



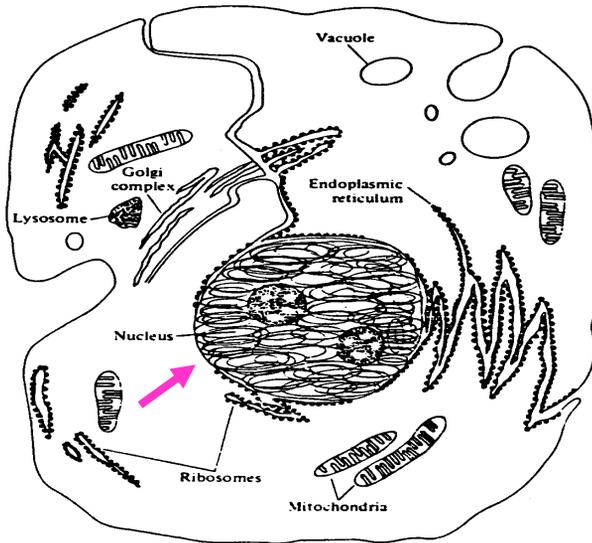
EUCARYOTES



Eukaryotes

- Eukaryotes have nuclear membrane and true nucleus, and membrane-bound organelles.
- Eukaryotes include **fungi (yeast and molds)**, **algae**, protozoa, and animal and plant cells.
- Eukaryotic cells are five to ten times larger than prokaryotic cells in diameter.
- Yeast is about 5 -10 μm , animal 10 μm and plant 20 μm .

Eucaryote Cell Structure

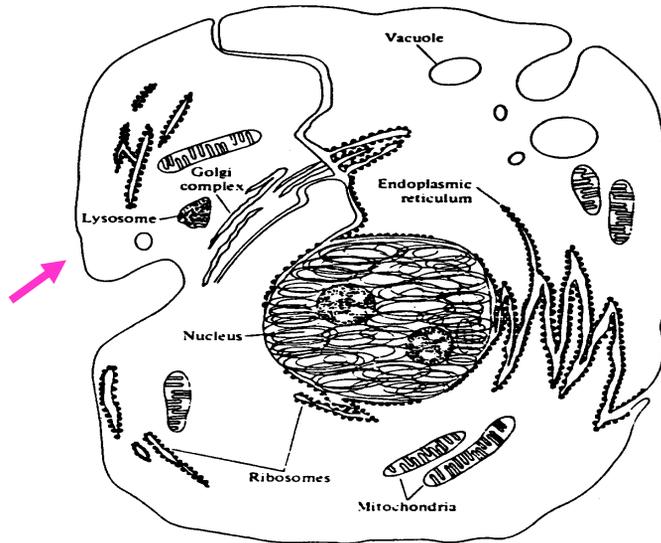


Eucaryote Cell Structure

Nucleus

- Nucleus contains chromosomes (DNA associated with small proteins) surrounded by a membrane.
- The membrane contains a pair of concentric and porous membrane.

Eucaryote Cell Structure

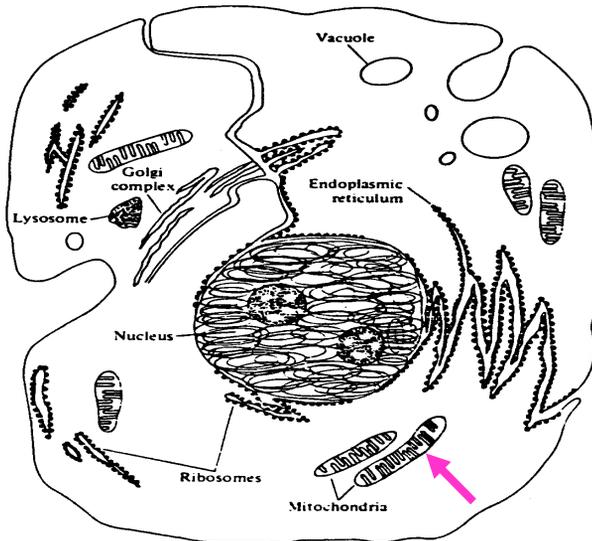


Eucaryote Cell Structure

Cell Wall and Membrane Structure

- Eucaryotes contain sterol which strengthen the wall structure and make the membrane less flexible.
- The cell wall of eucaryotes shows variations:
 - Fungi contain chitin
 - Plant cells contain cellulose
 - Animal cells do not have cell wall so that they are shear-sensitive and fragile

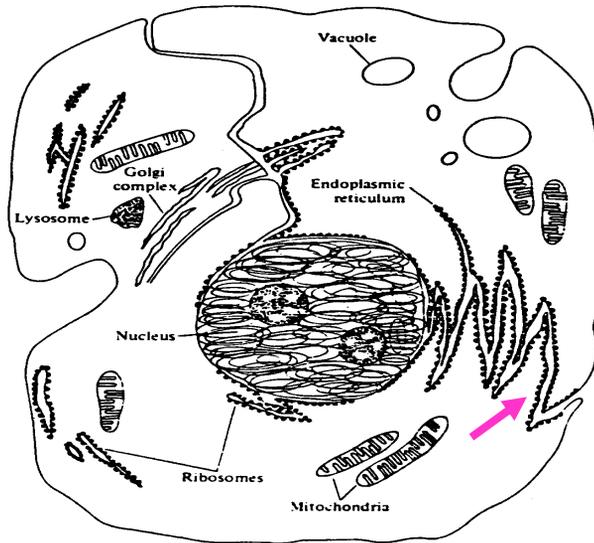
Eucaryote Cell Structure



Eucaryote Cell Structure

- There are **membrane-bounded organelles** with specialized functions, suspended in the cytoplasm of a eucaryotic cell.
- **Mitochondria** are the powerhouses of a eukaryotic cell, where respiration takes place. It reduces oxygen and store energy in ATP (Adenosine triphosphate).
- Shape: Mitochondria have cylindrical shape with 1 μm in diameter and 2-3 μm in length.

Eucaryote Cell Structure

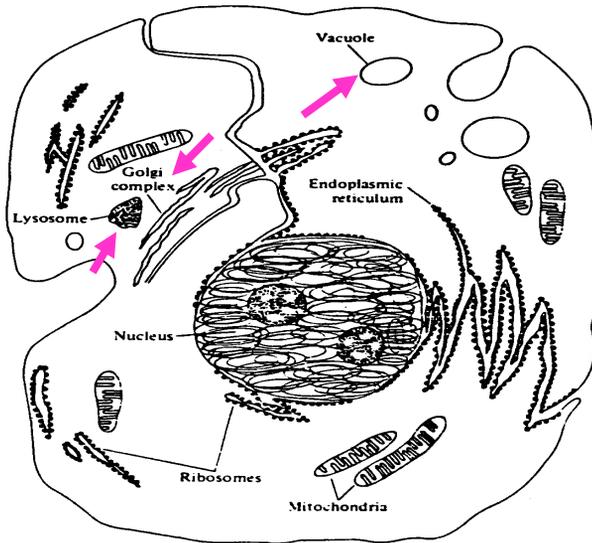


Eucaryote Cell Structure

Organelles (*CONT.*) :

- **Endoplasmic reticulum** is a complex, convoluted membrane system leading from the cell membrane into the cell.
 - The rough endoplasmic reticulum containing ribosomes is the site for protein synthesis.
 - The smooth one is involved with lipid synthesis.

Eucaryote Cell Structure



Eucaryote Cell Structure

Organelles (*CONT.*) :

- **Lysosomes** are very small membrane-bound particles that contain and release digestive enzymes, contributing to digestion of nutrients and invading substances.
- Enzymes in lysosomes:
 - Lipases digest lipids.
 - Carbohydrase digests carbohydrates (sugars).
 - Proteases digest proteins.



Eucaryote Cell Structure

Organelles (*CONT.*) :

- **Vacuole** are of low density and responsible for food digestion, osmotic regulation and waste product storage.
 - **Golgi complexes** are small particles composed of membrane aggregates.
 - Responsible for the secretion of proteins.
 - Golgi are sites where proteins are modified, important for protein function in the body.
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Eucaryote Cell Structure

Organelles (*CONT.*) :

- **Chloroplasts** are relatively large, chlorophyll-containing, green organelles that are responsible for photosynthesis in algae or plant cells.
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Eucaryotic Cell Reproduction

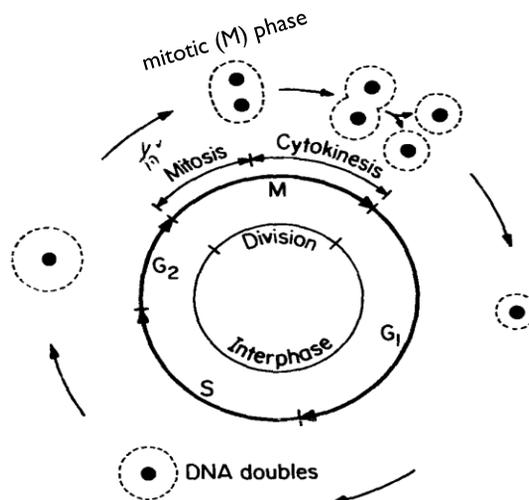
Cell Division (Asexual)

Nuclear DNA replicates

Nucleus division
(mitosis)

Cell division and
separation (cytokinesis)

Cell Division Cycle (Mitosis)



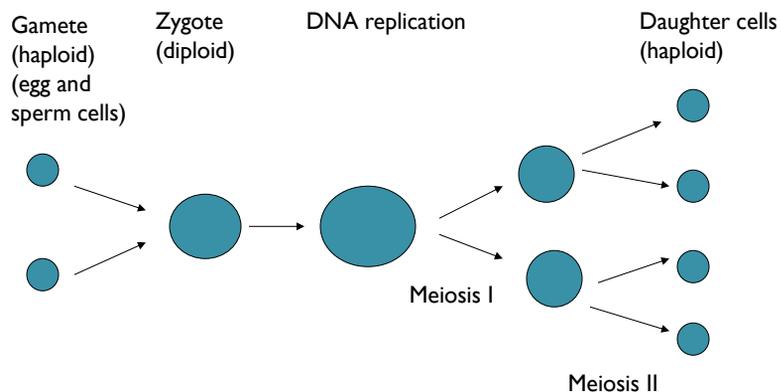
http://highered.mcgraw-hill.com/sites/0072437316/student_view0/chapter11/animations.html#

Mitosis

Mitosis results in:

- Two identical daughter cells with a roughly equal distribution of organelles and other cellular components.
- Each daughter cell is the genetic equivalent of the parent cell.

Meiosis Sexual Reproduction





Meiosis

- Meiosis forms the basis of sexual reproduction and can only occur in eukaryotes.
- The formation of a **zygote** (a **diploid** cell) is from fusion of two **haploid** cells (**gametes**).
- Each **haploid** cell has a set of chromosome.
- The **diploid** cells contains twice as many chromosome as does the gamete.
- The **diploid** cells divide two times (meiosis) to form new haploid cells.



Meiosis

In Meiosis:

- The diploid cell's chromosomes (DNA) is replicated **once** and separated **twice**, producing **four** sets of haploid cells each containing **half** of the original cell's chromosomes.
- These resultant haploid cells will fertilize with other haploid cells of the opposite gender to form a diploid cell again.

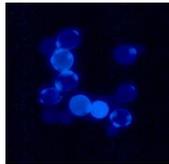
<http://www.csuchico.edu/~jbell/Biol207/animations/meiosis.html>

MICROSCOPIC EUCARYOTES

- Fungi: yeast and mold
- Algae

Fungi

- Fungi are heterotrophs which need to take nutrients from the environment for living.
- They are larger than bacteria.

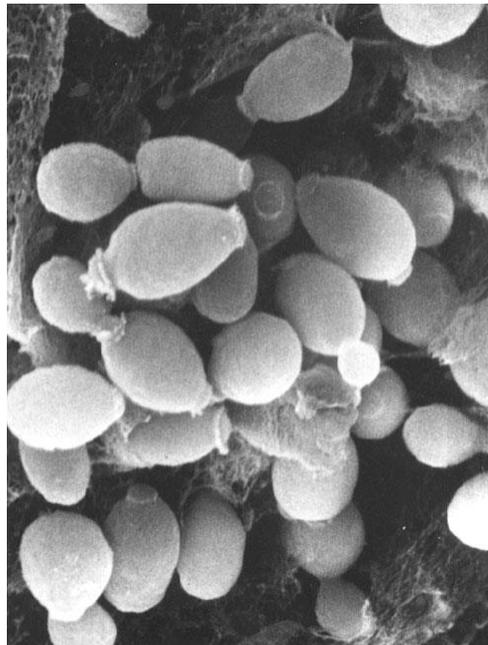


- Two major groups are **yeast** and **mold**.

Fungi: Yeast

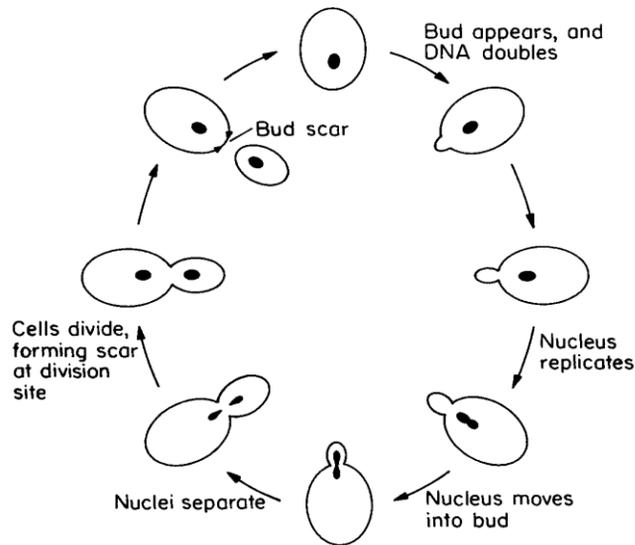
- Single-celled
- Size: 5 to 10 μm in diameter.
- Shape: spherical, cylindrical, or oval.
- Baker's yeast (*Saccharomyces cerevisiae*) is the most widely used yeast.
- Reproduction: by sexual or asexual means
 - Asexual reproduction is by either budding or fission.
 - **Budding:** a small bud cell forms on the cell, which gradually enlarge and separate from the mother cells.
 - Most yeasts reproduce by budding.

Yeast



http://www.sbs.utexas.edu/mycology/sza_images_SEM.htm

Budding



Yeast Reproduction

- **Asexual:**
 - **Fission:** similar to budding but the cells grow to certain size and divide into two equal cells.
 - Only a few yeast species can reproduce by fission.
- **Sexual:** involves the formation of a zygote from the fusion of two haploid cells, each having a single set of chromosome.

Yeast

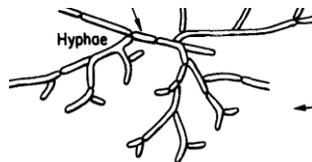
Yeasts are very important economically:

- Responsible for fermentation of bread and beer. (*Saccharomyces cerevisiae*)
- Ethanol production
- Wastewater treatment:
 - a mixed culture of yeasts (*Candida tropicalis*, and *Yarrowia lipolytica*) on hydrocarbons, or gas oil
- Yeasts and *Bacterium xylinum* are used to produce Kombucha, fermented sweet



Fungi: Mold

- Molds are filamentous fungi and have a mycelial structure.



- *Mycelium* is highly branched system of tubes that contains mobile cytoplasm with many nuclei.
- Hyphae are long thin filaments on the mycelium.

Molds

- Molds are very important economically:
 - Mushroom (*Agaricus bisporus*) farming is a large industry in many countries



- Food industry
 - *Aspergillus niger* for citric acid production
- Antibiotics production
 - *Penicillium notatum*

Molds

Size:

- When grown on moist solid nutrient surface, the filamentous form is 5-20 μm .
- When grown in submerged culture, it can form cell aggregates and pellets, of size varies between 50 μm -1mm.
 - Can cause nutrient-transfer (mainly oxygen) problem in the pellet, but
 - pellet formation reduces broth viscosity, which can improve bulk oxygen transfer.

Algae

- Algae are usually unicellular
- Also, plantlike multicellular structures present in marine water
- Like plants, most algae use the energy of sunlight to make their own food (photosynthesis).
- Algae lack the roots, leaves, and other structures typical of true plants
- Algae contain chloroplast which is responsible for photosynthesis.

Algae

- They are in the size of 10-30 μm .
- Algae can reproduce asexually or sexually.
 - Many of algae incorporate both sexual and asexual modes of reproduction.
- Marine algae and seaweeds produce gelling agents such as alginic acid and agar.



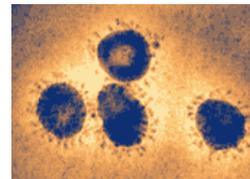


Virus



Virus

- Not free-living organisms, obligate parasite of other living cells.
- Size: 30-200nm.
- Can not capture or store free energy.
- Not functionally active except when inside their host cells.
- Can do harm but also be useful biotechnology tools (e.g. vaccines).



SARS Coronavirus virion

Virus

- **Bacteriophage** or phage: virus infecting bacteria.
- **Virus reproduction:**
 - Virus contains genetic materials such as DNA and RNA which is covered by a protein coat called **capsid**.
 - They can reproduce only by invading and controlling other cells as they lack the cellular machinery for self-reproduction.

