Cell Biology

amoeba, light micrograph

What is a cell?

What is a cell?

Cell = basic unit of life

A cell is the smallest 'thing' that has all of the characteristics of life

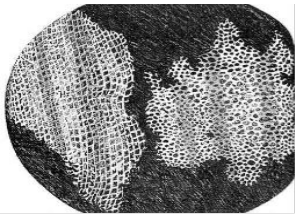
made of cells maintains homeostasis

can reproduce uses energy

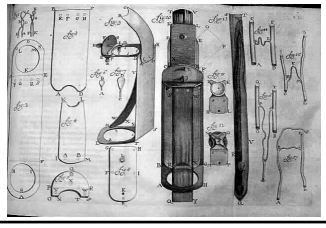
grows is organized

The Discovery of Cells

- **Robert Hooke** - 1st person to see cells, he was looking at cork and called them "a great many boxes." (1665)



- **Anton van Leeuwenhoek** - 1st to observe living cells in pond water, which he called 'animalcules' (1673)



- **Theodore Schwann** - zoologist who observed all tissues of animals had cells (1839)
- **Mattias Schleiden** - botanist, observed all tissues of plants contained cells (1845)

together they determined that all living things are made of cells

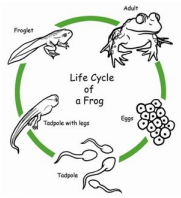
- **Rudolf Virchow** - also reported that every living thing is made up of vital units, known as cells. He predicted that cells come from other cells. (1850)

What invention allowed for the discovery of cells?

What are the 3 parts of cell theory?

The Cell Theory

- 1: every living organism is made of & develops from cells



The Cell Theory

- 2: the cell is the basic unit of structure and function (it's the smallest unit that has char. of life)

What are the characteristics of life?

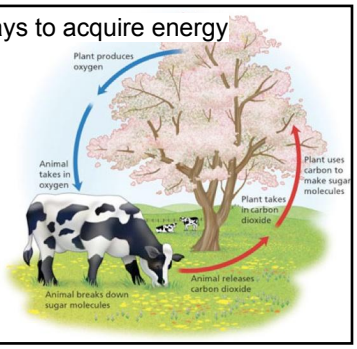
Characteristics of Living Things

made of cells
acquire/use energy
respond to stimuli/homeostasis
growth
reproduction
organization

there are 2 main ways to acquire energy

autotrophs -
produce food
ex. plants

heterotrophs –
acquire food
ex. animals



The Cell Theory

- 3: all cells come from reproduction of other cells

reproduction - producing new organisms like themselves
new organism = **offspring**

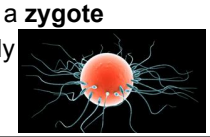
How many cells do organisms have?

one cell = **unicellular**
ex. Amoeba, bacteria
multiple cells = **multicellular**
ex. animals, plants
undergo **differentiation** = cells become specialized

2 types of reproduction:

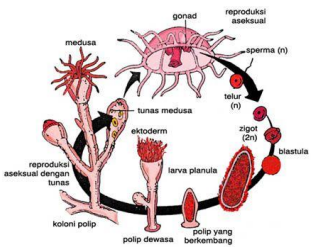
sexual reproduction – combination of hereditary info from 2 organisms or 2 parts of a single organism

- involves uniting of sperm (male sex cell) and egg (female sex cell) to form a **zygote**
- in multicellular organisms only



asexual reproduction – one organism copying itself

in bacteria, protists, certain fungi, plants, animals



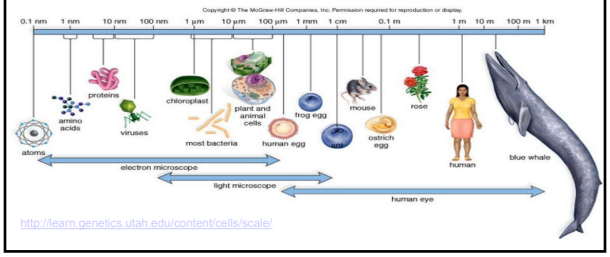
What is the difference between heterotrophs and autotrophs?

What is the difference between unicellular and multicellular?

How big are cells?

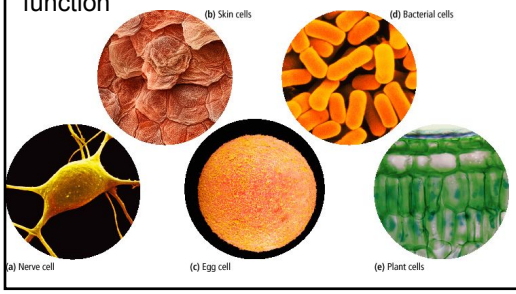
http://learn.genetics.utah.edu/content/cells/scale/

Cells are always small, how small depends on the type of cell
Cells can come in a variety of shapes/sizes



http://learn.genetics.utah.edu/content/cells/scale/

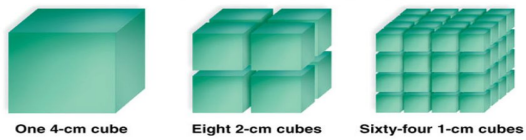
Cell size/shape depends on its function



The Size of Cells

-limited by ***Surface Area to Volume ratio***
surface area ÷ volume
-cells want more surface area
-cells absorb food through their surface
at a certain SA:V ratio, the cell won't be able to absorb enough food to survive

Figure 4.3



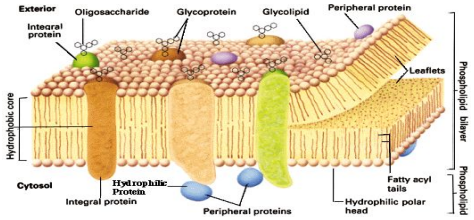
Total surface area (height × width × number of sides × number of cubes)		
96 cm^2	192 cm^2	384 cm^2
Total volume (height × width × length × number of cubes)		
64 cm^3	64 cm^3	64 cm^3
Surface area: Volume per cube (surface area ÷ volume)		
1.5:1	3:1	6:1

What are the 3 main features of cells that all cells have?

What is the difference between sexual and asexual reproduction?

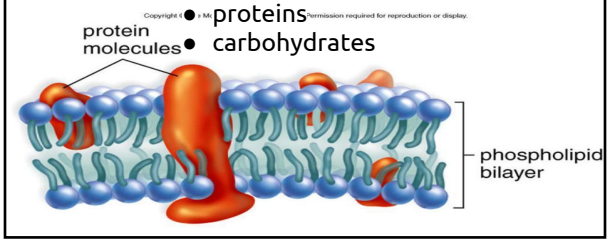
Three Features of Cells

1. **Plasma Membrane** - serves as a barrier, regulates what enters/leaves the cell



plasma membrane is made of:

- phospholipid bilayer (double layer)
- proteins
- carbohydrates



plasma membrane is the cell part responsible for maintaining **homeostasis** (= stable internal conditions) & responding to stimuli

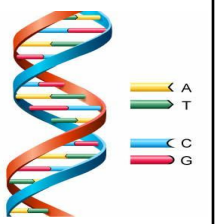
stimulus = any factor outside organism/cell

ex.

- env. conditions - temp, pH, etc.
- other organism

2. Genetic Material

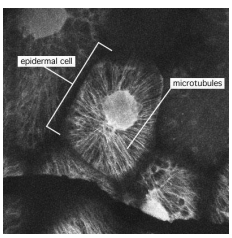
- **DNA** - "blueprint" that controls cell functions
- **Chromatin** = complex of proteins & DNA
- condenses into **chromosomes** before cell division



- genetic material is passed from cell to cell during cell division = cell reproduction
- and from parent to offspring
- contains **hereditary information** - the instructions for life passed from one generation to the next
- in the form of **genes** = segment of DNA that codes for a specific trait

3. Cytoplasm

- located within plasma membrane
- contains water, salts, and other chemicals



Cytoplasm vs. Cytosol

- **cytosol** = liquid jelly
- **cytoplasm** = cytosol + organelles + cytoskeleton

- **organelles** specialized cell structures; float in cytosol
- **cytoskeleton** = protein fibers for structural support

What is the difference between DNA and genes?

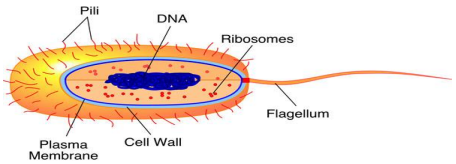
What is the difference between chromosomes and DNA?

What is the difference between chromosomes and chromatin?

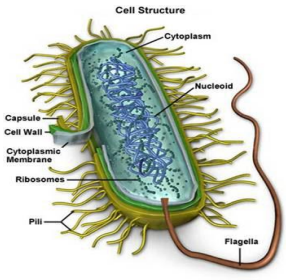
What are the 2 main types of cells?

Prokaryotic Cells

- no membrane bound nucleus, chromosomes grouped together in an area called the **nucleoid**
- no membrane bound organelles
- smaller than eukaryotes



- have cell wall and cell membrane, some have a **capsule** on the outside
- **ribosomes** make protein
- consist of bacteria and archaebacteria

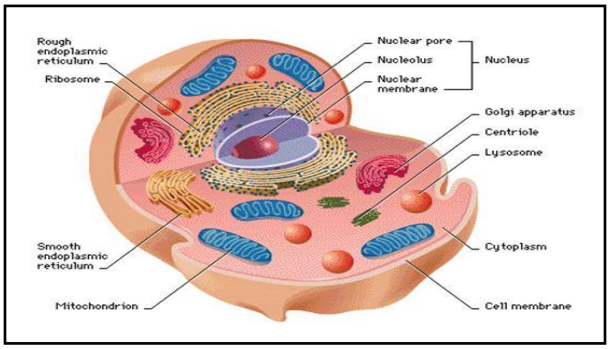


- Appendages include: fimbriae, pili, flagella
- **pili** - longer and fewer than **fimbriae**
- **pili/fimbriae** - function for attachment and recognition of molecules/other cells
- **flagella** - long tail-like structure for movement

Eukaryotic Cells

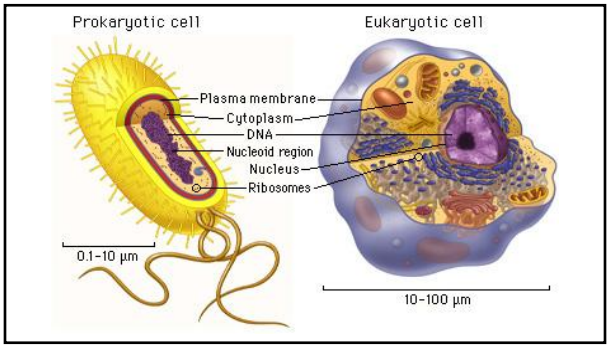
- have a membrane bound **<u>nucleus</u>**
- has membrane bound **<u>organelles</u>** in *cytoplasm*
- organelles perform specific functions
- much **larger** than prokaryotes

organisms in Animalia, Plantae, Protista and Fungi kingdoms all have eukaryotic cells



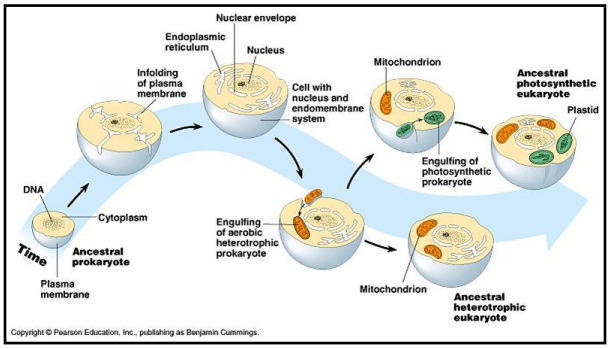
What is the difference between prokaryotic and eukaryotic cells?

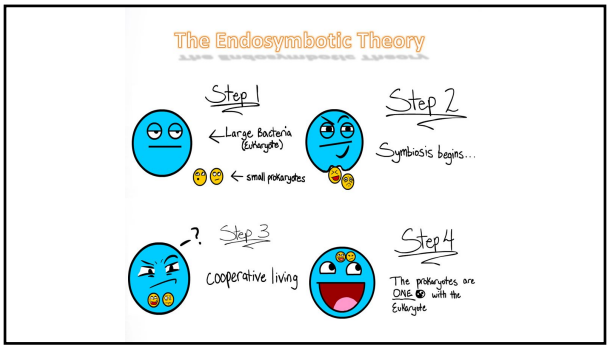
What is the difference between cytosol and cytoplasm?

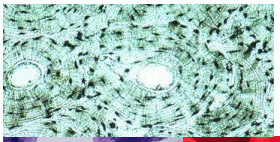


Endosymbiotic Theory

Endosymbiotic Theory:
-some organelles, called <u>mitochondria</u> *&* <u>chloroplasts</u>*, have their own* <u>DNA</u> *& reproduce* ***on their own***
-these organelles are descended from <u>bacteria</u> *which were eaten by the cell and developed a* ***symbiotic*** *relationship - which was mutually beneficial to both bacteria and larger eukaryotic cell*
-this theory helps explain the evolution of eukaryotic cells



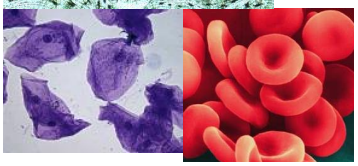




Specialized Cells

Bone Cells

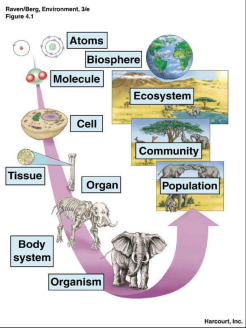
multicellular eukaryotes undergo differentiation



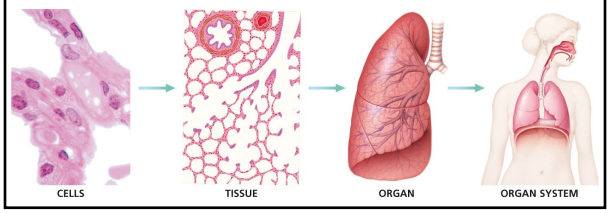
Cheek Cells Red Blood Cells

Levels of Organization

subatomic particle -> atom -> molecule -> cell -> tissue -> organ -> organ system -> organism -> population -> community -> ecosystem -> biosphere



tissue = group of specialized cells
organ = multiple tissues in a structural unit
organ system = multiple organs that work together
each level performs new specialized functions



definitions

tissue = specialized cells working to perform a function
organ = multiple tissues in a structural unit to serve a common function
organ system = organs that work together to perform 1 or more functions

definitions

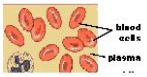
population = all the organisms of one species in an area
community = all the living things in an area
ecosystem = all the living & non-living things in an area
biosphere = all of the life on Earth

In this image, identify a population, community and ecosystem.

4 MAIN TYPES OF ANIMAL TISSUES

Epithelial: forming tight coverings, protecting layers below

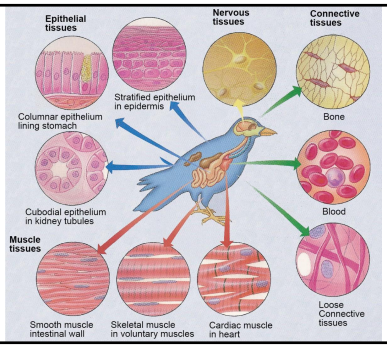
Connective: holding other tissues together, cells surrounded by lots of non-living material(e.g. liquid, mineral, secreted protein)

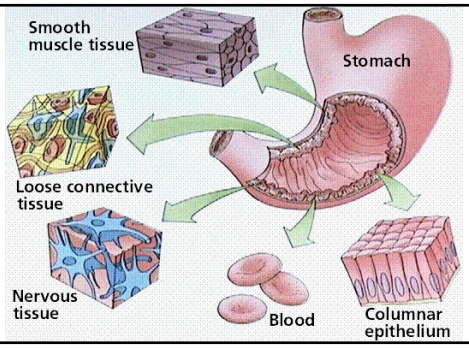


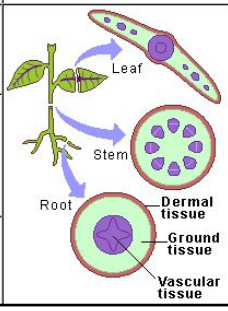
Muscle: shortening and lengthening to move other tissues

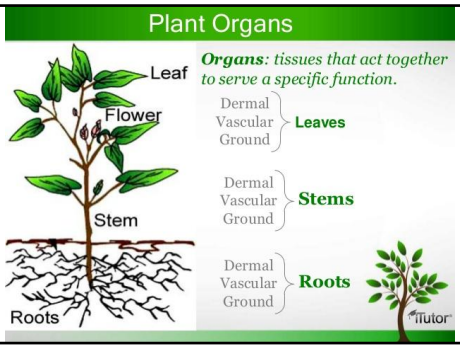
Nervous: allowing rapid flow of ions in and out to conduct signals

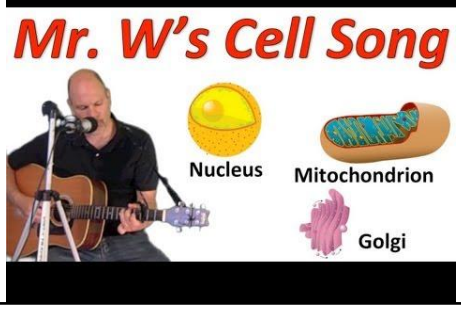
what process produced these different types of cells?





Tissue System and Its Functions	Component Tissues	Location of Tissue Systems
Dermal Tissue System • protection • prevention of water loss	Epidermis Periderm (in older stems and roots)	
Ground Tissue System • photosynthesis • food storage • regeneration • support • protection	Parenchyma tissue Collenchyma tissue Sclerenchyma tissue	
Vascular Tissue System • transport of water and minerals • transport of food	Xylem tissue Phloem tissue	





http://www.learnersty.com/animation/animation.php?ani=162&cat=biology
animation about eukaryotic and prokaryotic cells

http://www.ck12.org/book/CK-12-Biology/section/3.1/
CK-12 Biology chapter 3.1 Introduction to Cells

Review ?s

1. What are the two main types of cells?
2. Which one is larger?
3. Which one does not have a membrane bound nucleus?
4. What are the three main parts of the cell (that all cells have)?
5. What are the 3 components of the cell theory?
6. What theory explains how eukaryotes evolved?
7. What limits the size of cells?
8. Explain why this limits the size of cells.

Review ?s

1. What are the two main types of cells? EUKARYOTIC & PROKARYOTIC
2. Which one is larger? EUKARYOTIC
3. Which one does not have a membrane bound nucleus? PROKARYOTIC
4. What are the three main parts of the cell (that all cells have)? PLASMA MEMBRANE, CYTOPLASM, GENETIC MATERIAL
5. What are the 3 components of the cell theory? ALL ORGANISMS ARE MADE OF CELLS, CELLS ARE THE BASIC UNITS OF LIFE, ALL CELLS COME FROM OTHER CELLS

Review ?s

6. What theory explains how eukaryotes evolved? ENDOSYMBIOTIC THEORY
7. What limits the size of cells? SURFACE AREA TO VOLUME RATIO
8. Explain why this limits the size of cells. - cells absorb food through their surface & volume grows faster than s.a., so at a certain point, they are unable to feed themselves