Unit 3 Part 2

Earth's Biodiversity Classification

Earth's biodiversity can be explained both by genetic changes in populations over time and by major evolutionary changes that produce new species

Earth's biodiversity can be classified into _____- taxon (plural taxa) one of a series of progressively smaller groups made when subdividing the three domains and six kingdoms.

Domain

Kingdom

Phylum

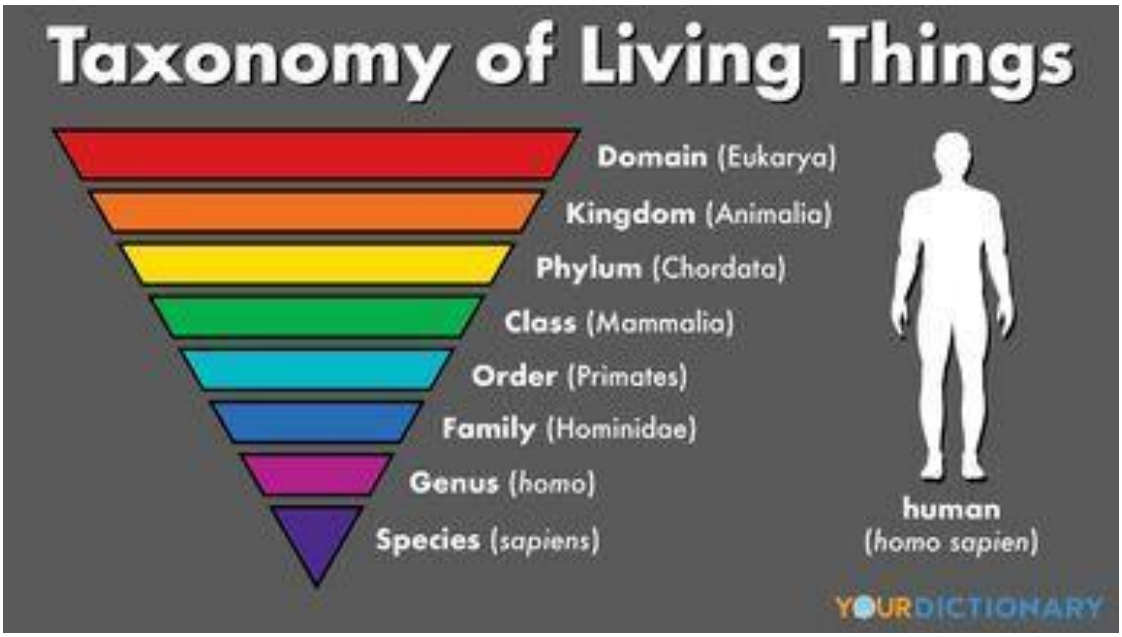
Class

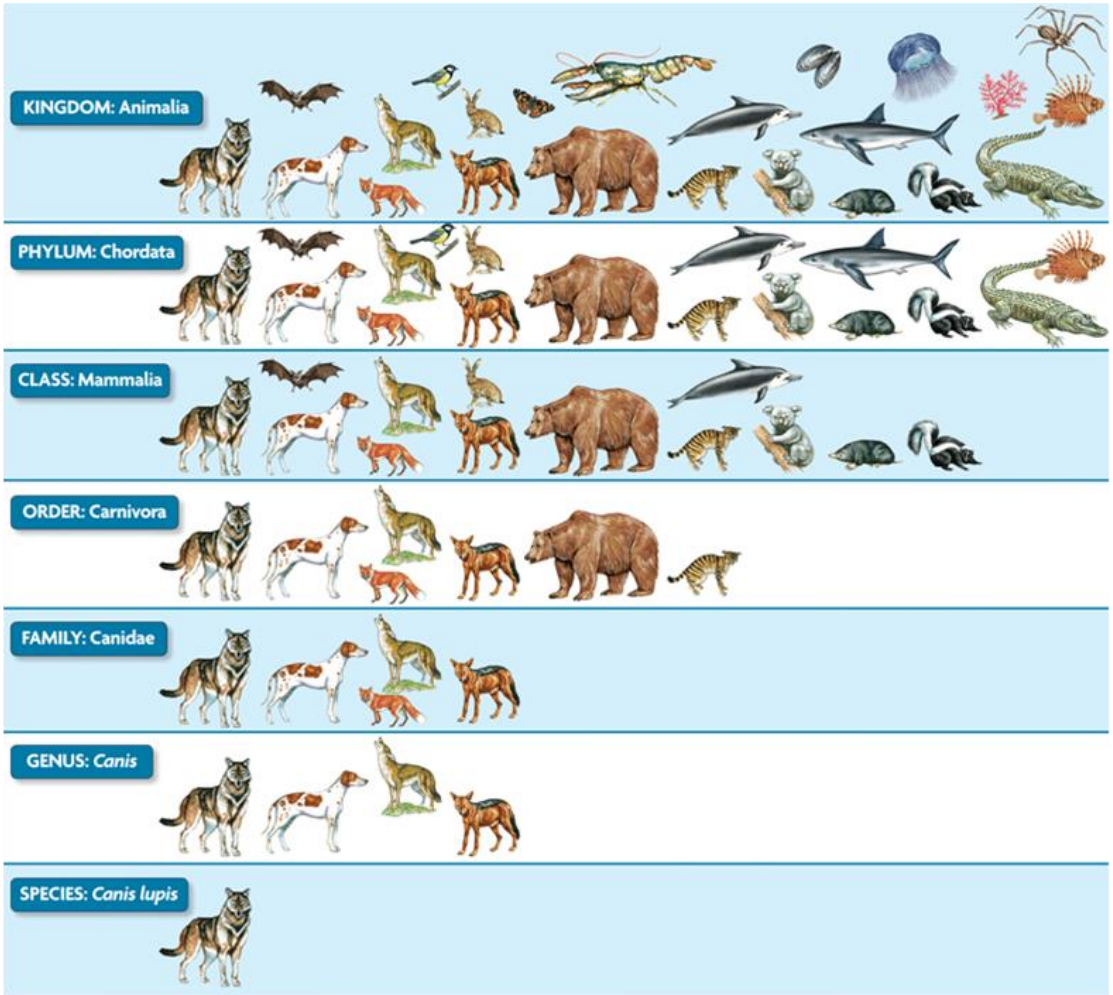
Order

Family

Genus

species





_____ system of using a two-word name for each species, the _____ together.

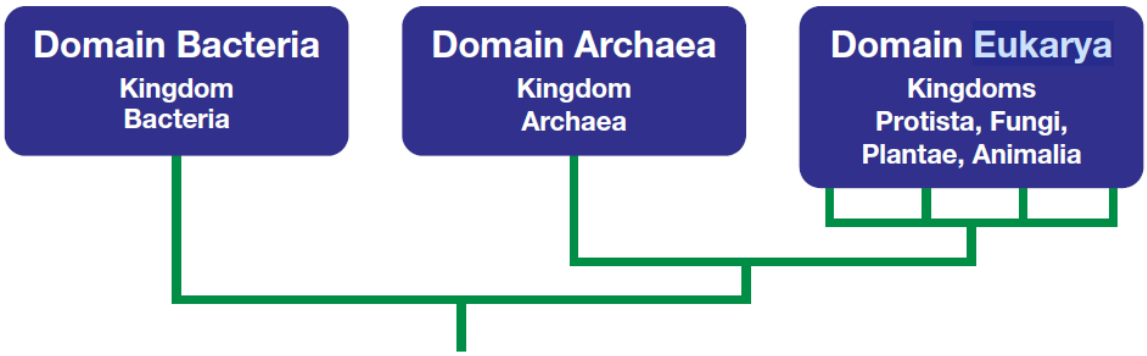
The first word is the name of the genus (plural genera) in which the organism is classified. The first letter of this name is capitalized. Because a genus may contain more than one species, there may be several species with the same first name. **For example, the genus Canis includes Canis lupus (wolf), Canis latrans (coyote), and Canis familiaris (domestic dog).**

_____

_____

_____

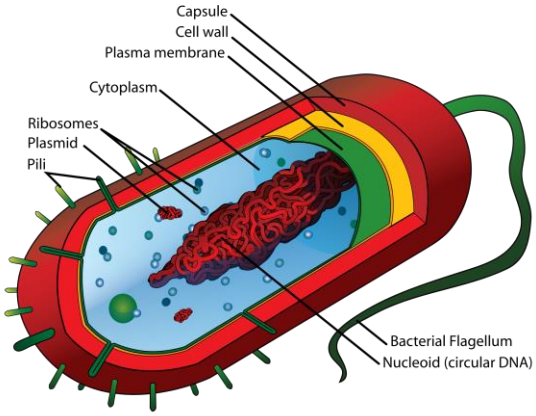
The Three Domains –Bacteria, Archaea and Eukarya



Domain Bacteria

_____

_____ a microscopic _____ organism that has neither a distinct nucleus with a membrane nor other specialized organelles.



They have a cell wall made of peptidoglycan

_____ a rigid layer of polysaccharides lying outside the plasma membrane of the cell. In bacteria it is made of _____.

Most bacterial species are _____

The largest number of bacteria are saprobic, meaning that they feed on dead or decaying organic matter.

A few bacterial species are _____; these bacteria live within host organisms and cause disease.

Certain bacteria are _____, meaning they synthesize their own foods. Such bacteria engage in the process of photosynthesis.

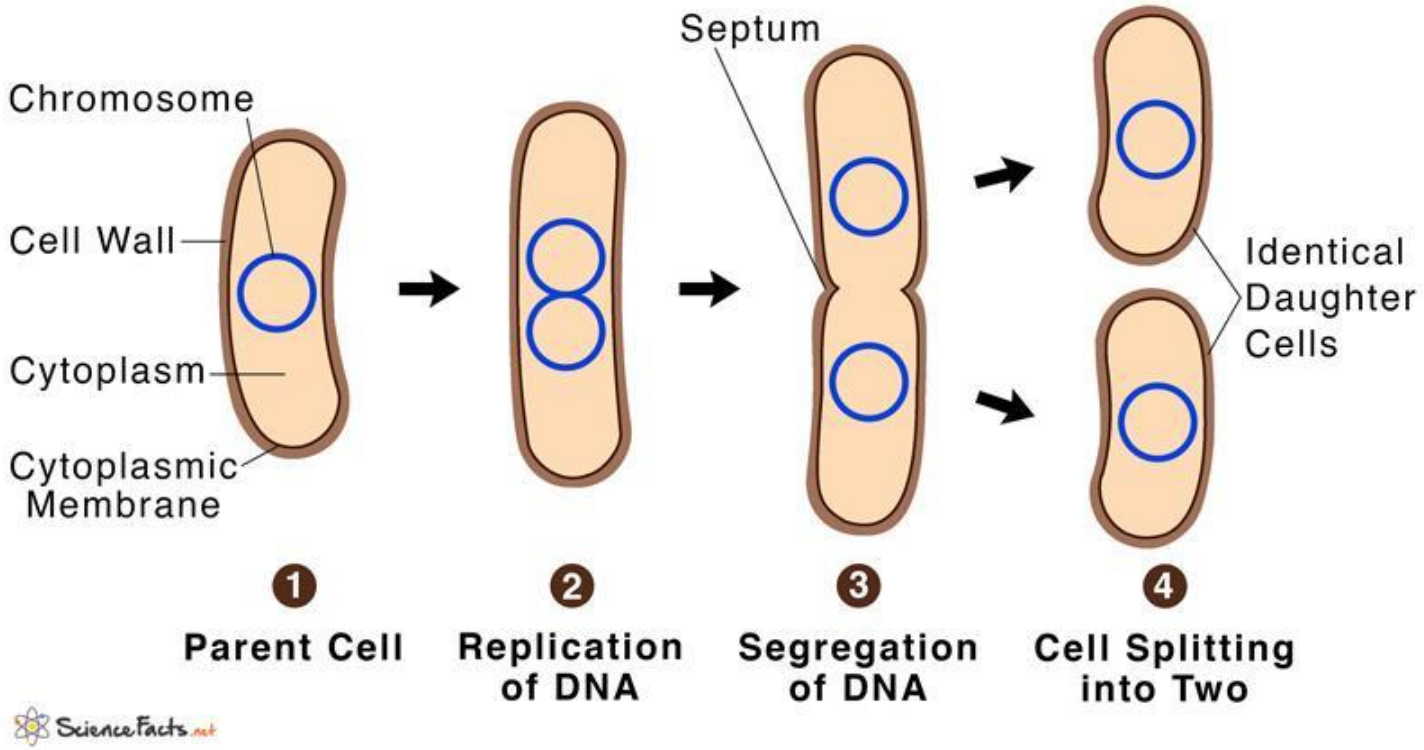
Bacterial movement (_____) depends on the use of different appendages to propel.

Swarming and swimming movements are both powered by rotating _____.

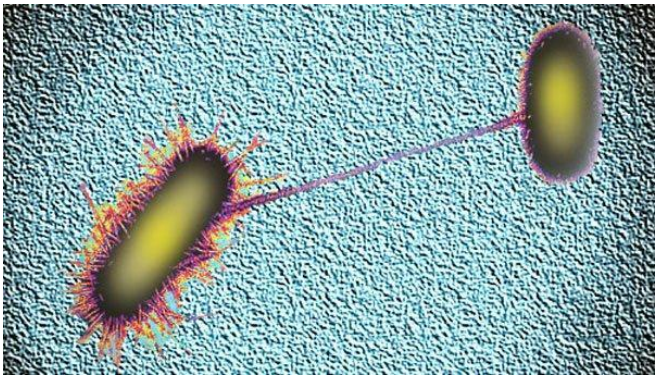
Bacteria reproduce by _____.

In this process the bacterium, which is a single cell, divides into two identical daughter cells. Binary fission begins when the DNA of the bacterium divides into two (replicates). The bacterial cell then elongates and splits into two daughter cells each with identical DNA to the parent cell. Each daughter cell is a clone of the parent cell.

Binary Fission



_____ is often regarded as the bacterial equivalent of sexual reproduction or mating since it involves the exchange of genetic material.

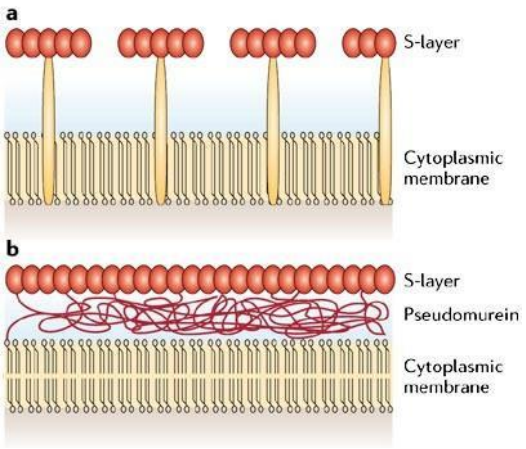


However, it is not sexual reproduction, since no exchange of gamete occurs, and indeed no generation of a new organism: instead an existing organism is transformed.

The genetic information transferred is often beneficial to the recipient.

Benefits may include antibiotic resistance, xenobiotic tolerance or the ability to use new metabolites.

Other elements can be detrimental and may be viewed as bacterial parasites.



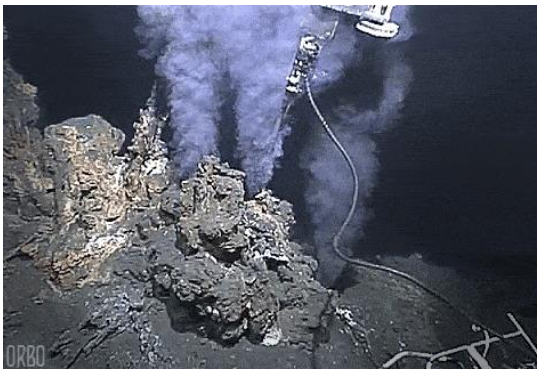
<u>Domain Archaea</u>

Are also _____ organisms lacking a true nucleus.

The cell wall of archaea is composed of _____ _____ molecules

_____ a paracrystalline protein surface layer, present in nearly all archaea described to date.

Most archaea are _____ and derive their energy and nutrients from breaking down molecules in their environment.



A few species of archaea are _____ and capture the energy of sunlight.

No known parasitic archaea

Archaea use a IV pili for _____ - motion is achieved by rotation.

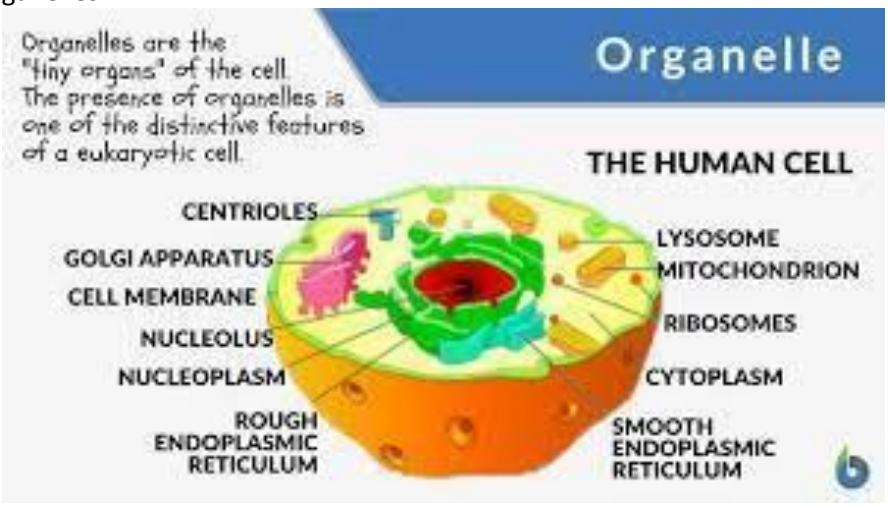
Archaea procreate using a process called _____.

In this binary fission process, archaeal DNA replicates, and the two strands are pulled apart as the cell grows.

Domain Eukarya

a domain of organisms having cells each with a distinct _____ within which the genetic material is contained and membrane bound organelles.

_____ a specialized cellular part (such as a mitochondrion, chloroplast, or nucleus) that has a specific function inside the cell



Kingdoms

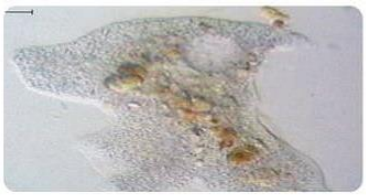
Protista, Fungi, Plantae and Animalia

Kingdom Protista

Protista is kingdom of simple eukaryotic organisms. They can be animal-like, plant-like, fungus-like

The vast majority of protists are _____ or form colonies consisting of one or a couple of distinct kinds of cells

There are _____ protists among brown algae and certain red algae.



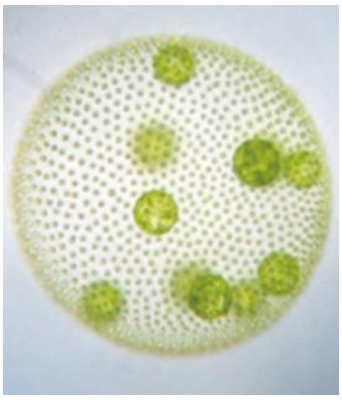
"Animal-like" *Chaos diffluens*

"Plant-like" *Eupodiscus radiatus*

"Fungus-like" *Fuligo septic*

Multi-cellular seaweed *Fucus vesiculosus*

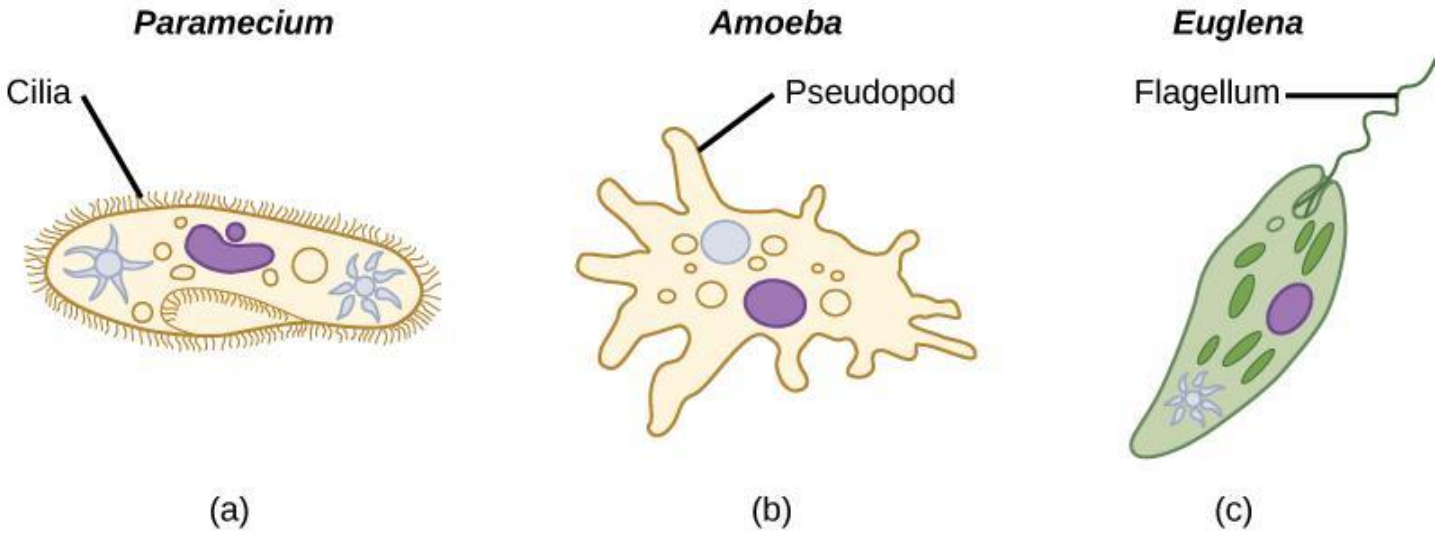
Plant like Protista have cell walls made of _____. Others do not have cell walls.



Some are _____and some are _____.

The majority of protists are _____, but different types of protists have evolved varied modes of movement.

Protists such as euglena have one or more _____ which they rotate or whip to generate movement. Paramecia are covered in rows of tiny _____ that they beat to swim through liquids. The Amoeba has feet like structures called _____.

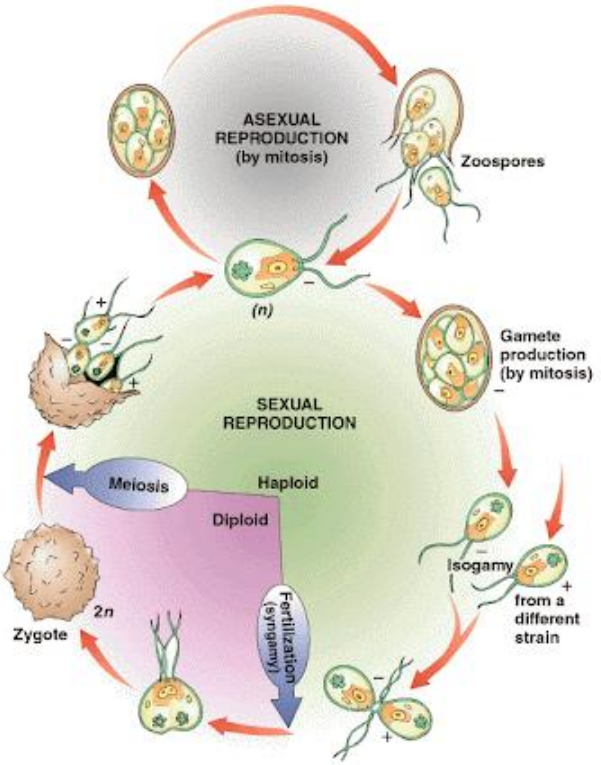


Protists reproduce by a variety of mechanisms.

Most undergo some form of _____, such as _____, to produce two daughter cells.

Others produce tiny _____ (_____) that go on to divide and grow to the size of the parental protist.

_____, involving meiosis and fertilization, is common among protists, and many protist species can switch from asexual to sexual reproduction when necessary.



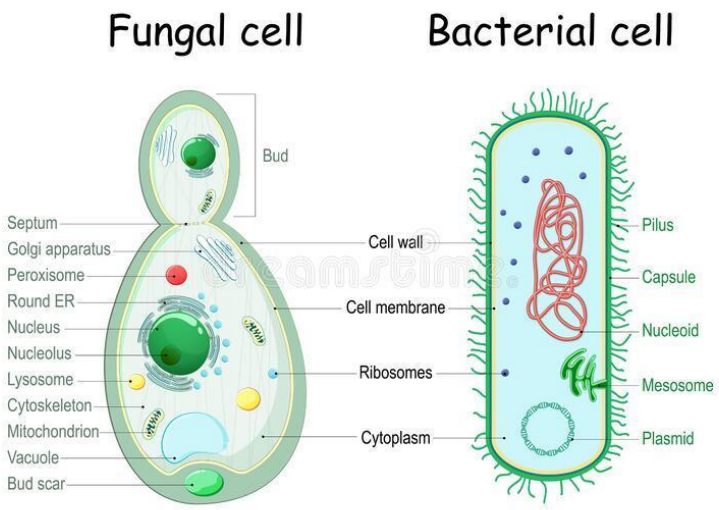
Kingdom Fungi

Fungi are _____ or _____.

They have a cell wall composed is composed mainly of _____.

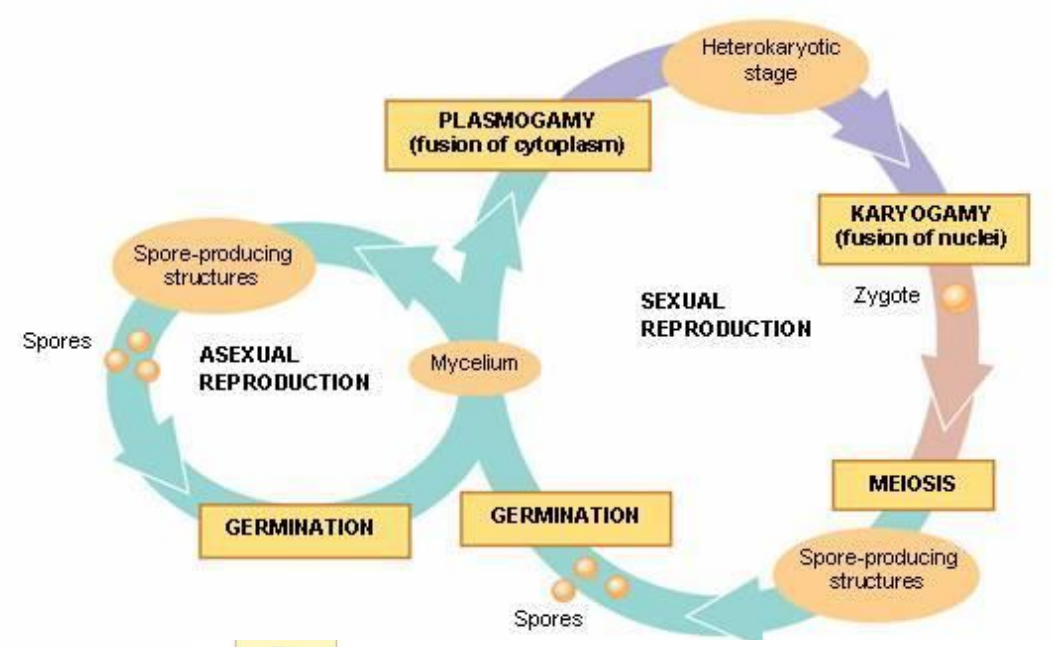
Fungi are heterotrophs, they are either _____ or parasites.

Fungi produce digestive enzymes for breaking down dead organic material into a simple form of food.



Fungi are classified as _____, BUT their spores can be motile.

Most fungi reproduce by forming _____ that can survive extreme conditions such as cold and lack of water. Both _____ _____ and _____ _____ spores may be produced, depending on the species and conditions. Most fungi life cycles consist of both a diploid and a haploid stage.



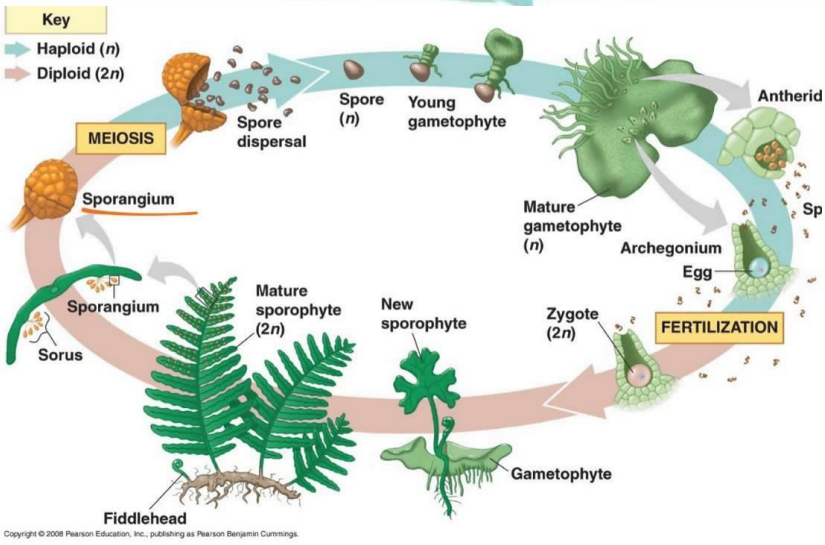
Kingdom Plantae

Plants are _____ organisms.

They have a _____ composed of _____and are _____, except some forms such as bryophytes have gametes that move using flagella or cilia.

Plants are autotrophs that can produce their own energy through _____.

Plant reproduction can be through _____ or _____.



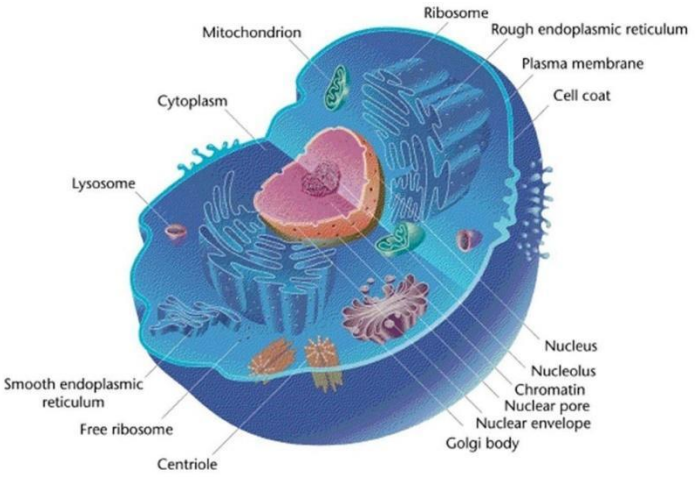
Kingdom Animalia

Animals are _____ organisms that do not have a cell wall.

All animals are considered _____ at some part of their life cycle.

All animals are _____ and cannot make their own food.

Animals can reproduce through _____ or _____.



Viruses

Viruses have no cellular structure.

By this definition, therefore, _____

_____

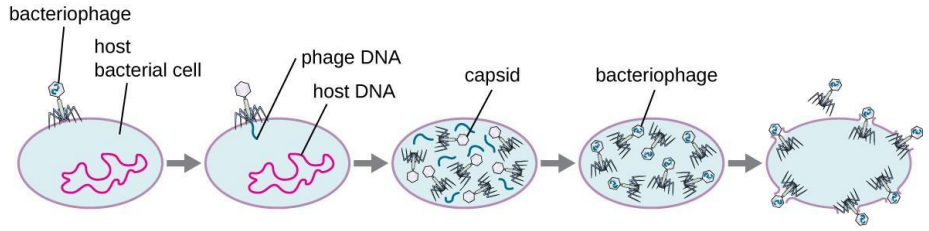
Viruses have no cytoplasm, organelles, or cell membranes. _____

_____

Viruses consist of little more than strands of _____ surrounded by a protective protein coat called a capsid.

They are mobile genes that parasitize cells.

Viruses attach to specific receptors on the host cell.



1. **Attachment** The phage attaches to the surface of the host.
2. **Penetration** The viral DNA enters the host cell.
3. **Biosynthesis** Phage DNA replicates and phage proteins are made.
4. **Maturation** New phage particles are assembled.
5. **Lysis** The cell lyses, releasing the newly made phages.

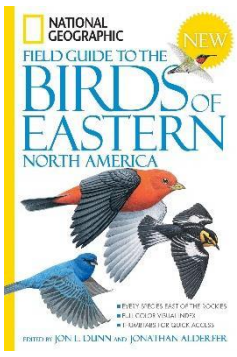
Specimen Identification Tools

_____ identification key that uses a series of paired comparisons to sort organisms into smaller and smaller groups.

_____ a book for the identification of birds, flowers, minerals, or other things in their natural environment.

_____ _____ can also be used to identify species of organisms.

Very common for insects and flowers. There are some apps that do animals as well.



Bird 1	Bird 2	Bird 3

1.	a. Has a short bill (smaller than the head)	go to 2
	b. Has long bill (longer than the head)	go to 5
2.	a. Has a crest on head	Tufted titmouse
	b. No crest on head	go to 3
3.	a. Bill is straight	go to 4
	b. Bill is not straight	Red-tailed hawk
4.	a. Has two black neck bands	Killdeer
	b. Has white eye ring	Ovenbird
5.	a. Has plumes extending from the head	Great blue heron
	b. No plumes extending from the head	Ruby-throated hummingbird

Lab Using a Dichotomous Key

Biological classification systems change as new understandings of organisms emerge

Often as a result of the invention of a technology.

_____, _____
_____ revealed key differences among organisms

Classification systems are then modified to better explain these differences.

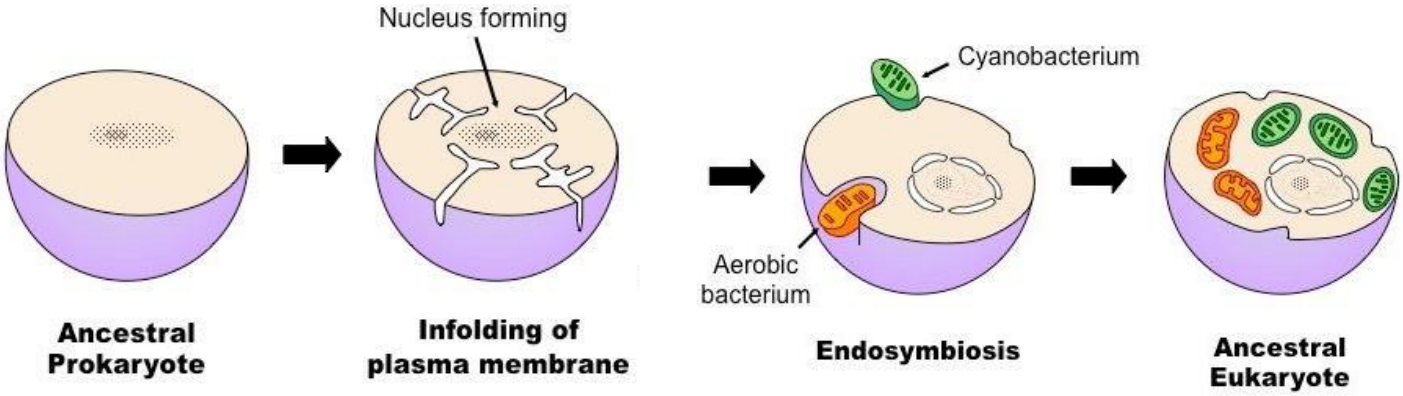
Macroevolution

_____ theory that explains eukaryotic cells arose through a process in which a larger prokaryotic cell engulfed another

Endosymbiosis

First – development of nucleus

Second - Endosymbiosis



1.2 Billion years ago a bacterium that uses oxygen begins living inside a common eukaryotic ancestor of animals, plants and fungi to form mitochondria

1 billion years ago a bacterium such as cyanobacteria begins living inside of a common eukaryotic ancestor of plants and protists to form chloroplasts.

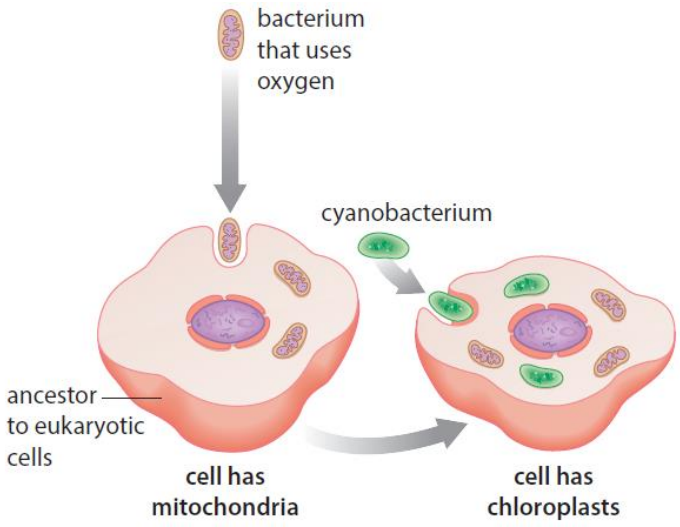


Figure 17.21 The theory of endosymbiosis explains that mitochondria were once oxygen-using bacteria that were engulfed by other bacterial cells. Chloroplasts were also bacteria that were engulfed by other cells.

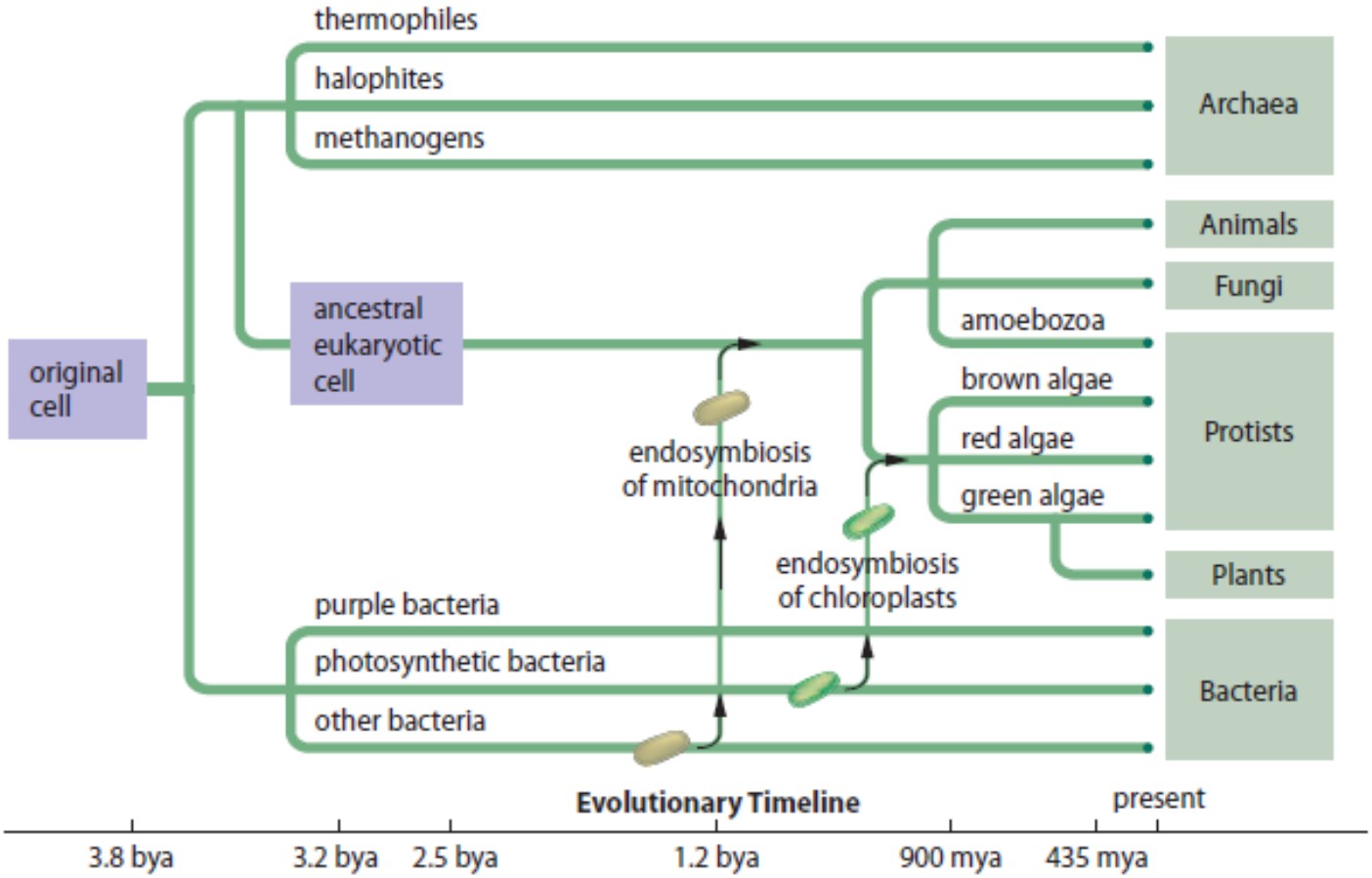


Figure 17.20 Simple single-celled life has existed on Earth since at least 3.5 billion years ago. Eukaryote evolution occurred much later. Eukaryotes share a more recent common ancestor with Archaea than with Bacteria.

_____ evolutionary history of a kind of organism.

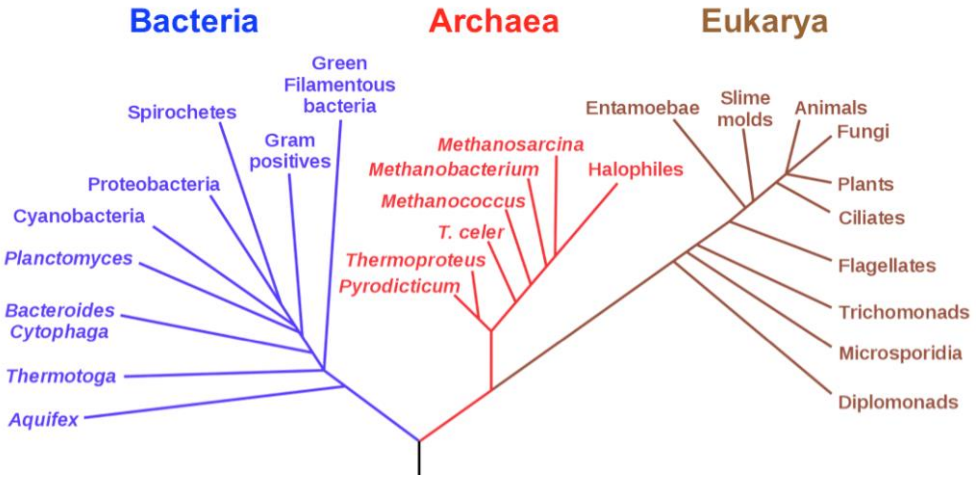
Organisms are classified by:

Relatedness

Homologous structures

Fossil records

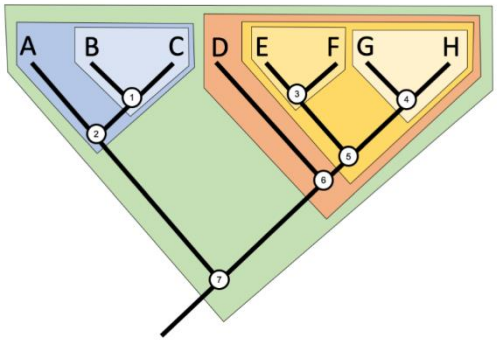
Genetic and molecular analysis

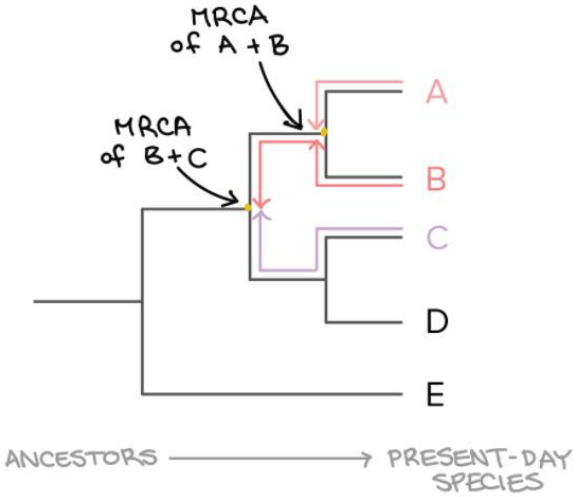


Relatedness

In an evolutionary tree, the relatedness of two species has a very specific meaning. Two species are more related if they have a more recent common ancestor, and less related if they have a less recent common ancestor.

A&B are more related than B&C.



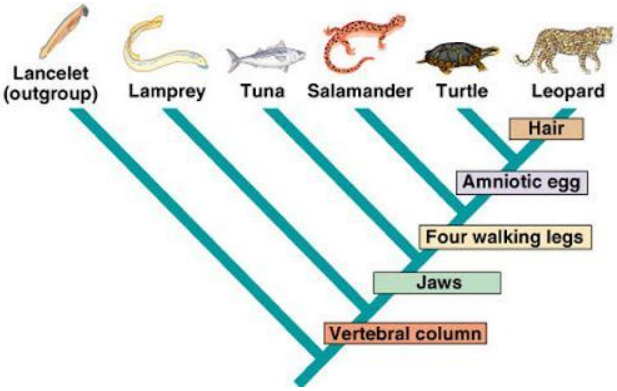


_____ group of species that includes one common ancestor and all its descendants

_____ _____ a shared character is one that two lineages have in common, and a derived character is one that evolved in the lineage leading up to a clade and that sets members of that clade apart from other individuals. Shared derived characters can be used to group organisms into clades.

Two groups that share a recently evolved trait are thought to be more closely related to each other than to groups that do not share the trait.

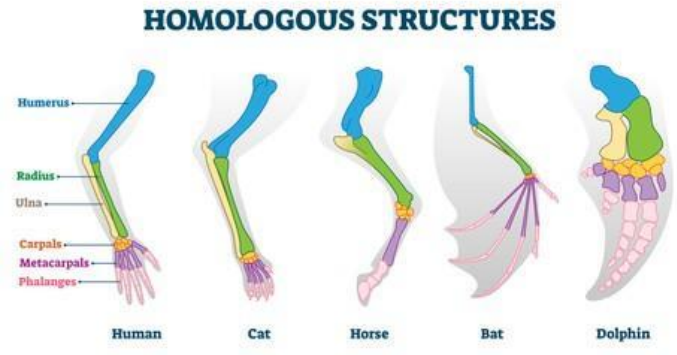
Turtles and Leopards both share the amniotic egg as an evolved trait so they are more closely related than the leopard and the salamander.



Homologous Structures

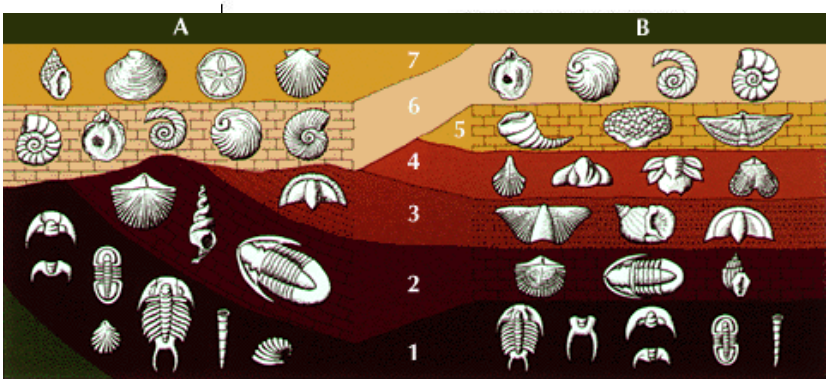
_____

physical features with the same evolutionary origin and underlying structural elements, but that may have different functions



Fossil Record

fossil record remains or traces of past life preserved in sedimentary rock, which reveal the history of life on Earth



Genetic and Molecular Analysis

Molecular phylogenetics is the branch of phylogeny **that analyzes genetic, hereditary molecular differences, predominately in DNA sequences**, to gain information on an organism's evolutionary relationships.

From these analyses, it is possible to determine the processes by which diversity among species has been achieved.

The result of a molecular phylogenetic analysis is expressed in an evolutionary tree

Molecular phylogenetics is one aspect of molecular systematics, a broader term that also includes the use of molecular data in taxonomy and biogeography.

Genetic characters

Sequence of portion of chloroplast DNA

Japanese black pine *(Pinus thunbergii)*	TAATAAAGGAGG------GACTTATGTCAC
Bhutan white pine (*Pinus bhutanica*)	TAATAAAGGAGGGA------CTTATGTCGC
Chiapas pine (*Pinus chiapensis*)	TAATAAAGGAGGGACTTAGACTTATGTCAC
Eastern white pine (*Pinus strobus*)	TAATAAAGGAGGGACTTAGACTTATGTCAC
Lacebark pine (*Pinus bungeana*)	TAATAAAGGAGGGAC-TGA-CTTATGTCAC
Red pine (*Pinus resinosa*)	TAATAAAGGAGGGA------CTTATGTCAC
Single leaf pinyon (*Pinus monophylla*)	TAATAAAGGAGGGA------CTTATGTCAC

Morphological characters

	number of vascular bundles per needle	sheath around needle bundle (1=straight, 2=curling back)	number of needles per bundle	seed wing (0=absent, 1=detachable, 2=permanent)
Japanese black pine *(Pinus thunbergii)*	2	1	2	2
Bhutan white pine (*Pinus bhutanica*)	1	2	5	1
Chiapas pine (*Pinus chiapensis*)	1	2	5	1
Eastern white pine (*Pinus strobus*)	1	2	5	1
Lacebark pine (*Pinus bungeana*)	1	2	3	2
Red pine (*Pinus resinosa*)	2	1	2	2
Single leaf pinyon (*Pinus monophylla*)	1	2	1	0

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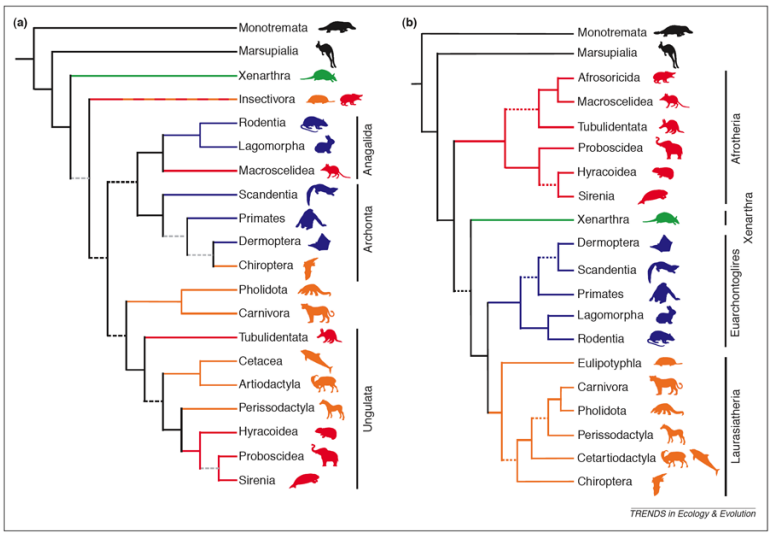
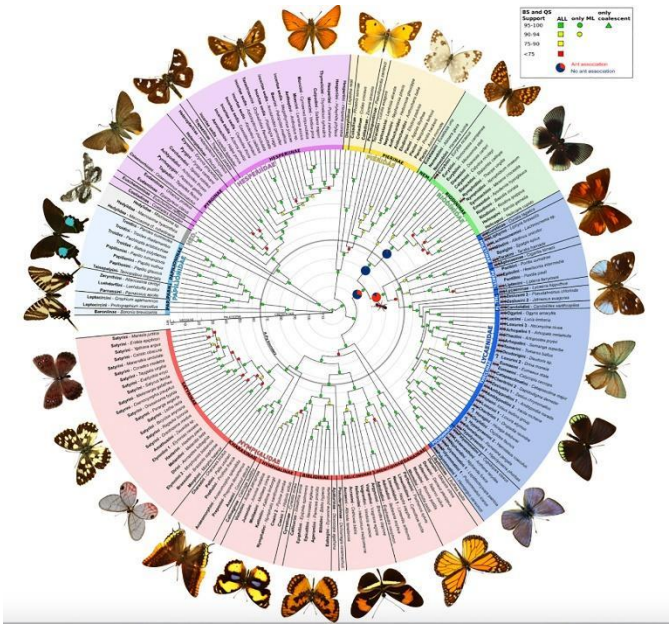
diagram used to illustrate the evolutionary relationships among different types of organisms.

Trees can be drawn many different ways.



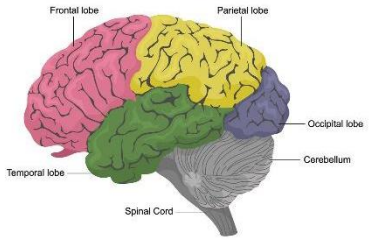


Research Project - Activity 17.4

Non-Chordates

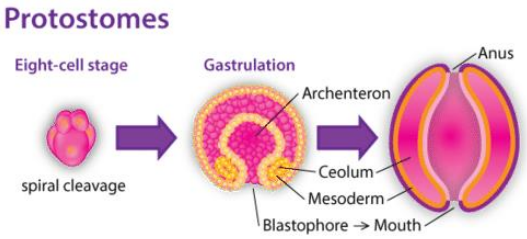
Porifera	Cnidaria	Platyhelminthes	Rotifera	Annelida
Mollusca	Arthropoda	Nematoda	Echinodermata	

_____ the concentration of sense organs, nervous control, etc., at the anterior end of the body, forming a head and brain, both during evolution and in the course of an embryo's development.



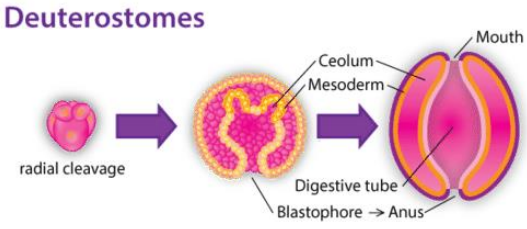
_____ a multicellular organism whose mouth develops from a primary embryonic opening, such as an annelid, mollusk, or arthropod.

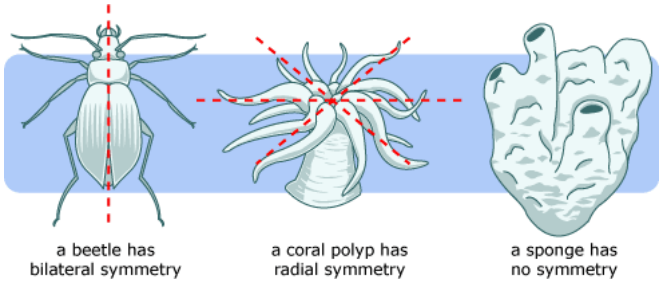
_____ are animals typically characterized by their anus forming before their mouth during embryonic development.



_____ in biology is the balanced arrangement of body parts or shapes around a central point or axis.

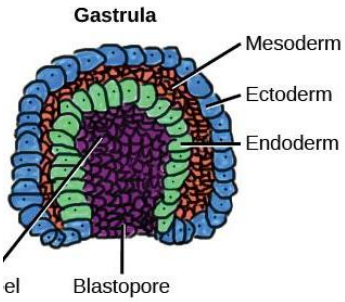
Asymmetry – no symmetry
Radial – round or circular
Bilateral – split in two





Embryonic Cell Layers

Ectoderm Mesoderm Endoderm



Monoblastic – one layer

Diploblastic – two layers

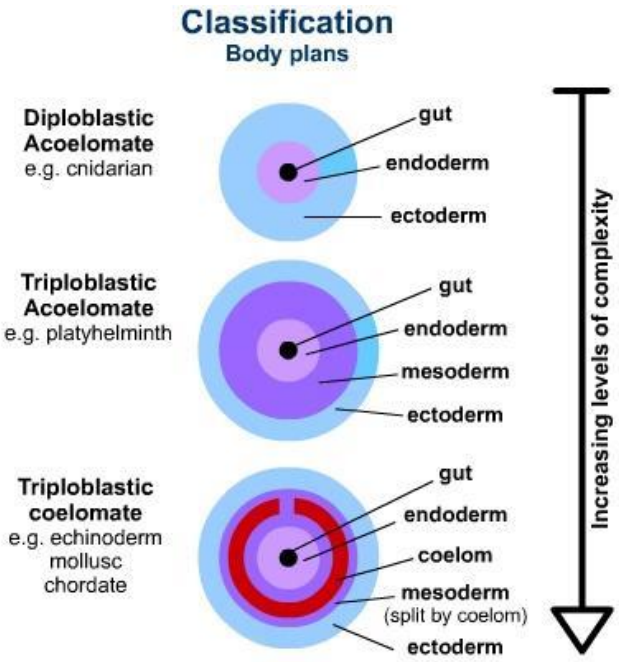
Triploblastic – three layers

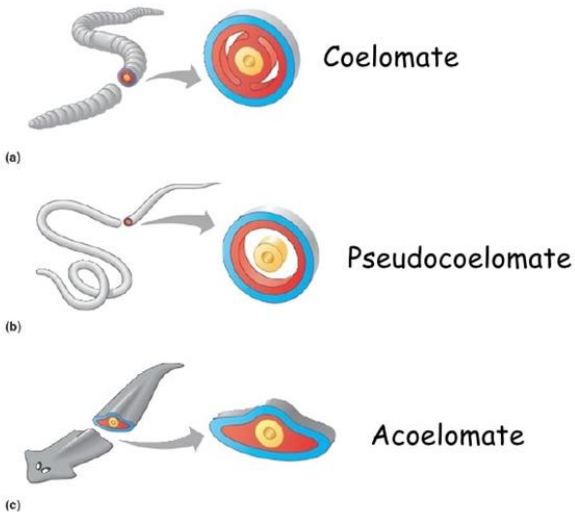
_____ the body cavity in metazoans, located between the intestinal canal and the body wall.

_____ having a body cavity that is a coelom

_____ an invertebrate (such as a nematode or rotifer) having a body cavity that is a pseudocoel.

_____ an invertebrate lacking a coelom



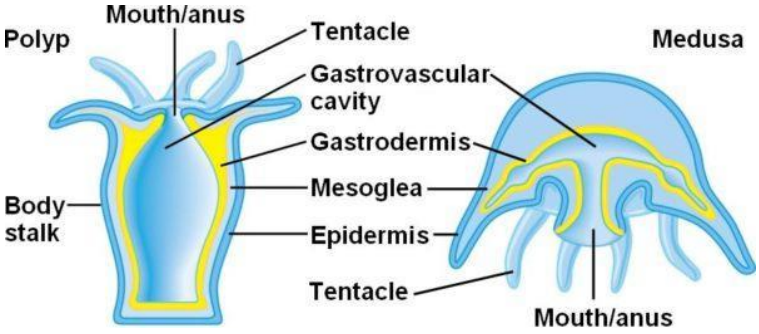


Porifera (Sponges)

Specialized Tissues: No Nerves
Body plan symmetry: Asymmetry (no body plan) or sometimes radial (round)
Embryonic cell layers: None
Coelom: Acoelomate
Embryonic Development Pattern: Absent
Digestive System: None
Cephalization: not present
Motility: Larvae can swim but adults are non-motile
Segmentation: Absent
Molting: Absent

Cnidaria (Jellyfish)

Specialized Tissues: Nerve Net
Body plan symmetry: Radial (round)
Embryonic cell layers: Diploblastic (two layers), ectoderm and endoderm
Coelom: Acoelomate
Embryonic Development Pattern: Absent
Digestive System: Two-way one opening
Cephalization: not present
Motility: motile
Segmentation: Absent
Molting: Absent

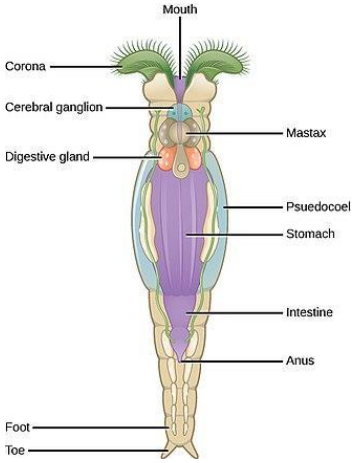


Platyhelminthes (Flatworms)

Specialized Tissues: Present (Brain and Nerve Cords)
Body plan symmetry: Bilateral
Embryonic cell layers: triploblastic (three layers), ectoderm, mesoderm and endoderm
Coelom: Acoelomate
Embryonic Development Pattern: Protostome
Digestive System: One-way two opening
Cephalization: Present
Motility: motile
Segmentation: Absent
Molting: Absent

Rotifera (rotifers)

Specialized Tissues: Present (Brain and Nerve Cords)
Body plan symmetry: Bilateral
Embryonic cell layers: triploblastic (three layers), ectoderm, mesoderm and endoderm
Coelom: Pseudocoelomate
Embryonic Development Pattern: Protostome
Digestive System: One-way two opening
Cephalization: Present
Motility: Motile
Segmentation: externally but not internally segmented
Molting: Absent



Annelida (segmented Worms)

Specialized Tissues: Present (Brain and Nerve Cords)
Body plan symmetry: Bilateral
Embryonic cell layers: triploblastic (three layers), ectoderm, mesoderm and endoderm
Coelom: Eucoelomate
Embryonic Development Pattern: Protostome
Digestive System: One-way two opening
Cephalization: Present
Motility: Motile
Segmentation: Segmented internally and externally
Molting: Absent

Mollusca

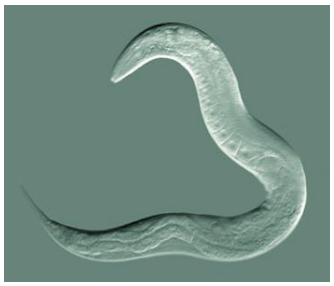



Specialized Tissues: Present
Body plan symmetry: Bilateral
Embryonic cell layers: triploblastic (three layers), ectoderm, mesoderm and endoderm
Coelom: Eucoelomate
Embryonic Development Pattern: Protostome
Digestive System: One-way two opening
Cephalization: Present
Motility: Motile/Sessile (attached to rocks)
Segmentation: Segmented internally and externally
Molting: Absent

Arthropoda

Specialized Tissues: Present
Body plan symmetry: Bilateral
Embryonic cell layers: triploblastic (three layers), ectoderm, mesoderm and endoderm
Coelom: Eucoelomate
Embryonic Development Pattern: Protostome
Digestive System: One-way two opening
Cephalization: Present
Motility: Motile
Segmentation: Segmented internally and externally
Molting: Present

Nematoda (roundworms)

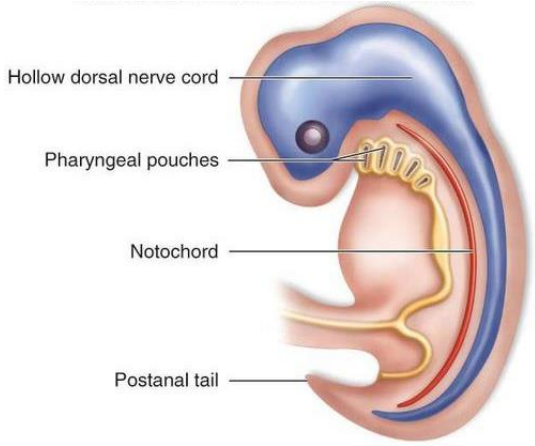


Specialized Tissues: Present
Body plan symmetry: Bilateral
Embryonic cell layers: triploblastic (three layers), ectoderm, mesoderm and endoderm
Coelom: Pseudocoelomate
Embryonic Development Pattern: Protostome
Digestive System: One-way two opening
Cephalization: Present
Motility: Motile
Segmentation: Absent
Molting: Present (four times)

Echinodermata

Specialized Tissues: Present
Body plan symmetry: Radial (pentamerous - five)
Embryonic cell layers: triploblastic (three layers), ectoderm, mesoderm and endoderm
Coelom: Eucoelomate
Embryonic Development Pattern: Deuterostomes
Digestive System: One-way two opening
Cephalization: Absent
Motility: Motile
Segmentation: Absent
Molting: Absent

Anatomy Lab 1



Chordata

All chordates possess primary characteristics, at some point during their larval or adulthood stages that distinguish them from all other taxa. These characteristics include a
Notochord
Dorsal hollow nerve cord
Pharyngeal slits (gills),
Post-anal tail.

_____ a cartilaginous skeletal rod supporting the body in all embryonic and some adult chordate animals.

_____ develops into the central nervous system: the brain and spine.

_____ are openings in the pharynx that develop into gill arches in bony fish and into the jaw and inner ear in terrestrial animals.

_____ is a skeletal extension of the posterior end of the body, being absent in humans and apes, although present during embryonic development.

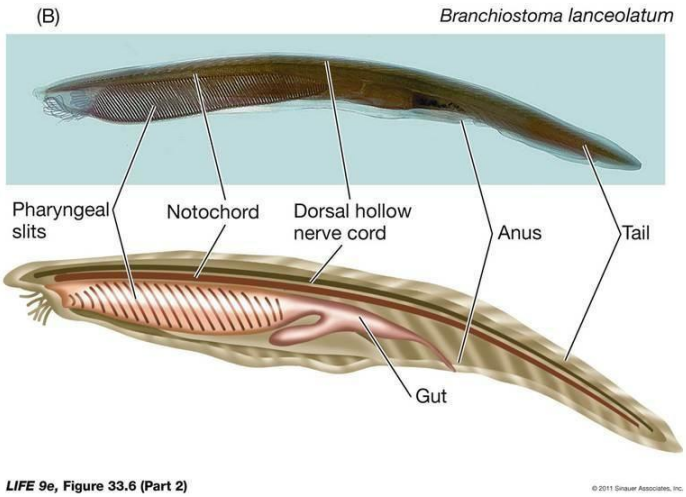
Chordata	Cephalochordata	Urochordata [tunicata]	Agnatha
Chondrichthyes	Osteichthyes	Amphibia	Reptilia
Aves	Mammalia		

_____ an animal that is dependent on or capable of the internal generation of heat; a warm-blooded animal. _____.

_____ any cold-blooded animal whose regulation of body temperature depends on external sources, such as sunlight or a heated rock surface. The ectotherms include the_____
_____

Cephalochordata

a small group of marine invertebrates comprising the _____.



Urochordata [tunicata]

They are basically a barrel-shaped sack with two openings or siphons that water passes through. They draw water into their body through one siphon, filter out food like plankton, and expel the remaining water out of the other siphon.

_____

Agnatha (Jawless Fish)
a group of primitive jawless vertebrates which includes the _____, hagfishes, and many fossil fishlike forms.


Chondrichthyes (cartilaginous Fish)
any member of the diverse group of cartilaginous fishes that includes the _____ (_____), _____, rays, and chimaeras. Most have internal fertilization and development except skates which produce an egg case.


Osteichthyes (bony Fish)
Bony fishes share several distinguishing features:
_____
_____
_____ and paired nostrils.
Aquarium fish
Trout

Amphibia
a class of subphylum Vertebrata comprising forms (_____/_____, toads, newts, and salamanders) they are intermediate in many respects between fishes and reptiles.
are _____ a _____
and that have gilled aquatic larvae and air-breathing lunged adults. They can also absorb oxygen directly though their skin.

Reptilia
These are creeping and burrowing terrestrial animals with scales on their body. They are _____ animals found in most of the warmer regions of the world.

Their skin is _____ and rough, without any glands. The body is divided into head, neck, trunk, and tail. Few of these shed the scales on their skin as skin cast. The respiration takes place with the help of the lungs. They have two pairs of pentadactyl limbs, each bearing claws. Snakes are an exception. The heart is _____. However, crocodiles have a _____ _____. The nervous system comprises of 12 pairs of cranial nerves. They possess a typical cloaca.

Aves

Birds are _____ distinguished by having the body more or less completely covered with _____ and the _____ _____. They have a _____ _____they have _____ and _____.

Mammalia

the highest class of the subphylum Vertebrata comprising humans and all other animals that nourish their young with _____secreted by _____, that have the skin usually more or less covered with _____, a mandible articulating directly with the squamosal, a chain of small ear bones, a brain with four optic lobes, a muscular diaphragm separating the _____ _____ and lungs from the abdominal cavity, only a left arch of the aorta, warm blood containing red blood cells without nuclei except in the fetus, and embryos developing both an amnion and an allantois, and that _____.

Anatomy Lab 2

In-Class Assignment

	Cephalochordata	Urochordata [tunicata]	Agnatha (Jawless fish)	Chondrichthyes (Cartilaginous fish)	Osteichthyes (Bony fish)	Amphibia	Reptilia	Aves	Mammalia
Braincase	Absent	Absent	Present	Present	Present	Present	Present	Present	Present
Jaws (Cartilaginous and bony)	Absent	Absent	Absent	Present (Cartilaginous)	Present (bony)	Present (bony)	Present (bony)	Present (bony)	Present (bony)
Skeleton (Cartilaginous and bony)	Absent	Absent (Hydrostatic Skeleton)	Present (Cartilaginous)	Present (Cartilaginous)	Present (bony)	Present (bony)	Present (bony)	Present (bony - hollow)	Present (bony)
Vertebrae	Absent	Absent	Absent	Present	Present	Present	Present	Present	Present
Limbs (paired – ray or lobed, four – tetrapod, wings – modified forelimbs)	Absent	Absent	Absent	Paired Fins	Paired (Ray finned or lobe finned)	Tetrapod	Tetrapod	Tetrapod Wings – modified forelimbs	Tetrapod
Respiratory (skin, gills – gills slits or operculum, lungs)	Oxygen Absorption Through Skin	Absorption through pharynx	Gill slits	Gill slits	Gills with Operculum	Skin and lungs, gill slits in some stages of life.	Lungs	Lungs	Lungs
Ectotherm or Endotherm	Ectotherm	Ectotherm	Ectotherm	Ectotherm	Ectotherm	Ectotherm	Ectotherm	Endotherm	Endotherm
Heart Chambers (two, three or four)	Absent	Two curved tubes	Two chambers	Two chambers	Two Chambers	Three Chambers	Three Four in Crocodiles	Four Chambers	Four Chambers
External and internal fertilization and development	External Fertilization and Development	External Fertilization and Development	External Fertilization and Development	Internal Fertilization and Development in most, skates lay eggs.	External Fertilization and Development	External Fertilization and Development (Some Salamanders have Internal Fertilization)	Internal Fertilization and External Development	Internal Fertilization and External Development	Internal Fertilization and Development
Eggs (produced and amniotic – soft or hard shell)	Millions, Not amniotic	Millions, Not amniotic	Millions, Not amniotic	One to seven	Millions, not amniotic	Hundreds to tens of thousands, not amniotic	5-100, amniotic with shell	1-50, amniotic with shell	1-15,
Degree of parental care	Absent	Absent	Absent	Absent (skates may guard eggs)	Absent	Absent (most of the time)	Absent (most of the time)	Present	Present
Mammary Glands	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Present
Scales, waterproof skin, feathers, hair,	Skin	Tough Leathery Skin	Skin	Skin	Scales	Skin	Scales	Feathers	Skin
Cephalization	Absent/Weakly Developed	Absent	Present	Present	Present	Present	Present	Present	Present
Brain development	Absent	Absent	Present	Present	Present	Present	Present	Present	Present
Complex sex organs	Numerous Gonads in Paired Rows	Present - One Teste and One Ovary	Present	Present	Present	Present	Present	Present	Present
Examples	Lancelet	Sea Squirt	Lamprey Hagfish	Skate Ray Shark	Herring Trout Aquarium Fish	Tadpole Frog Salamander	Gecko Turtle	Chicken	Rat Pig