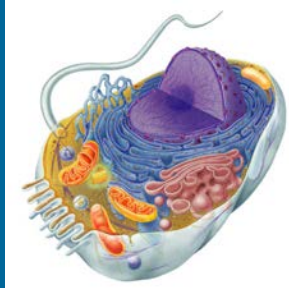


Biology: How Life Works Levels of Organization

■ Cells: the basic units of life



What are the “Characteristics of Life”

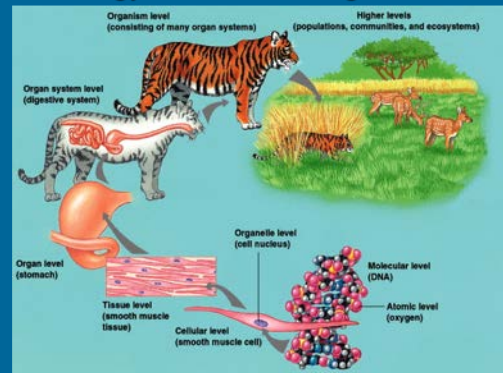
- Complexity & Order
- Regulation
 - Homeostasis
- Respond to changes in environment
 - Physiology
 - Behavior
- Harness energy - metabolism
- Growth and reproduction
 - Inheritance - DNA
- Cellular structure — “Cell Theory”



The Cell Theory

1. The cell is the basic unit of life.
2. All organisms are constructed of cells.
3. All cells derive from previous cells.

Biology: Levels of Organization

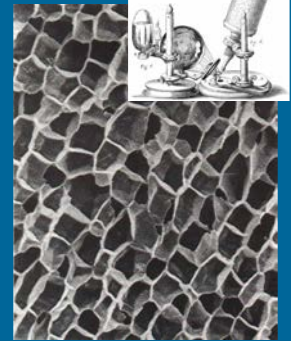


What does a cell need?

- Selective isolation from environment (plasma membrane)
- Energy (ATP)
- Instructions (DNA)
- Machinery to carry out instructions and regulate processes (proteins)
- Compartmentalization of incompatible or specialized activities (organelles)

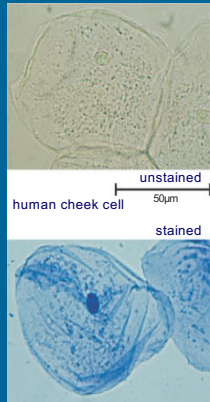
Early views of cells

- Microscope invented ~1600
- Cells identified 1665
 - first cells visualized
- “Cells” (“tiny rooms”)
 - surrounded by “walls”



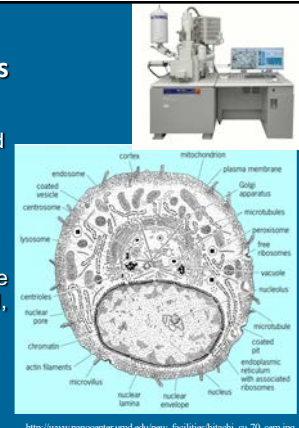
Early views of cells

- ~1840 recognized that *all* life made of cells
- Animal cells lack a cell wall
- “Cytoplasm” (“cell fluid”)
- Plasma membrane
 - Aka, “plasmalemma”
- “Nucleus” (“center”)
 - filled with “chromatin” (“colored stuff”)

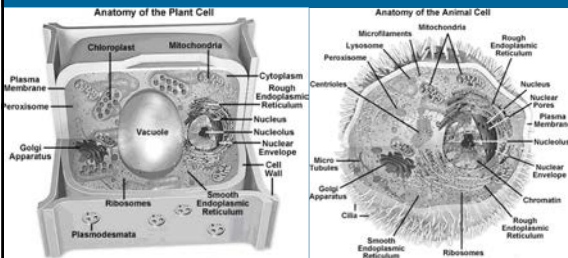


Modern views of cells

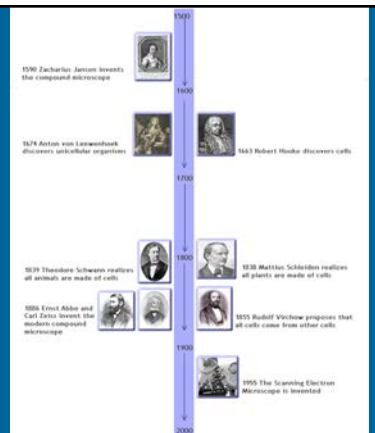
- Better microscopes and stains.
- ~1950's - Electron microscope.
- “Cytoplasm” and “chromatin” much more complicated, structured, and dynamic than previously appreciated.



Modern views of cells

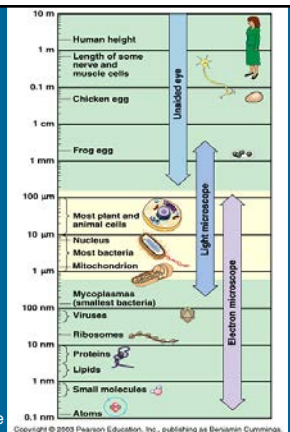


Historical Synopsis of Cell Biology



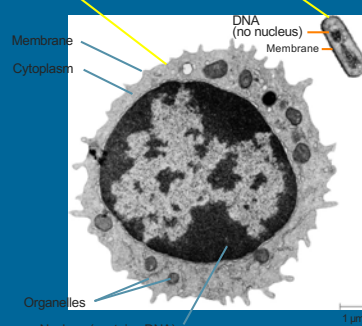
Cell Size Varies with Function

- Typical eukaryotic cell: ~50 µm
- Human nerve cell: up to 1 meter
- Human red blood “cell”: ~8 µm
- Bacteria: ~1 µm

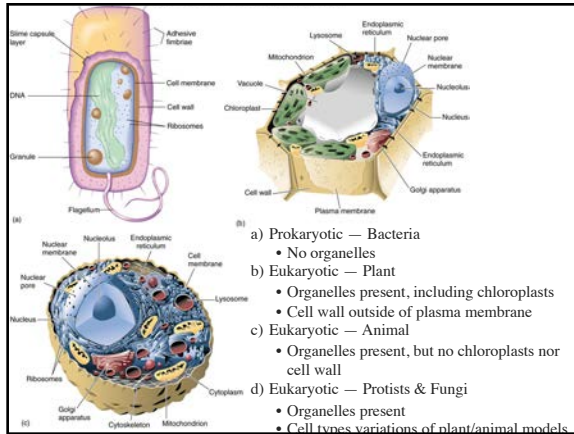


Two major types of cells

EUKARYOTIC CELL PROKARYOTIC CELL



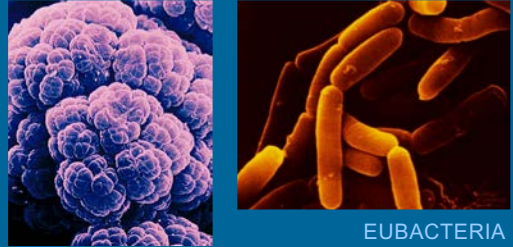
Contrasting eukaryotic and prokaryotic cells in size and complexity



Cellular vs. molecular taxonomy

Prokaryotes — no nucleus, or other membranous organelles

ARCHAEA




EUBACTERIA

Similar cells,
... but significant differences in some critical molecular machines

Two kingdoms of bacteria?

PROCESS SCIENTISTS USE TO ANSWER QUESTIONS ABOUT NATURE



Scientific method

- Observations
- Question
- Hypothesis
- Prediction
- Experiment

Applications of molecular biology methods across disciplines



Articles include:

- Compound-specific radiocarbon dating and mitochondrial DNA analysis of the Pleistocene hominins from Sahliht Mongolia
- A Novel MicroRNA-124/PTEN1 Signal Pathway Mediates Synaptic and Memory Deficits in Alzheimer's Disease
- Airborne environmental DNA metabarcoding detects more diversity with less sampling effort than a traditional plant community survey
- PLK1 protects intestinal barrier function during sepsis by targeting mitochondrial dynamics through DAM-NF- κ B signalling

Designing & conducting molecular biology experiments

You have been given a project to study the newly discovered aromatase-kinase H (AKH), a ~41 kDa protein. A colleague has isolated a ~1400-bp Xho I restriction fragment of human cDNA that molecular probes indicate contains the *akh* gene. Your assignment is to clone the gene to produce sufficient AKH for further study.

- Prepare a recombinant plasmid carrying the *akh* gene.
- Transform *E. coli* bacterial cells with the recombinant plasmid.
- Verify the presence of the recombinant plasmid in the bacteria by RFLP & PCR.
- Verify the expression of the *akh* gene in the bacteria by purifying the AKH protein from transformed bacterial cultures.

Course Logistics

- Schedule
- Syllabus
- Objectives
- Lecture notes
- Student success
- Lab protocols
- Grading



<https://www.deanza.edu/faculty/heyerbruce/bio6bsyllabus.html>