


(A) Cell Structure

Cell structure and function

AICE Biology



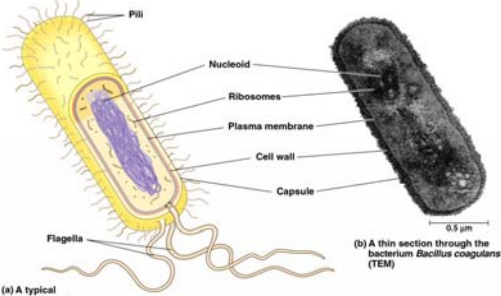
Cell Theory

- All living things are composed of cells
- Cells are the basic units of structure and function in living things
- New cells are produced from existing cells

Cells

<ul style="list-style-type: none"> • Prokaryotes <ul style="list-style-type: none"> – do <u>not</u> have a nucleus • <i>Bacterial cells</i> 	<ul style="list-style-type: none"> • Eukaryotes <ul style="list-style-type: none"> – have a nucleus • <i>Fungal cells</i> • <i>Animal Cells</i> • <i>Plant Cells</i>
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Bacterium: Prokaryotic



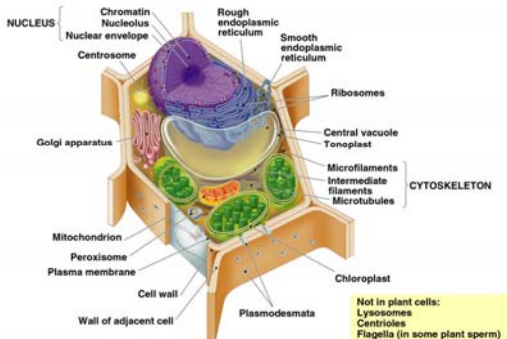
(a) A typical rod-shaped bacterium

(b) A thin section through the bacterium *Bacillus coagulans* (TEM)

• Review page 17

(Cummings, 2002)

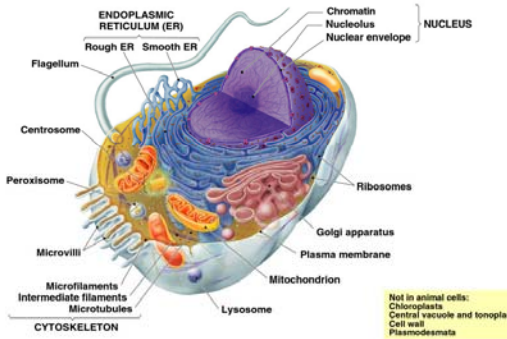
Plant Cell: Eukaryotic



Not in plant cells:
Lysosomes
Centrioles
Flagella (in some plant sperm)

(Cummings, 2002)

Animal Cell: Eukaryotic



Not in animal cells:
Chloroplasts
Central vacuole and tonoplast
Cell wall
Plasmodesmata

(Cummings, 2002)

Ultra-structure of an animal cell as viewed by the TEM

- Nucleus:
 - Largest cell organelle
 - Surrounded by two membranes known as the nuclear envelope
 - Outer membrane of nuc env is continuous with ER
 - Perforated by pores for exchange between the nuc and the cytoplasm
 - mRNA and rib's leave, some hormones and nuc's enter
 - Chromosomes are in a loosely coiled state known as chromatin except during division
 - DNA is organized into units called genes, genes control all the cells activities, growth and repair
 - Nucleolus manufactures ribosomes using the information in its own DNA

Differences between plant and animal cells?

- Cell membrane verses a cell wall
 - Cell walls are composed of beta-glucose
 - Beta glucose is the most abundant organic molecule on the planet.
 - The –OH group projects above the ring
 - *More on this in chapter 2*

- Centrioles:
 - Two, lying close together at right angles
 - Hollow cylinder about .4 μ m long
 - Formed from a ring of microtubules (scaffolding proteins)
 - Used to grow the spindle fibers for nuclear division

- ER and ribosomes
 - Extensive membranous organelle
 - System of flattened sacs called cisternae
 - Cisternae then go on to form the Golgi apparatus
 - Rough ER: dotted with ribosomes
 - Ribosomes are made from small and large subunits
 - The site of protein synthesis
 - Smooth ER: no ribosomes
 - synthesize lipids (cholesterol) and steroids (reproductive hormones) and drug detoxification

- Golgi Apparatus
 - Stack of flattened sacs called cisternae
 - Constantly being formed at the end where is connects with ER and buds off at the end to form Golgi vesicles
 - Collects, processes and sorts molecules for transport either to other parts of the cell or out of the cell (secretion)
 - Golgi vesicles make lysosomes

- Lysosomes:
 - Spherical sacs, single membrane, no internal structure
 - Contain hydrolytic (digestive) enzymes to breakdown old or unwanted structures.
 - Mammary glands after lactation
 - WBC's to fight bacterial infections
 - Released into interstitial places to help with tissue rebuilding
 - Heads of sperm (acrosome)

- Mitochondria:
 - Two membranes
 - Inner membranes form cristae which project into interior matrix
 - Carries out later stages of aerobic respiration
 - Creation of ATP, adenosine triphosphate, the universal energy carrier in cells
 - Involved in the synthesis of lipids

- Plasma Membrane
 - 7nm
 - Lipid bi-layer
 - Partially permeable to control exchanges between the insides and outside of the cell
 - *More in chapter 4*



- Cilia:
 - 3-4 μm long
 - Covered with an extension of the plasma membrane
 - Contains microtubules that extend the length
 - Microtubules arise from basal body in cytoplasm
 - Basal bodies are identical in structure to centrioles (structural proteins)
 - Arranged in an outer cylinder of 9 pairs, surrounding two central microtubules
 - Movement in a coordinated manner (rhythmic beats)
 - Trachea and bronchioles (thoracic cavity, lungs)

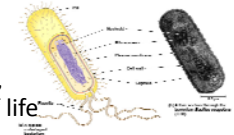
- Flagella:
 - Similar in structure to cilia, but fewer in number and much longer
 - Sperm are only human cells with flagella
 - Found in many mobile bacteria

Ultra-structure of a plant cell as viewed by the TEM

- Same as animal, except:
 - No centrioles
 - Very rare to find cilia
 - Thick cell wall
 - Larger vacuoles (animal cells may have vacuoles, will not be as large)
 - Chloroplasts (photosynthesis)

Prokaryotic Cells

- Pro (before) karyon (nucleus)
- Lacks a true nucleus
- All prokaryotes are classified as bacteria
- DNA lies freely in cytoplasm in a circle called a plasmid
- Smaller than eukaryotes
- First signs of life on earth, evolutionary precursor of life



Eukaryotes

- Nucleus which is a membrane bound organelle for DNA
- Plants, animals, fungi and unicellular eukaryotes called protocists.
- Using figure 1.24, create a Venn diagram of prokaryotic and eukaryotic cells

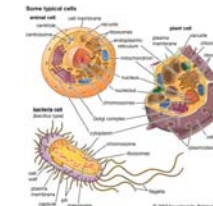
Organelles

Exterior Structures

- Cell wall
- Cell membrane
- Flagella (few & long)
- Cilia (many & short)

Interior Structures

- Endoplasmic reticulum
- Ribosomes
- Microtubles
- Centrioles
- Golgi Apparatus
- Nucleus
- Mitochondria
- Chloroplasts (plant)
- Chromosomes
- Lysosomes
- Vacuoles



Specialized cells and the division of labour

Structure & Function

Specialized cells and the division of labor

- **Tissue:** collection of cells, with their secretions, specialized to perform one or more functions. Can be same type or different
 - *Same:* Parenchyma (P); squamous epithelium (A)
 - *Mixed:* xylem and phloem (P); cartilage, bone and connective tissue (A)
- **Organ:** composed of one or more tissues forming a structural and functional unit
 - Plant: leaves, stems and roots
 - Animal: brain, heart, liver, kidney, eye
- **System:** collection of organs performing a particular task
 - digestive, cardio., reproductive

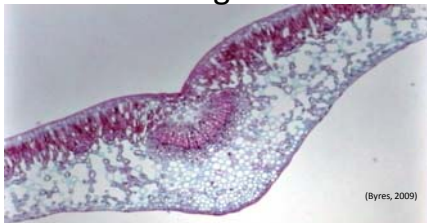
Palisade Cells

- Closely packed, columnar cells, lying in the upper surfaces of leaves
- Contain many chloroplasts and are well adapted to receive and process the components necessary for photosynthesis
 - carbon dioxide, water, and sunlight
- Vertical arrangement means that there are few cross-walls to interfere with the passage of sunlight.



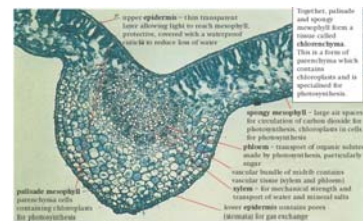
(Farlex, 2009)

Dicot leaf Magnification : 40x



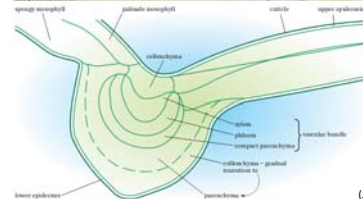
(Byres, 2009)

- This image shows the large central vein (vascular tissue) in the middle of a dicot leaf.
- The white areas inside the leaf are air spaces, which allow the cells to take up carbon dioxide gas for photosynthesis.
- The rows of elongated cells near the top surface of the leaf are the palisade layer, where most of the photosynthesis takes place.

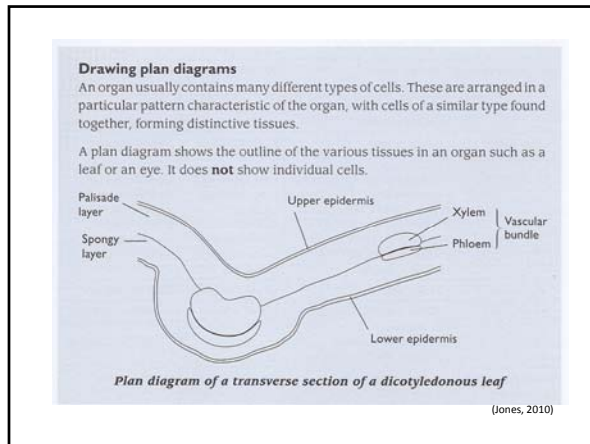


Plan Diagram

Shows where the different tissues are located, no individual cells are drawn



(Jones, et al, 2007)



The generalized cell

- <http://www.cellsalive.com/>
- You will be **drawing and labeling** a typical plant and animal cell in your notes from this website.
- Use pages 4-5 from the text and make sure you have all of the organelles for a plant and animal cell.
 - Create a data table to list organelles/similarities and differences.

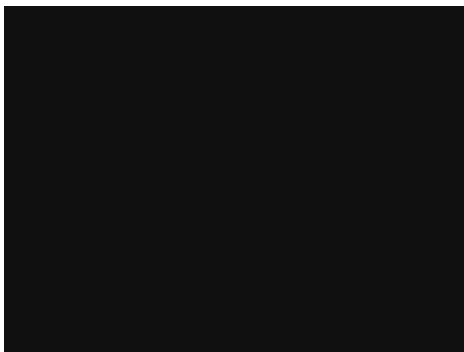
Common Misconceptions

Remember

- Animal cells never have a cell wall, chloroplasts or sap vacuoles
 - (may have temp vacuoles where food is stored)
- Not all cells have all cell parts when mature
 - Red blood cells do not have a nucleus
 - Xylem cells do not have a nucleus or cytoplasm
- Animal cells have 3 parts: MNC...
 - **m**embrane, **n**ucleus, and **c**ytoplasm

- Plant cells are usually larger than animal cells
- It is **not** true that all plant cells contain chloroplasts
 - Epidermis cells and root cells do not
- Chloroplasts are different from chlorophyll
 - Chloroplasts = organelle
 - Chlorophyll = chemical found in chloroplasts

Cell Review



Learning Outcomes

- (a) [PA] use an eyepiece graticule and stage micrometer scale to measure cells and be familiar with units (millimetre, micrometre, nanometre) used in cell studies;
- (b) explain and distinguish between resolution and magnification, with reference to light microscopy and electron microscopy;
- (c) describe and interpret drawings and photographs of typical animal and plant cells, as seen under the electron microscope, recognising the following: rough and smooth endoplasmic reticula, Golgi apparatus, mitochondria, ribosomes, lysosomes, chloroplasts, cell surface membrane, nuclear envelope, centrioles, nucleus and nucleolus;
- (d) outline the functions of the structures listed in (c);
- (e) [PA] compare and contrast the structure of typical animal and plant cells;
- (f) [PA] draw and label low power plan diagrams of tissues and organs (including a transverse section of stems, roots and leaves) and calculate the linear magnification of drawings;
- (g) [PA] calculate linear magnification of drawings and photographs;
- (h) [PA] calculate actual sizes of specimens from drawings and photographs;
- (i) describe the structure of a prokaryotic cell and compare and contrast the structure of prokaryotic cells with eukaryotic cells;
- (j) use the knowledge gained in this section in new situations or to solve related problems.

Resources

- Allied Video. (2004). The magic of cells. Retrieved August 16, 2009, from Discovery Education: <http://streaming.discoveryeducation.com/>
- Bloom and Fawcett. (1994). *A Textbook of Histology*. Chapman and Hall, N.Y., 12th edition.
- Byres, D. (2009). BSC 2010c. Retrieved August 22, 2009, from Biology Web site: http://www1.fccj.cc.fl.us/dbyres/bsc_2010c.htm
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- Jones, M. (2010). Cambridge International A/AS- Level Revision Guide. London, NWI. Hodder Education.
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