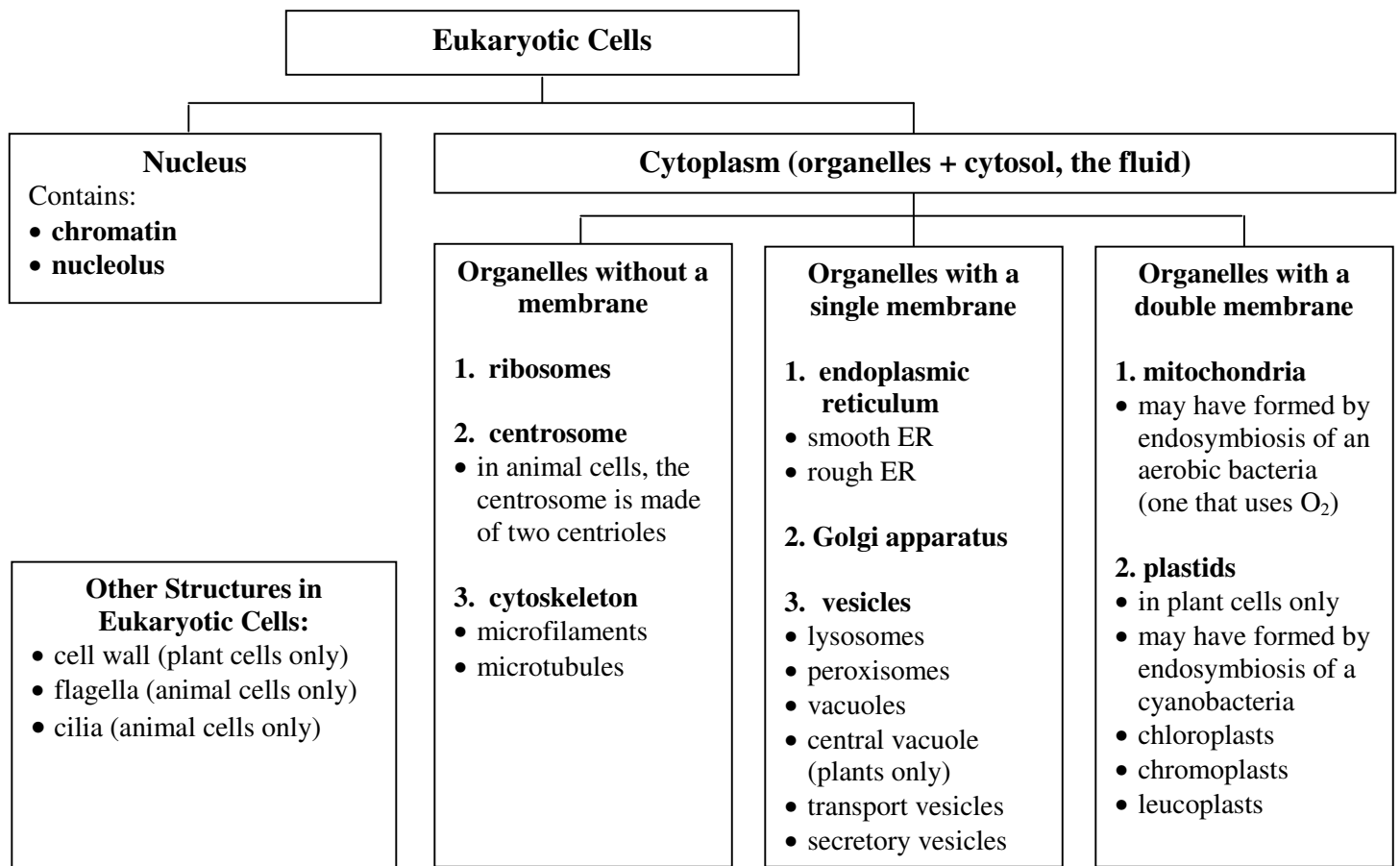


## Summary: Function and Structure of Cell Parts in Eukaryotic Cells



### Descriptions of Cell Parts and Functions

#### 1. Cytoplasm

- this includes the cytosol (see below) and the organelles, but does not include the nucleus

#### 2. Cytosol (also called the intracellular fluid, or ICF)

- a watery liquid inside the cell which contains a lot of proteins, salts, dissolved molecules, etc.
- the organelles are suspended in the cytosol

#### 3. Cell membrane (also called the plasma membrane)

- a “fluid mosaic” phospholipid bilayer, the middle region is hydrophobic (‘water fearing’)
- made of phospholipids, proteins and cholesterol
- separates the contents of the cell from its environment and controls the movement of substances into and out of the cell
- it is semi-permeable and selectively permeable because it allows only some substances to pass through while excluding others:
  - i) non-polar and very small polar molecules can move through it by simple diffusion from areas of higher concentration to areas of lower concentration
  - ii) ions and large polar molecules can move through by facilitated diffusion (with the help of a protein carrier or channel) from areas of higher concentration to areas of lower concentration
  - iii) ions and large polar molecules can move through by active transport with the help of a protein carrier or channel from areas of lower concentration to areas of higher concentration
  - iv) ICF, ECF and large particles can move into or out of the cell by bulk transport involving vesicles (endocytosis and exocytosis)

#### 4. Nucleus

- surrounded by the nuclear membrane, a double membrane which keeps the DNA together in one place
- the outer nuclear membrane folds outward into the cytoplasm and is continuous with the endoplasmic reticulum
- nuclear pores go through both the inner and the outer membranes and allow ribosomes and RNA to leave the nucleus and pass into the cytoplasm

##### b) Chromatin

- this is how the DNA is found inside the nucleus when the cell is not dividing
- consists of DNA wrapped around histone proteins
- DNA contains the genetic information which includes all of the information which the cell needs to make the cell's proteins and control cellular functions

##### c) Nucleolus

- a dense region of RNA and protein inside the nucleus
- this is where ribosomes are made

#### 5. Ribosomes

- these organelles make proteins
- they can be free in the cytoplasm or attached to the rough endoplasmic reticulum
- free ribosomes make proteins that are used in the cytoplasm, for example, for the cytoskeleton
- ribosomes that are attached to the ER make proteins which must be kept separate from the cytoplasm, either because they are going to be secreted by the cell (for example, polypeptide hormones like insulin) or because they are too dangerous to be released into the cytoplasm (for example, digestive enzymes for the lysosomes)

#### 6. Centrosome

- this is a region within the cytoplasm which organizes the cytoskeleton
- in animal cells, you can see two centrioles which are made of microtubules and found at right angles to one another
- during cell division, the centrosome/centrioles make the spindle fibers

#### 7. Cytoskeleton

- this includes both the is a network of proteins which are (microfilaments and microtubules) that run throughout the cell and:
  - i) gives a cell its shape
  - ii) allows the cell to move
  - iii) anchors organelles in a particular location within the cell, and
  - iv) guides the movement of vesicles through the cytoplasm

#### 8. Endoplasmic reticulum (ER)

- a series of membrane canals that begin at the outer nuclear membrane and extend throughout the cell

##### b) Rough ER

- it has ribosomes attached to the outside of the ER membrane
- when these ribosomes make proteins, they “inject” the protein through the membrane to the inside of the ER, so these proteins can be kept separate from the cytoplasm
- enzymes inside the ER can modify (work on) the proteins
- cells that secrete a lot of protein (e.g., stomach cells, pancreas cells) have a lot of rough ER
- transport vesicles containing the modified proteins “pinch off” from the rough ER and travel to the Golgi apparatus

### c) **Smooth ER**

- it has no ribosomes attached to it so it is not an important site for protein synthesis
- it makes lipids and detoxifies drugs, including alcohol
- transport vesicles containing the lipids “pinch off” from the smooth ER and travel to the Golgi apparatus

## 9. **Golgi apparatus**

- these are ‘stacks’ of flattened membranes which are physically separated from the ER
- vesicles carry proteins and lipids from the rough and smooth ER to the Golgi apparatus, the vesicles fuse with the Golgi and release their contents inside
- enzymes on the inside of the Golgi membranes modify (work on) the proteins and lipids from the ER to give them the “finishing touches”
- vesicles containing the finished proteins “pinch off” from the Golgi apparatus
- if these vesicles are lysosomes, they travel where they are needed in the cell, guided by the cytoskeleton
- if these vesicles are secretory vesicles, they travel to the cell membrane (guided by the cytoskeleton) and release their contents out of the cell by exocytosis

## 10. **Vesicles**

- vesicles are membrane-bound sacs
- there are many types of vesicles, depending on their contents and function:

### a) **Lysosomes**

- these vesicles contain powerful digestive (catabolic) enzymes
- they are like little recycling centers inside the cell that digest macromolecules, worn out organelles, viruses etc into their basic building blocks so these can be reused by the cell

### b) **Peroxisomes**

- these vesicles contain powerful digestive (catabolic) enzymes that are specialized for breaking down long chain fatty acids and some types of drugs (such as alcohol)

### c) **Vacuoles**

- these vesicles are generally used for storage of materials such as macromolecules (‘food’), ions (salts) and water
- in animal cells, vacuoles tend to be very small

### d) **Central Vacuole (only found in plant cells)**

- store water, salts and sugar in a very large vacuole
- important in maintaining the water balance of the cell
- when the central vacuole is full of water, it exerts turgor pressure on the inside of the cell wall and this keeps the cell rigid so the plant is not wilted
- when the central vacuole is less full of water, it exerts less turgor pressure on the inside of the cell wall so the cell goes flaccid and the plant wilts

### e) **Transport vesicles**

- pinch off from the rough and smooth endoplasmic reticulum (ER) and carry the contents to the Golgi apparatus where they fuse (join) with the membranes of the Golgi apparatus and empty their contents inside

### f) **Secretory vesicles**

- pinch off from the Golgi apparatus and carry the contents to the cell membrane
- secretory vesicles fuse with the cell membrane and empty their contents outside of the cell by exocytosis
- the vesicle membrane becomes part of the cell membrane, helping maintain the size of the cell and the amount of cell membrane

## 11. Mitochondria (singular, mitochondrion)

- cellular respiration takes place in the mitochondria and releases energy from glucose and stores it as ATP
- mitochondria have both an inner and an outer membrane
- the enzymes for cellular respiration are found on the inner membrane which is highly folded (into cristae) to provide a large surface area for the chemical reactions
- mitochondria their own ribosomes and DNA which are similar to those of bacteria
- mitochondria divide on their own, independently of cell division, so it is believed that they probably originated from bacteria by endosymbiosis

## 12. Plastids (found in plant cells)

- plastids have both an inner and an outer membrane
- they have their own ribosomes and DNA which are similar to those of cyanobacteria
- plastids divide on their own, independently of cell division, so it is believed that they probably originated from cyanobacteria (bacteria that contain chlorophyll) by endosymbiosis
- there are different types of plastids found in different types of cells, depending on their function:

### a) Chloroplasts

- these are green plastids that contain chlorophyll (a green pigment)
- they perform photosynthesis by using energy from sunlight to turn CO<sub>2</sub> and water into glucose
- enzymes for photosynthesis are found on the membranes of thylakoids (stacks of thylakoids are called “grana”) which provide a large surface area for the chemical reactions

### b) Chromoplasts

- these are plastids which contain pigments that can be a variety of colours, such as red, blue and yellow
- they give specific parts of the plant a distinctive colour
- example: the petals of a flower may be brightly coloured to attract insects or other pollinators
- example: the fruit of a plant may be brightly coloured to attract animals which eat the fruit and then spread the seeds in their feces

### c) Leucoplasts

- these are colourless or white plastids that are specialized to store starch (they looked blue/black in the banana cells because we stained the starch with iodine stain)
- potatoes, seeds (such as beans and corn) and other “starchy” foods contain a large number of leucoplasts

## Other specialized cell parts:

## 13. Cilia and flagella (animal cells only)

- cilia (singular, cilium) and flagella (singular, flagellum) are projections on the outside of the cell
- cilia bend and wave in a sweeping motion which may cause the cell to move. If a cell is anchored in place then the movement of the cilia pushes water or fluids past the cell. This is how the cilia on cells lining our lungs move mucous up and out of our lungs
- flagella have a whip-like or spiral motion to move cells through a fluid. Sperm cells ‘swim’ by the whip-like motion of their flagella (‘tails’)

## 14. Cell wall (plant cells only)

- plant cell walls are made of a polysaccharide called cellulose (a complex carbohydrate)
- the cell wall gives the plant cell strength – it is like an external skeleton for the plant
- the cell wall does not control the movement of substances into or out of the cell (the cell membrane, which lies just inside the cell wall does this)