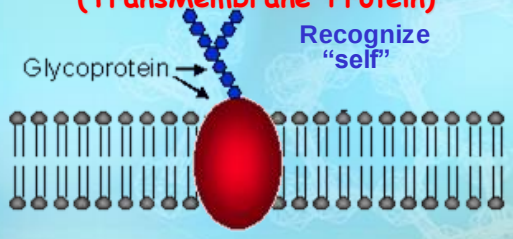
## Cell Membrane Proteins

- Proteins help move large molecules or aid in cell recognition
- Peripheral proteins are attached on the surface (inner or outer)
- Integral proteins are embedded completely through the membrane




## GLYCOPROTEINS

(TransMembrane Protein)

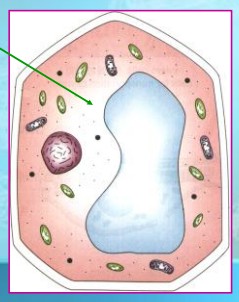



Glycoproteins have carbohydrate tails to act as markers for cell recognition




## Cytoplasm of a Cell

- Jelly-like substance enclosed by cell membrane
- Provides a medium for chemical reactions to take place

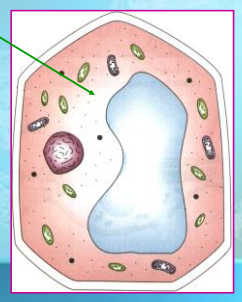






## More on Cytoplasm

- Contains organelles to carry out specific jobs
- Found in ALL cells

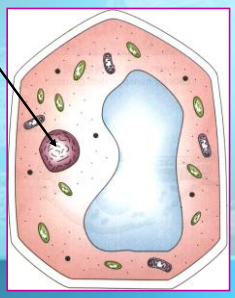


## The Control Organelle - Nucleus

- Controls the normal activities of the cell
- Contains the DNA in chromosomes
- Bounded by a nuclear envelope (membrane) with pores
- Usually the largest organelle



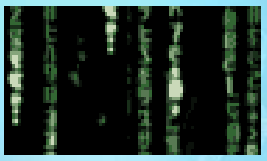

## More on the Nucleus




- Each cell has fixed number of chromosomes that carry genes
- Genes control cell characteristics




## What Does DNA do?



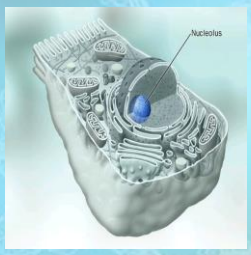
DNA is the hereditary material of the cell

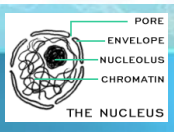

Genes that make up the DNA molecule code for different proteins




## Nucleolus

- Inside nucleus
- Cell may have 1 to 3 nucleoli
- Disappears when cell divides
- Makes ribosomes that make proteins



## Mitochondrion (plural = mitochondria)

- "Powerhouse" of the cell
- Generate cellular energy (ATP)
- More active cells like muscle cells have MORE mitochondria
- Both plants & animal cells have mitochondria
- Site of CELLULAR RESPIRATION (burning glucose)



## MITOCHONDRIA


Surrounded by a DOUBLE membrane

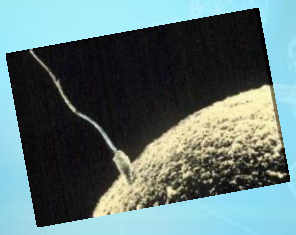
Has its own DNA

Folded inner membrane called CRISTAE (increases surface area for more chemical Reactions)

Interior called MATRIX



## Interesting Fact ---



- Mitochondria Come from cytoplasm in the EGG cell during fertilization

Therefore …

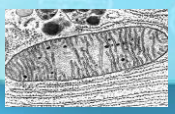
- You inherit your mitochondria from your mother!

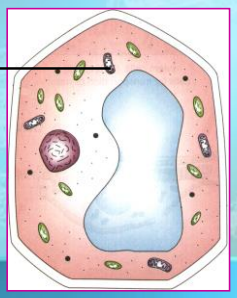


## Cell Powerhouse

Mitochondrion ( mitochondria )

Rod shape





## Differences in a Nutshell

1. Nuclear DNA is found inside the nucleus of the cell while mitochondrial DNA is found only in the mitochondria of the cell.

2. Nuclear DNA is linear in shape while mitochondrial DNA is circular in shape.

3. Nuclear DNA is longer as compared to the mitochondrial DNA which is shorter.



## Differences in a Nutshell

4. Nuclear DNA is inherited from the mother and father both whereas on the other hand the mitochondrial DNA is inherited from the mother only.

5. Nuclear DNA consists of forty six chromosomes while mitochondrial DNA consists of only one chromosome.

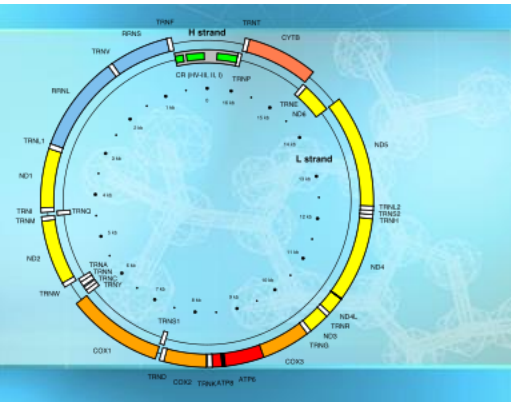


## Differences in a Nutshell

6. The nuclear DNA contains 20,000 to 25,000 genes while mitochondrial DNA contains only thirty seven genes.

7. The chromosomes in nuclear DNA are responsible genetic make-up of a human being while the chromosome of the mitochondrial DNA is responsible for the metabolic activities.

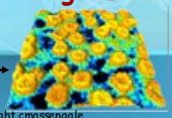


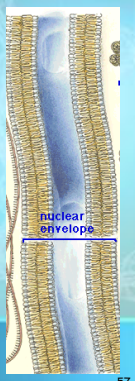


## Nuclear Envelope

- Double membrane surrounding nucleus
- Also called nuclear membrane
- Contains nuclear pores for materials to enter & leave nucleus
- Connected to the rough ER

Nuclear pores









## Inside the Nucleus -

The genetic material (DNA) is found


DNA is spread out
And appears as
CHROMATIN
in non-dividing cells

DNA is condensed & wrapped around proteins forming
as CHROMOSOMES
in dividing cells




1923 by Theophilus Painter
- counted 24 pairs

Until 1956!




The prokaryotes

Bacteria

1.3 M bp

Eukaryotes may have small circular or linear cytoplasmic chromosomes.



| Chromosome | Genes[14] | Total base pairs | % of bases | Sequenced base pairs[15] |
|---|---|---|---|---|
| 1 | 2000 | 247,199,719 | 8.0 | 224,999,719 |
| 2 | 1300 | 242,751,149 | 7.9 | 237,712,649 |
| 3 | 1000 | 199,446,827 | 6.5 | 194,704,827 |
| 4 | 1000 | 191,263,063 | 6.2 | 187,297,063 |
| 5 | 900 | 180,837,866 | 5.9 | 177,702,766 |
| 6 | 1000 | 170,896,993 | 5.5 | 167,273,993 |
| 7 | 900 | 158,821,424 | 5.2 | 154,952,424 |
| 8 | 700 | 146,274,826 | 4.7 | 142,612,826 |
| 9 | 800 | 140,442,298 | 4.6 | 120,312,298 |
| 10 | 700 | 135,374,737 | 4.4 | 131,624,737 |
| 11 | 1300 | 134,452,384 | 4.4 | 131,130,853 |
| 12 | 1100 | 132,289,534 | 4.3 | 130,303,534 |
| 13 | 300 | 114,127,980 | 3.7 | 95,559,980 |
| 14 | 800 | 106,360,585 | 3.5 | 88,290,585 |
| 15 | 600 | 100,338,915 | 3.3 | 81,341,915 |
| 16 | 800 | 88,822,254 | 2.9 | 78,884,754 |
| 22 | 500 | 49,528,953 | 1.6 | 34,893,953 |
| X (sex chromosome) | 800 | 154,913,754 | 5.0 | 151,058,754 |
| Y (sex chromosome) | 50 | 57,741,652 | 1.9 | 25,121,652 |
| **Total** | **21,000** | **3,079,843,747** | **100.0** | **2,857,698,560** |



## Endoplasmic Reticulum - ER

- Network of hollow membrane tubules
- Connects to nuclear envelope & cell membrane
- Functions in Synthesis of cell products & Transport

Two kinds of ER ---ROUGH & SMOOTH



## Rough Endoplasmic Reticulum (Rough ER)

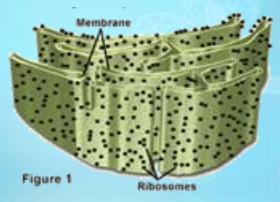
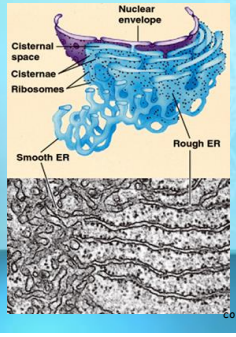


Figure 1

- Has ribosomes on its surface
- Makes membrane proteins and proteins for EXPORT out of cell

## Rough Endoplasmic Reticulum (Rough ER)

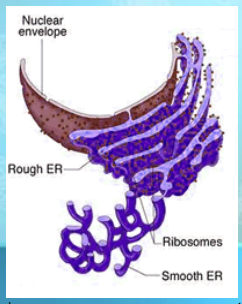



- Proteins are made by ribosomes on ER surface
- They are then threaded into the interior of the Rough ER to be modified and transported




## Smooth Endoplasmic Reticulum

- *Smooth ER* lacks ribosomes on its surface
- Is attached to the ends of rough ER
- Makes cell products that are USED INSIDE the cell





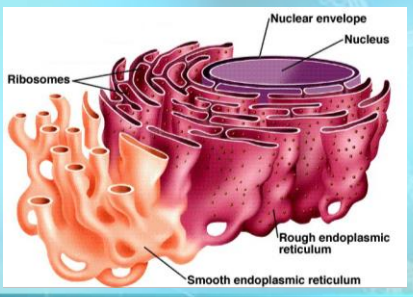


## Functions of the Smooth ER

- Makes membrane lipids (steroids)
- Regulates calcium (muscle cells)
- Destroys toxic substances (Liver)




## Endomembrane System




Includes nuclear membrane connected to ER connected to cell membrane (transport)

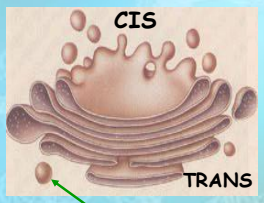
## Ribosomes

- Made of PROTEINS and rRNA
- "Protein factories" for cell
- Join amino acids to make proteins
- Process called protein synthesis




## Golgi Bodies

- Stacks of flattened sacs
- Have a shipping side (trans face) and receiving side (cis face)
- Receive proteins made by ER
- Transport vesicles with modified proteins pinch off the ends



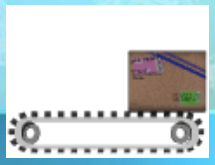

Transport vesicle



## Golgi Bodies

Look like a stack of pancakes

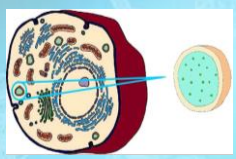
Modify, sort, & package molecules from ER for storage OR transport out of cell





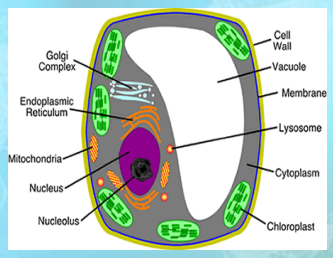
## Lysosomes

- Contain digestive enzymes
- Break down food, bacteria, and worn out cell parts for cells
- Programmed for cell death (AUTOLYSIS)
- Lyse (break open) & release enzymes to break down & recycle cell parts)



## Vacuoles

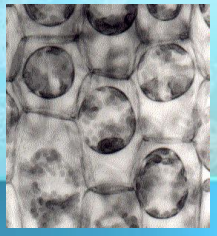
- Fluid filled sacks for storage
- Small or absent in *animal* cells
- *Plant* cells have a large Central Vacuole
- No vacuoles in *bacterial* cells






## Vacuoles

- In plants, they store Cell Sap
- Includes storage of sugars, proteins, minerals, lipids, wastes, salts, water, and enzymes





## Size

Animal cells are generally smaller than plant cells.
Animal cells range from 10 to 30 micrometers in length
Plant cells range from 10 and 100 micrometers in length.



## Shape

Animal cells come in various sizes and tend to have round or irregular shapes.
Plant cells are more similar in size and are typically rectangular or cube shaped.

## Proteins

Of the 20 amino acids needed to produce proteins, only 10 can be produced naturally in animal cells.
The rest are through diet.
Plants are capable of synthesizing all 20 amino acids.




## Differentiation

In animal cells, only stem cells are capable of converting to other cell types.
Most plant cell types are capable of differentiation.




## Growth

Animal cells increase in size by increasing in cell numbers.
Plant cells mainly increase cell size by becoming larger. They grow by absorbing more water into the central vacuole.




## Cell Wall

Animal cells do not have a cell wall but have a cell membrane.
Plant cells have a cell wall composed of cellulose as well as a cell membrane.

## Centrioles

Animal cells contain these cylindrical structures that organize the assembly of microtubules during cell division.

Plant cells do not typically contain centrioles.



## Cilia

Cilia are found in animal cells but not usually in plant cells. Cilia are microtubules that aid in cellular locomotion.



## Lysosomes

Animal cells possess lysosomes which contain enzymes that digest cellular macromolecules.
Plant cells rarely contain lysosomes as the plant vacuole handles molecule degradation.



## Plastids

Animal cells do not have plastids. Plant cells contain plastids such as chloroplasts, which are needed for photosynthesis.

## Energy Storage

Animals cells store energy in the form of the complex carbohydrate glycogen.

Plant cells store energy as **starch**.



## Vacuole

Animal cells may have many small vacuoles. Plant cells have a large central vacuole that can occupy up to 90% of the cell's volume.



| | |
|---|---|
| 1958 | Work on the structure of proteins, especially that of insulin |
| 1958 | Discovery that genes act by regulating definite chemical events |
| 1959 | Discovery of the mechanisms in the biological synthesis of ribonucleic and deoxyribonucleic acid |
| 1962 | Studies of the structures of globular proteins |
| 1962 | Discoveries concerning the molecular structure of nuclear acids and its significance for information transfer in living material |
| 1965 | Discoveries concerning genetic control of enzyme and virus synthesis |
| 1968 | Interpretation of the genetic code and its function in protein synthesis |
| 1969 | Discoveries concerning the replication mechanism and the genetic structure of viruses |
| 1975 | Discoveries concerning the interaction between tumour viruses and the genetic material of the cell |
| 1978 | Discovery of restriction enzymes and their application to problems of molecular genetics |
| 1980 | Contributions concerning the determination of base sequences in nucleic acids |
| 1983 | Discovery of mobile genetic elements |
| 1989 | Discovery of catalytic properties of RNA |
| 1993 | Discoveries of split genes |
| 2006 | Studies of the molecular basis of eukaryotic transcription |
| 2006 | Discovery of RNA interference - gene silencing by double-stranded RNA |
| 2009 | Studies of the structure and function of the ribosome |
| 2015 | Mechanistic studies of DNA repair |
| | |