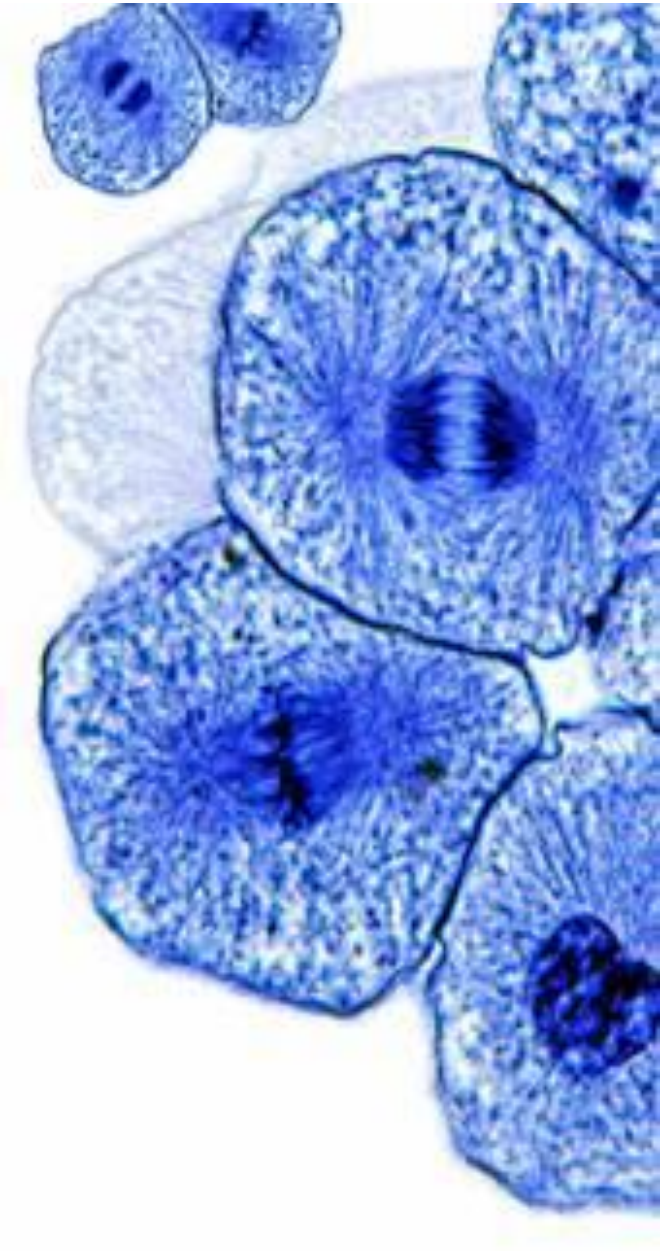


Cellular functions

Biochemistry

Genetics

Ecology

Biology

The Study of Life

Physiology

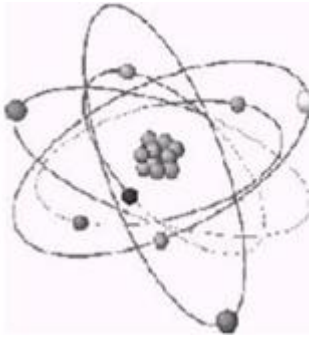
Phylogeny

Evolution

ORGANIZATION OF LIVING THINGS:

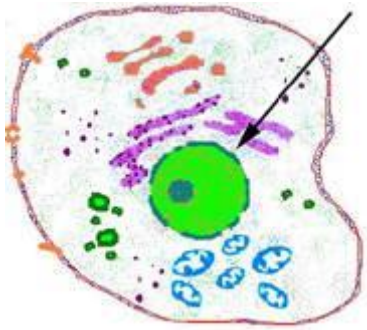
Biological organization is based on a hierarchy of structural levels, with each level building on levels below

Atoms

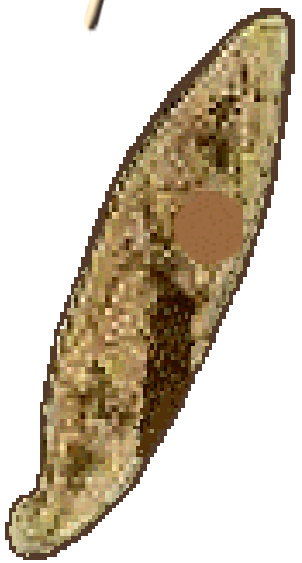


Complex biological molecules
e.g. proteins, lipids, carbohydrates

Subcellular organelles
e.g. nucleus, mitochondria



Cells- simplest complete unit of structure and function of life

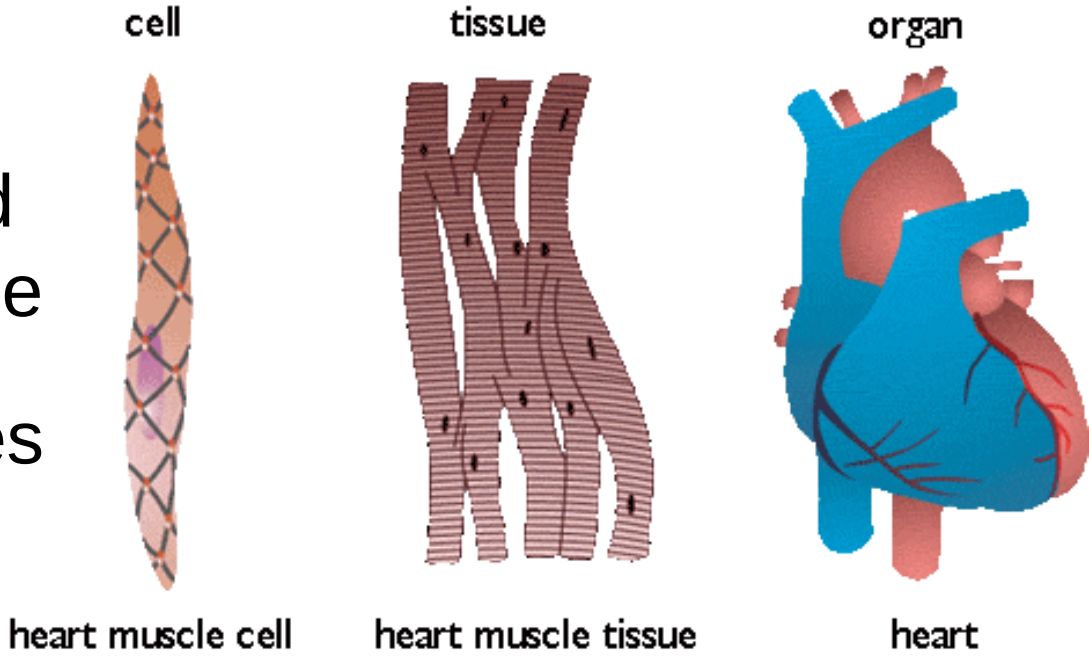


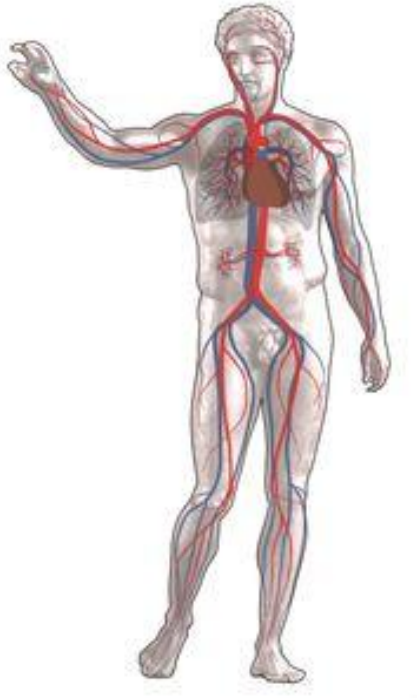
Tissues- groups of cells with similar structure and function e.g. heart muscle

Organs- groups of tissues that perform a similar function e.g. heart

Organ systems- groups of organs performing an overall function e.g. circulatory system

Complex organisms- total living creature composed of many systems e.g. human





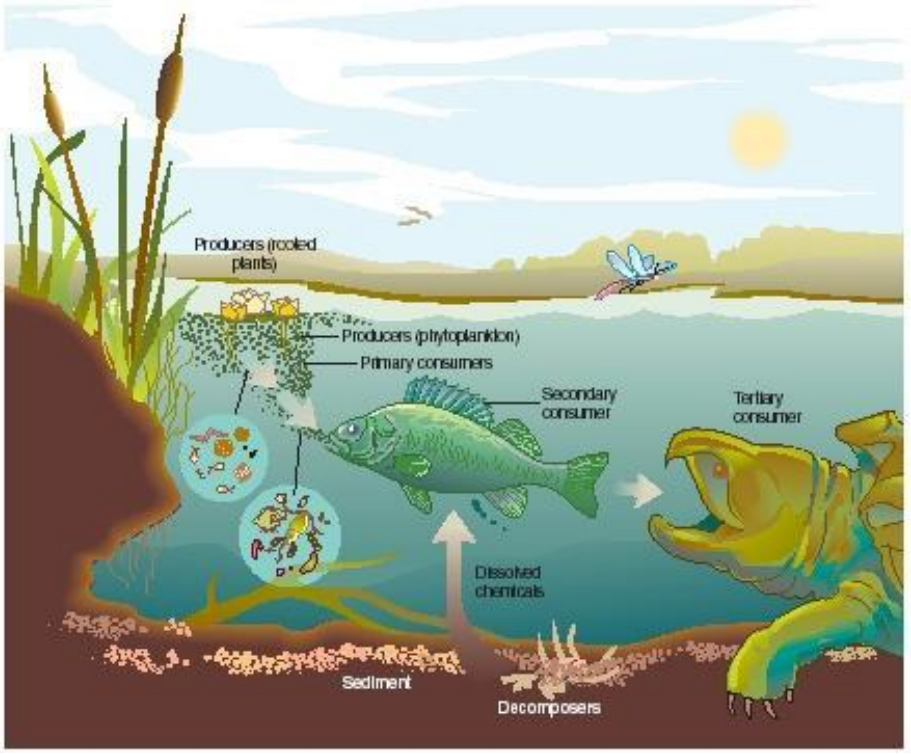
Beyond the individual the levels include:

Population- localized group of organisms belonging to the same species

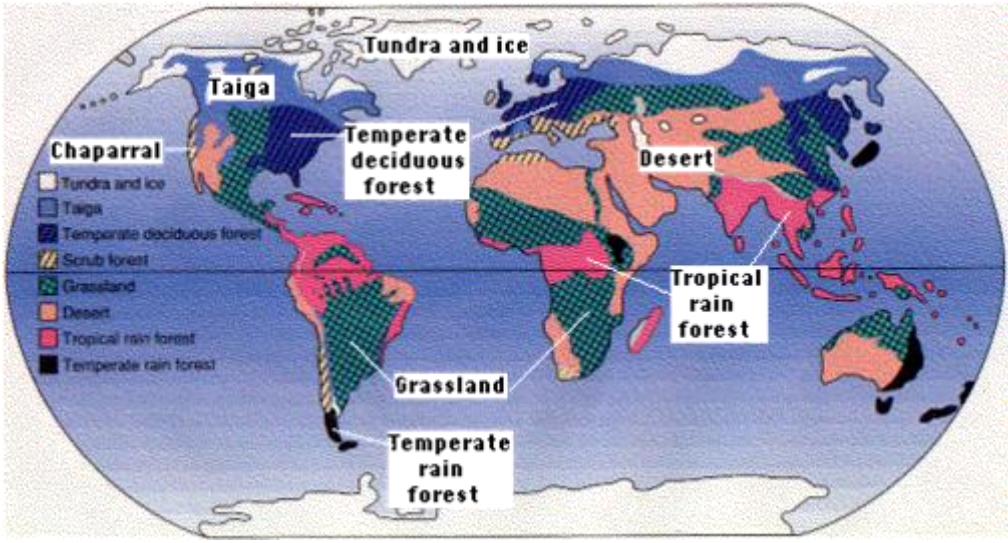
Community- populations of species living in same area

Species: is defined as a group of organisms with similar structural and functional characteristics that freely interbreed and produce fertile offspring.

Ecosystem- an energy-producing system of community interaction that include abiotic factors such as soil, temperature and water

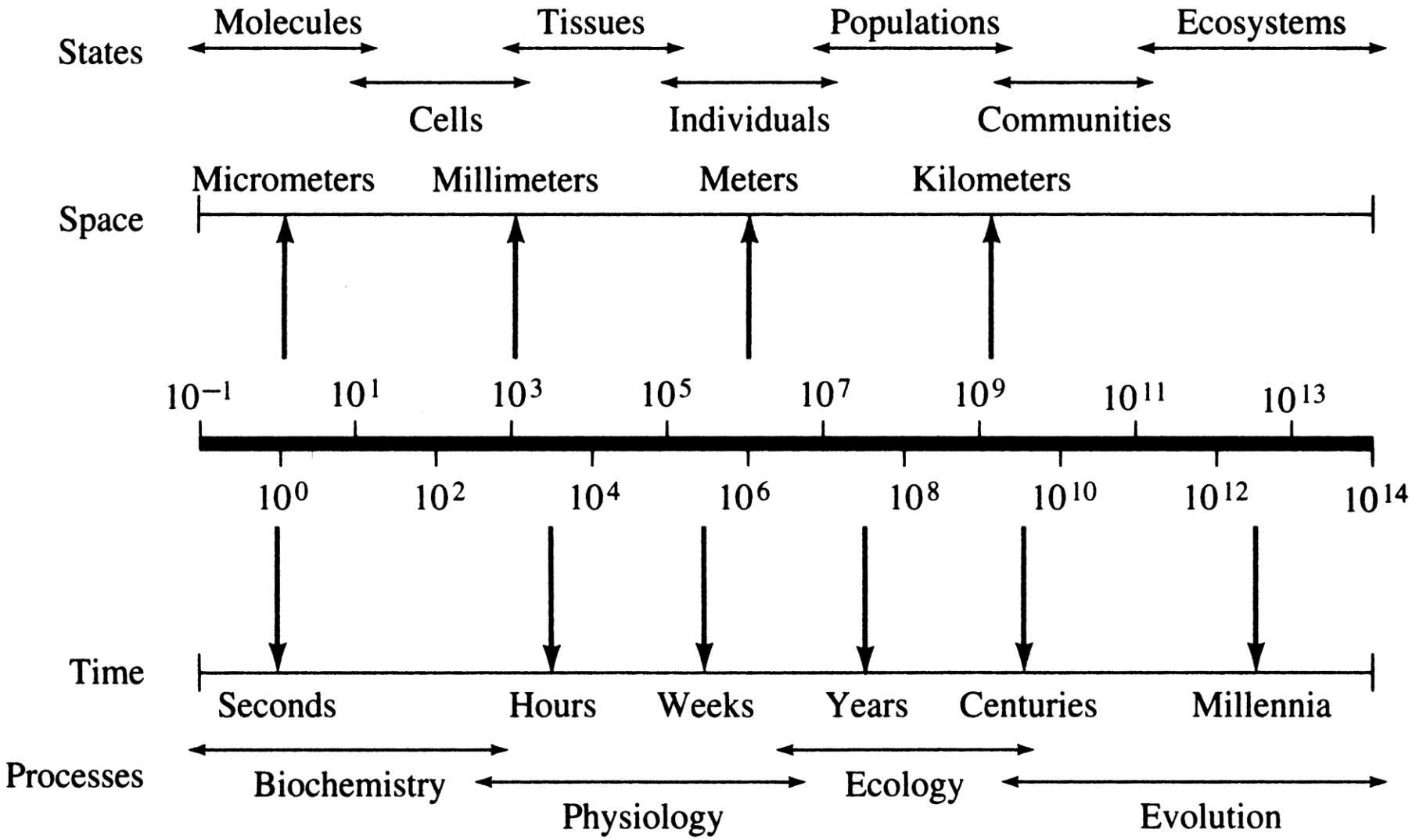


Biomes- large scale communities classified by predominant vegetation type and distinctive combinations of plants and animals



Biosphere- the sum of all planet's ecosystems

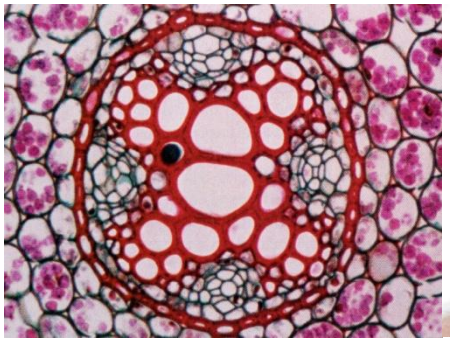
Hierarchical Organization of the Biological Sciences



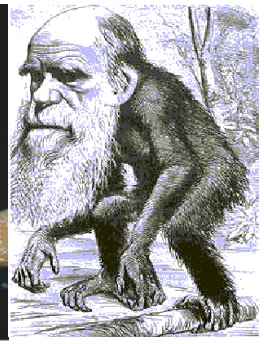
Integrative Biology

What is Life?

How do you know that you are living?







Life is defined in terms of qualities that the living uniquely share:

1. Organization
2. Energy Utilization
3. Internal constancy
4. Grow, Develop, Reproduce
5. React to Environment
6. Evolution

1. Life is organized

in sequences of increasing complexity (structures within structures) the basic unit of life is the cell

Levels of biological organization are hierarchical

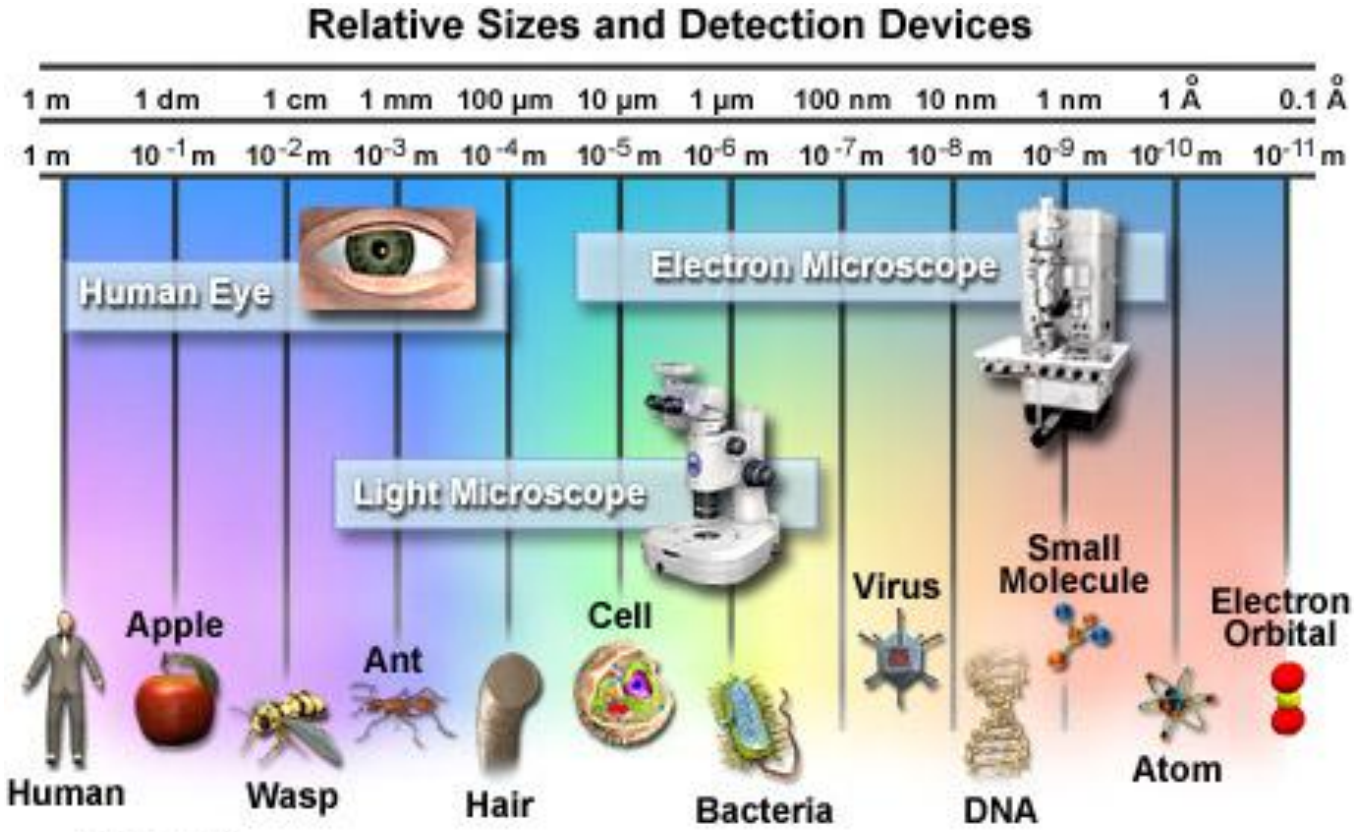


Figure 1

2. Life requires energy

The natural tendency of matter is towards disorder (i.e., entropy or randomness) living systems acquire and use energy to maintain their highly organized state

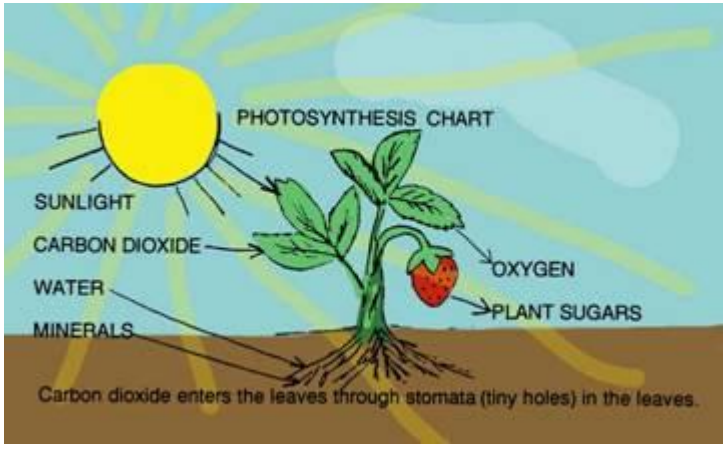
Metabolism: the biochemical reactions that acquire and use energy

Organisms take and transform energy to do work, including the maintenance of their ordered states

Examples:

a. plants use solar energy to make glucose:

$$6CO_2 + 6H_2O \longrightarrow C_6H_{12}O_6 + 6O_2$$



b. animals consume glucose for cell respiration:

$$C_6H_{12}O_6 + 6O_2 \longrightarrow 6CO_2 + 6H_2O + 36\ ATP + heat$$

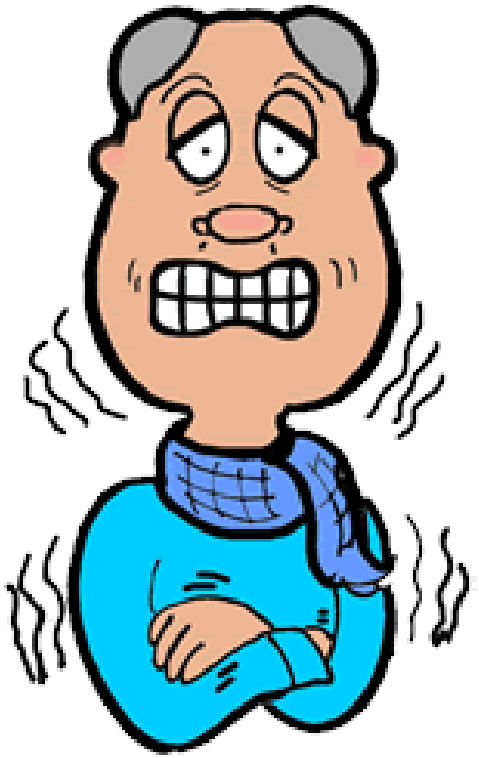
3. Living things must maintain an internal constancy

This requires a separation from the non-living world for metabolic processes to function normally, living things need to keep themselves stable in temperature, moisture level, chemistry, etc.

Homeostasis: the ability to maintain internal constancy (i.e., to stay the same)

Example:

humans shiver and get goose bumps if cold



Organisms regulate their internal environment to maintain a steady-state, even in the face of a fluctuating external environment

4.Living things grow, develop, and reproduce

vital if a population of organisms is to survive more than one generation
"Instructions" for growth and development are encoded in genes

Growth and Development:
heritable programs stored in DNA
direct the species-specific pattern of growth and development
a. plants grow indefinitely
b. animals develop and stop growing

Reproduction:
organisms reproduce their own kind; life comes from life (biogenesis)
gametes are produced for sexual reproduction
asexual reproduction takes place by binary fission

5.Living things react to environmental change

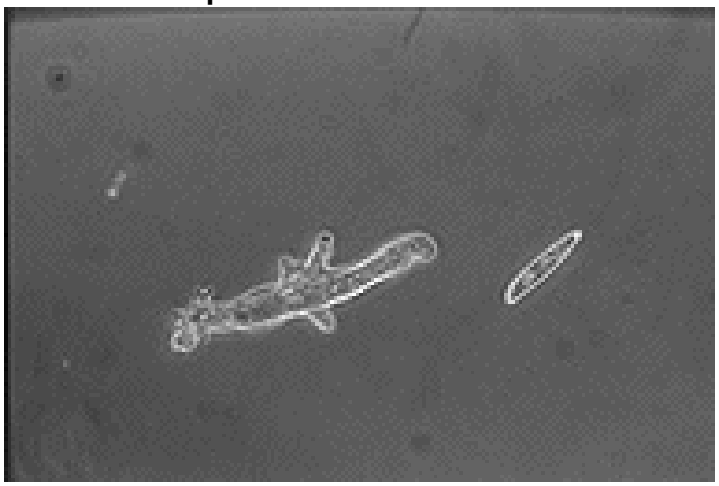
organisms respond to stimuli from their environment

Reaction may be immediate as in a reaction to extreme heat, or longer as in a change in leaf color in response to day length, but certainly within the lifetime of the individual.

Behavior - move towards or away from stimuli
Change in metabolism
Change in development

Examples:

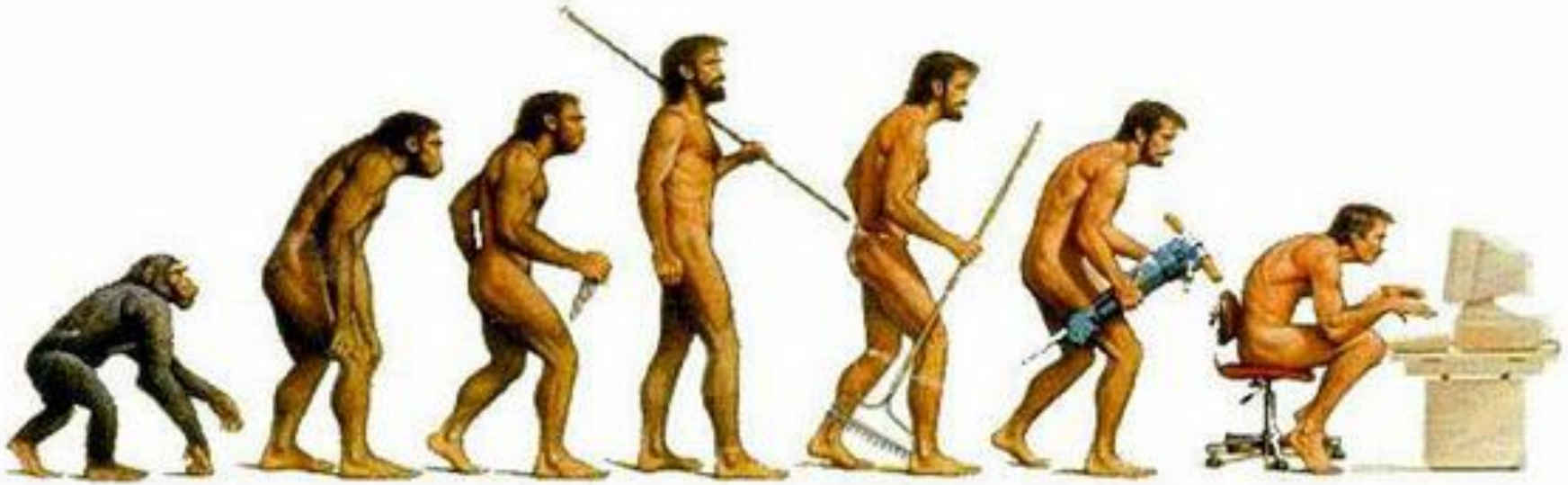
Phototropism



Amoeba eating a parmecium by chemotaxis

6.Living things Adapt (EVOLUTION)

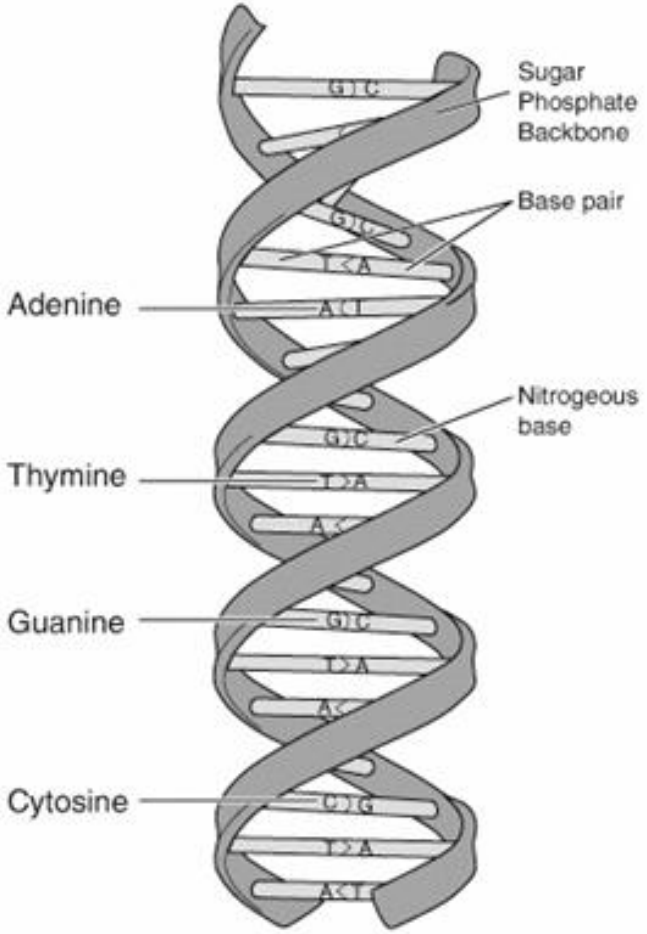
Evolutionary change in a population over many generations. An inherited characteristic or behavior enables an individual to live and reproduce with greater success than other members of their population in a given environment . These adaptations/ modifications become more frequent in the population over several generations

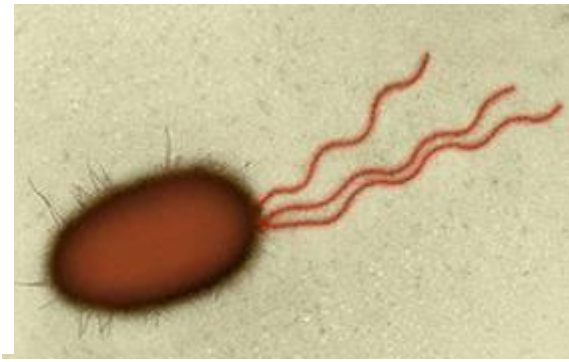


Unity of All Life

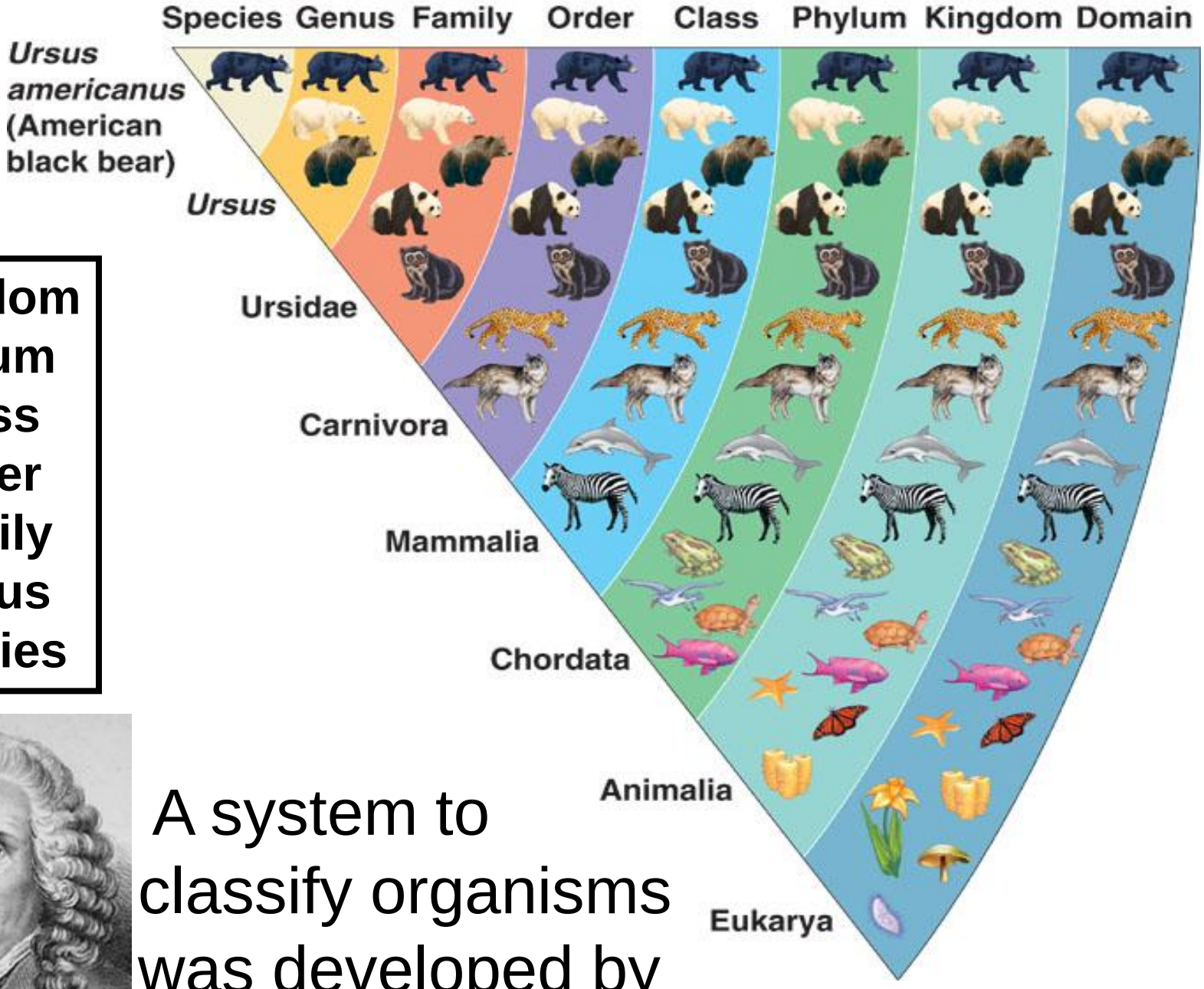
There is unity in the diversity of life forms at the lower levels of organization. For example:

- A universal genetic code.
- Similar metabolic pathways (e.g., glycolysis).
- Similarities of cell structure (e.g., flagella of protozoans and mammalian sperm cells).





Bacteria



Kingdom
Phylum
Class
Order
Family
Genus
Species

A system to classify organisms was developed by Linnaeus

Three Domains of Life

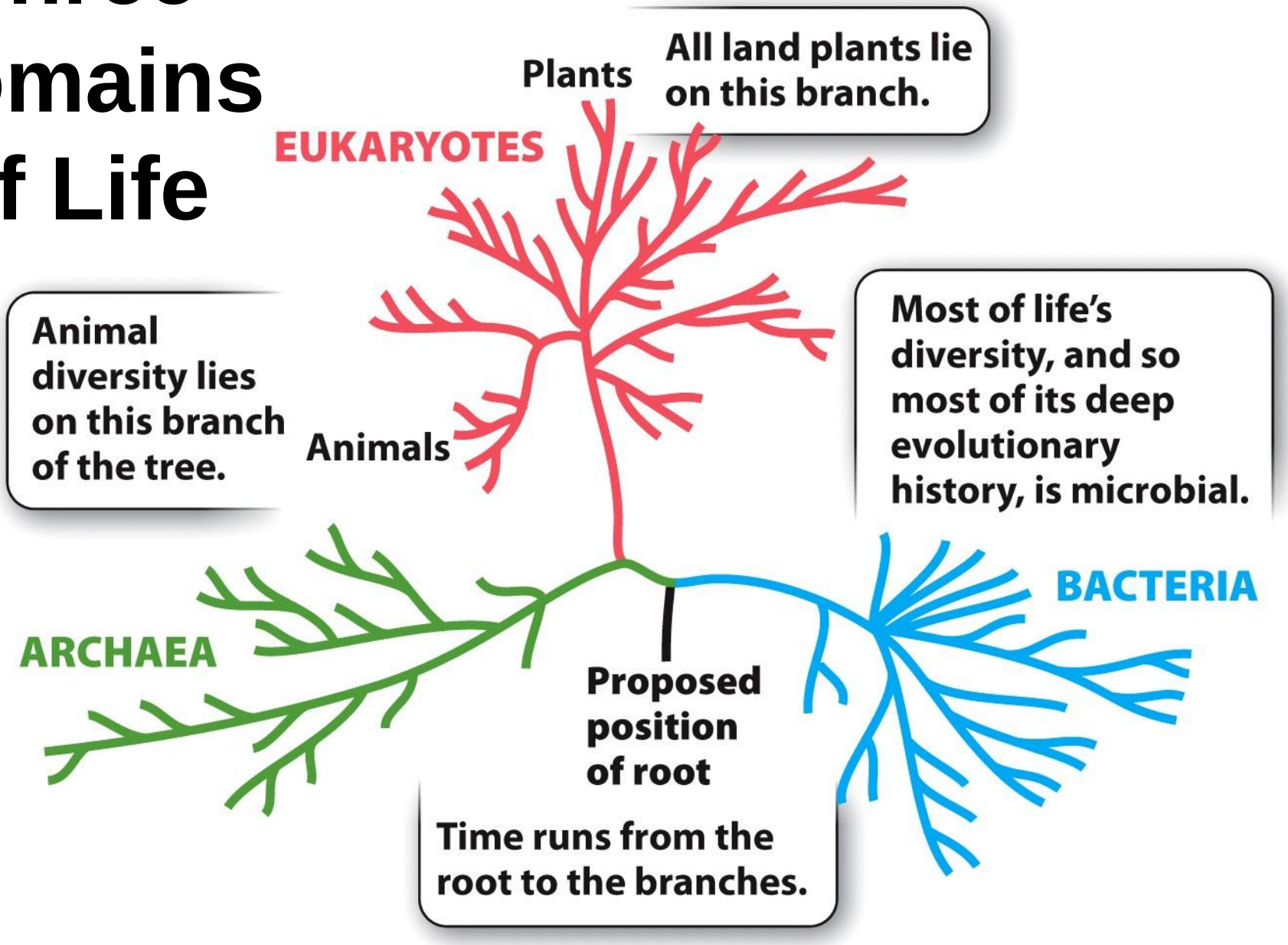


Figure 1.17
Biology: How Life Works

Archaea and Bacteria are Prokaryotic

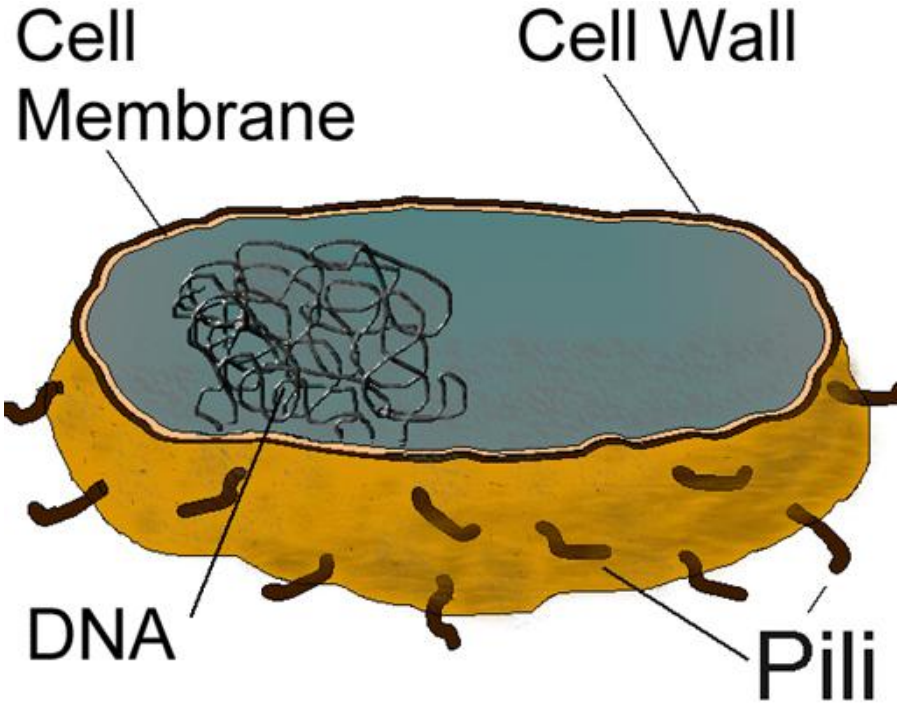
Prokaryotes: Domains Archaea and Bacteria

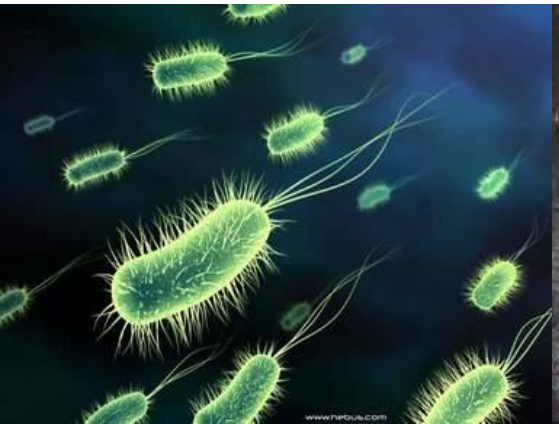
No membrane bound nucleus (*pro* = before, *karyon* = nucleus)

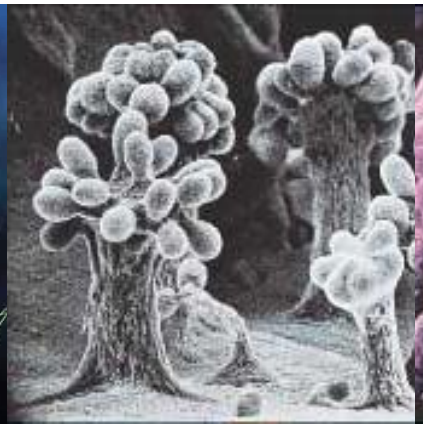
DNA in nucleoid area
no membrane bound organelles at all

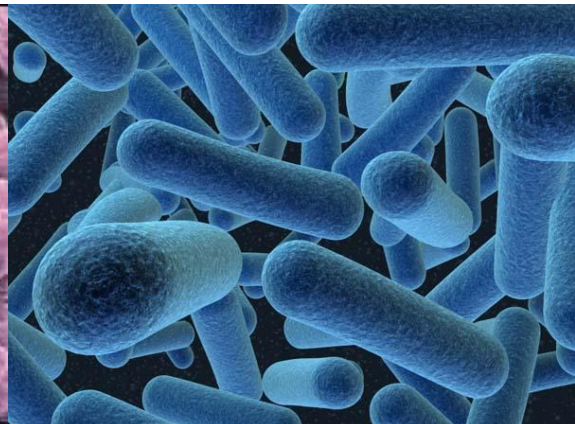
Single celled (although some may cluster)

Very small
(0.1 – 10 μm)

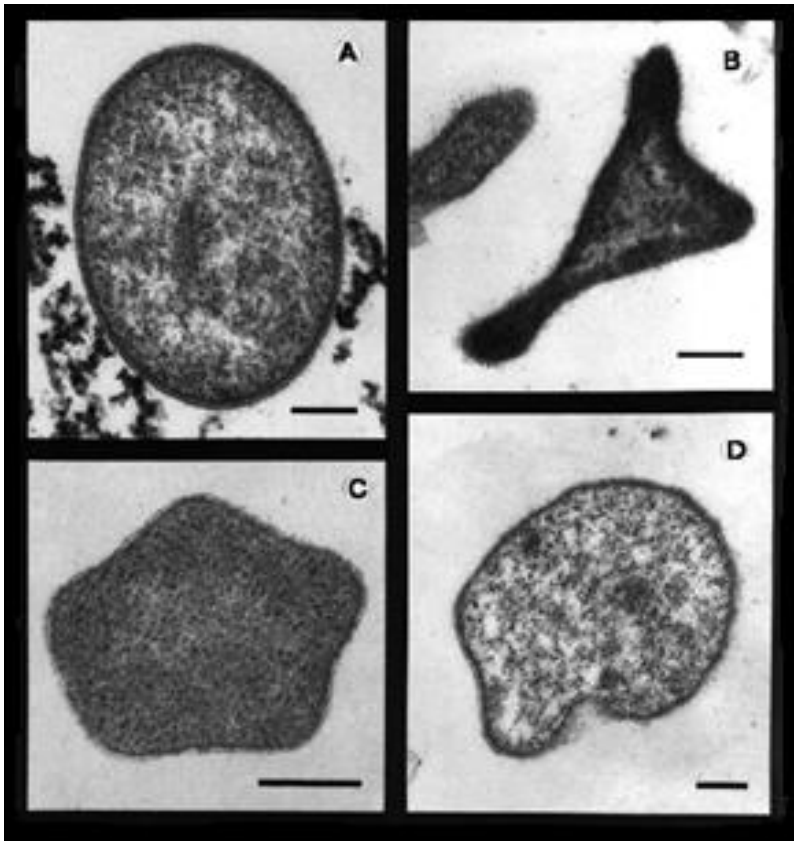








Archaea: believed to have evolved from the earliest cells able to live in the most extreme environments, those similar to the conditions that were existing when earth was forming



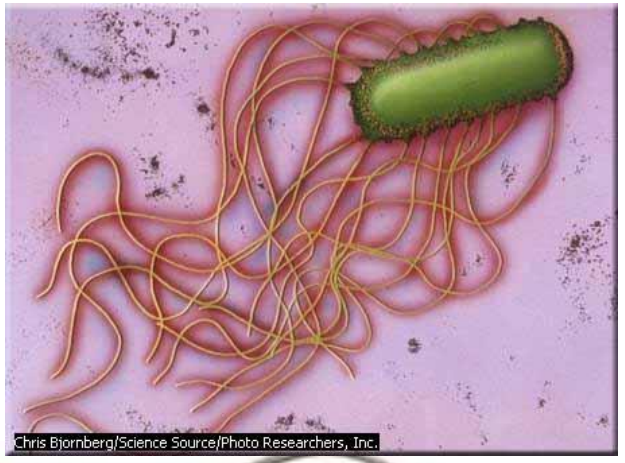
Examples of Archaea are:

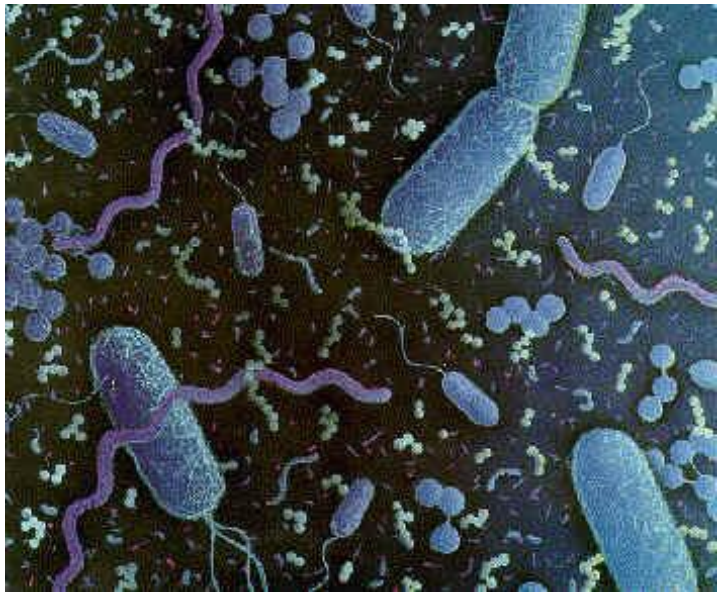
- **methanogens**: anaerobic (live without oxygen), live in swamps & marshes where other microbes consume all the O2, produce methane, also called swamp gas
- **halophiles**: live where it is salty (Great Salt Lake in Utah)
- **thermoacidophiles**: live in hot (600 - 800C) acidic environments (hot sulfur springs) obtain energy by oxidizing (taking electrons from) sulphur most related to eukaryotes some can live in deep-sea thermal vents at 1000C

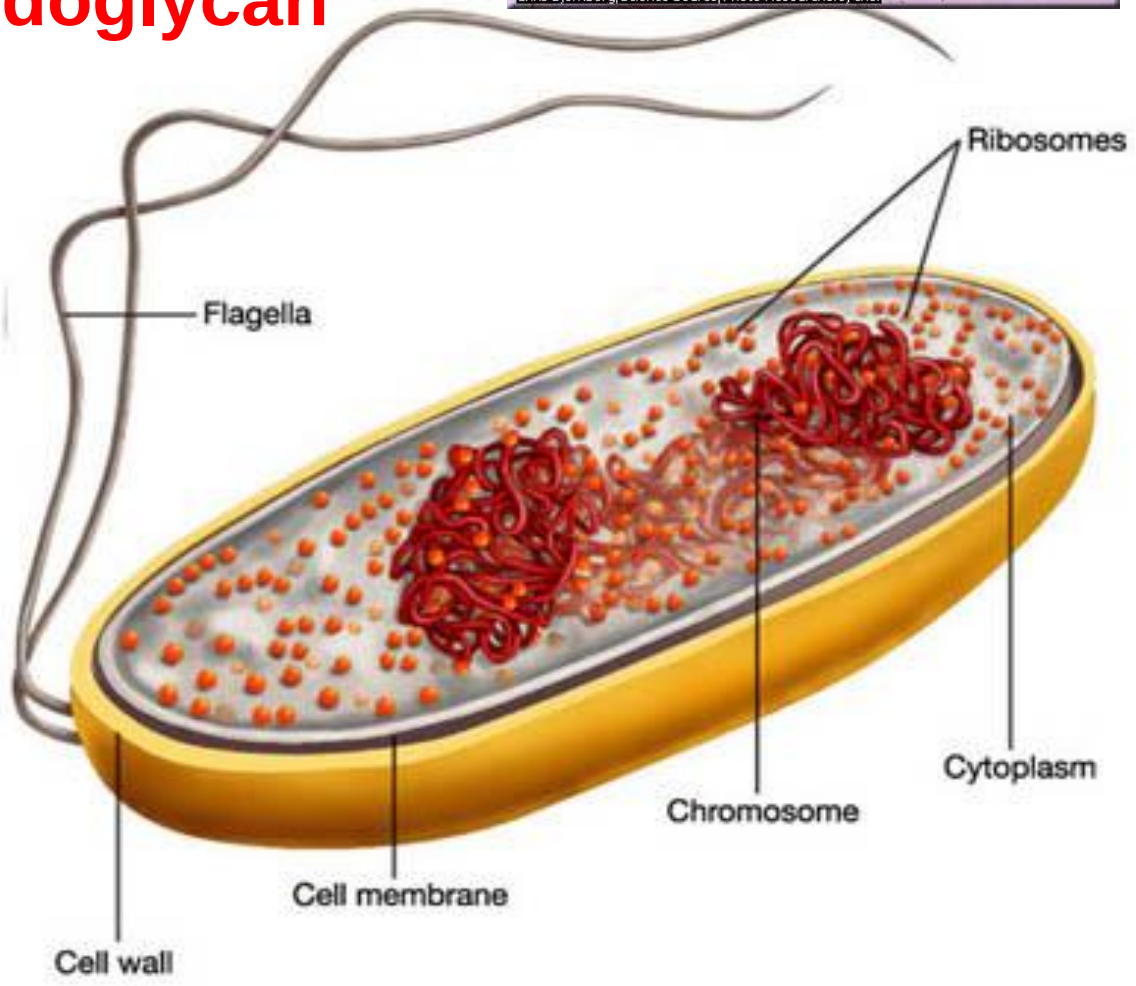
Bacteria: more “modern” bacteria and more numerous than Archaea

Are EVERYWHERE!!!

cell walls contain **peptidoglycan**







Eukaryotes: Domain Eukarya:

Eukaryotic cell has a membrane bound nucleus and membrane bound organelles. Larger than prokaryotes (10 – 100 μm).

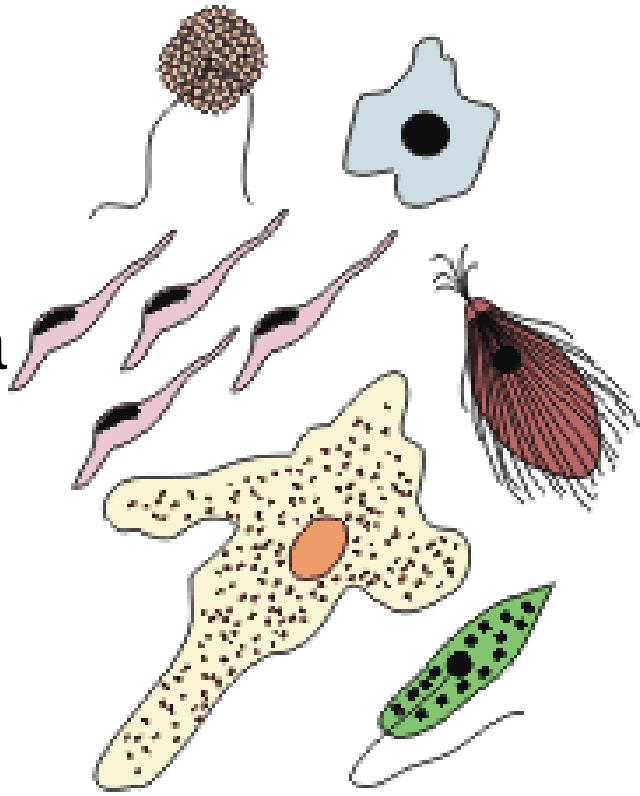
Subdivided by internal membranes into different functional compartments called *organelles*

- Contains DNA that is segregated from the rest of the cell. DNA is organized with proteins into *chromosomes* that are located within the *nucleus*, the largest organelle of most cells.
- *Cytoplasm* surrounds the nucleus and contains various organelles of different functions
- Some cells have a tough *cell wall* outside the plasma membrane (e.g., plant cells). Animal cells lack cell walls.

Though structurally different, eukaryotic and prokaryotic cells have many similarities, especially in their chemical processes.

4 Kingdoms of Eukarya

Animallia, Plantae, Fungi, Protista



Kingdom "Protista"

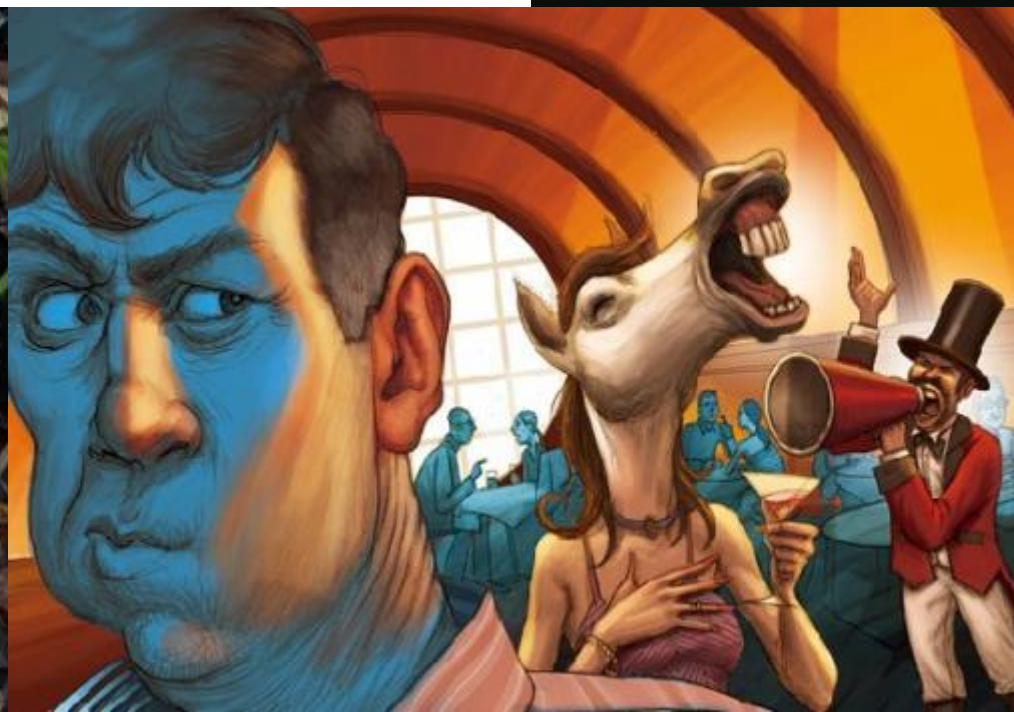
- Evolved from Archaea or Bacteria
- Mostly unicellular, but sometimes are colonial or simple multicellular

3 types

plant-like e.g. dinoflagellates which cause red tide
most have a cell wall of cellulose; are photosynthetic
range in size from unicellular to multicellular seaweeds
and are therefore very important for biosphere
animal-like- also called protozoans (first animals)
e.g. *Paramecium* and *Amoeba*
have no cell wall
some are parasitic like *Entamoeba hystolytica*
fungal-like similar to fungi at different stages in life cycle
reproduce by spores and cell wall made of chitin e.g. slime molds

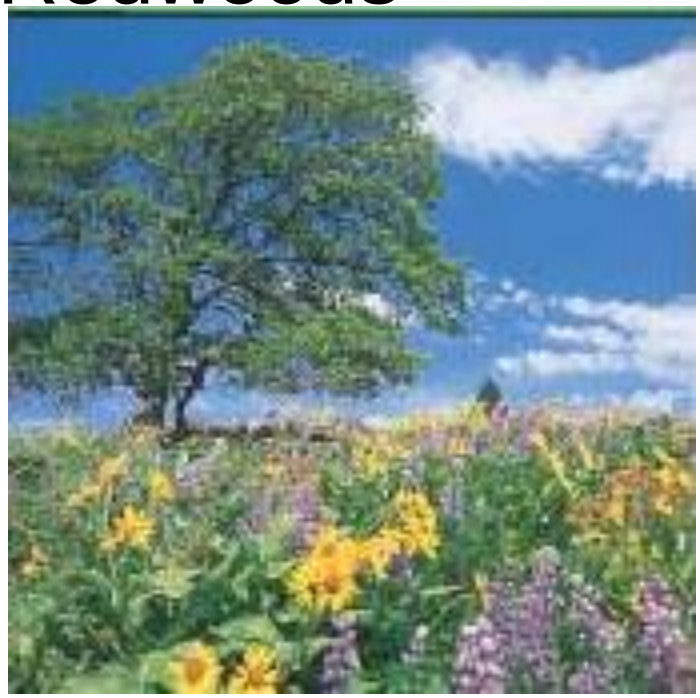
Kingdom Fungi

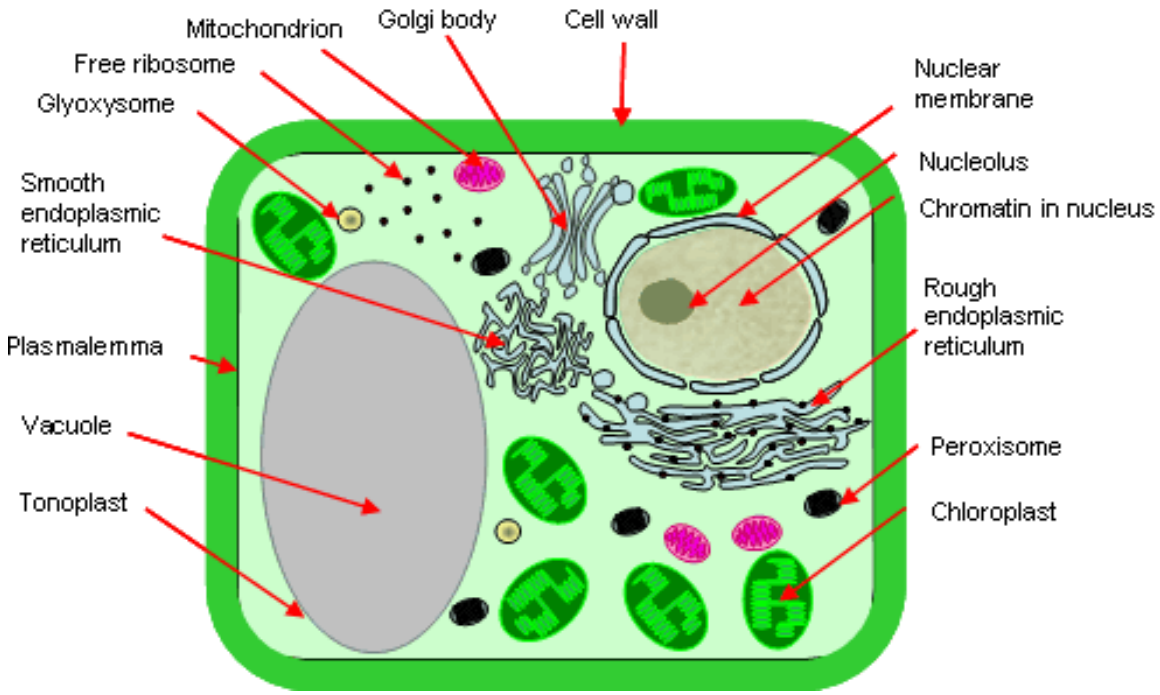
- Mostly multicellular e.g. mushrooms
- Some are unicellular, e.g. yeast
- Cell walls made of chitin
- Many are *decomposers* in ecosystem,
- They *absorb* food (this is not the same as ingesting) e.g. mushrooms



Kingdom Plantae

- Multicellular
- Photosynthetic
- *Producers* in ecosystem
- Cell walls made of cellulose
- From mosses to the Redwoods





Kingdom Animalia

- Multicellular
- *Consumers*
- *Ingest* food
- No cell wall