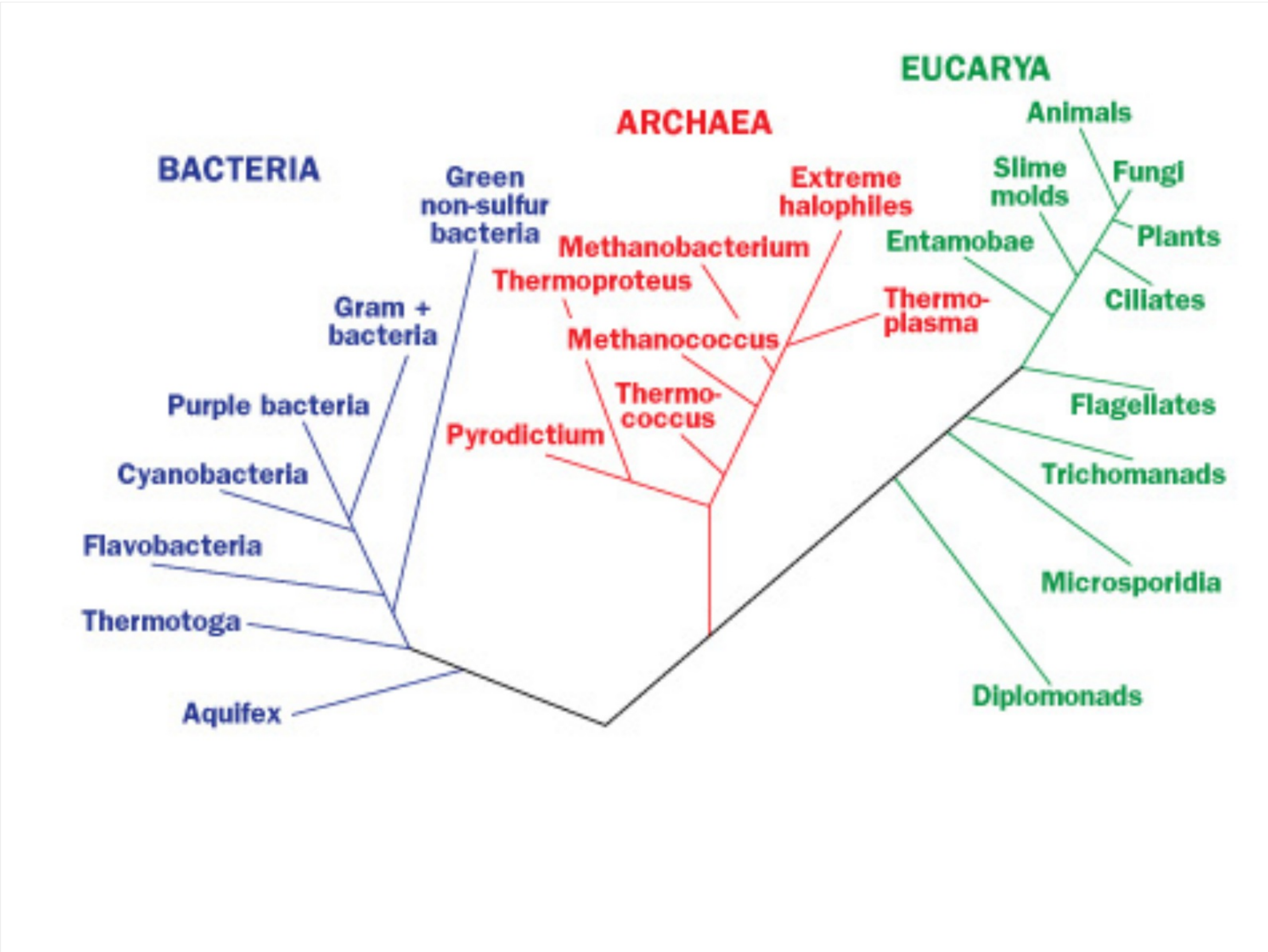
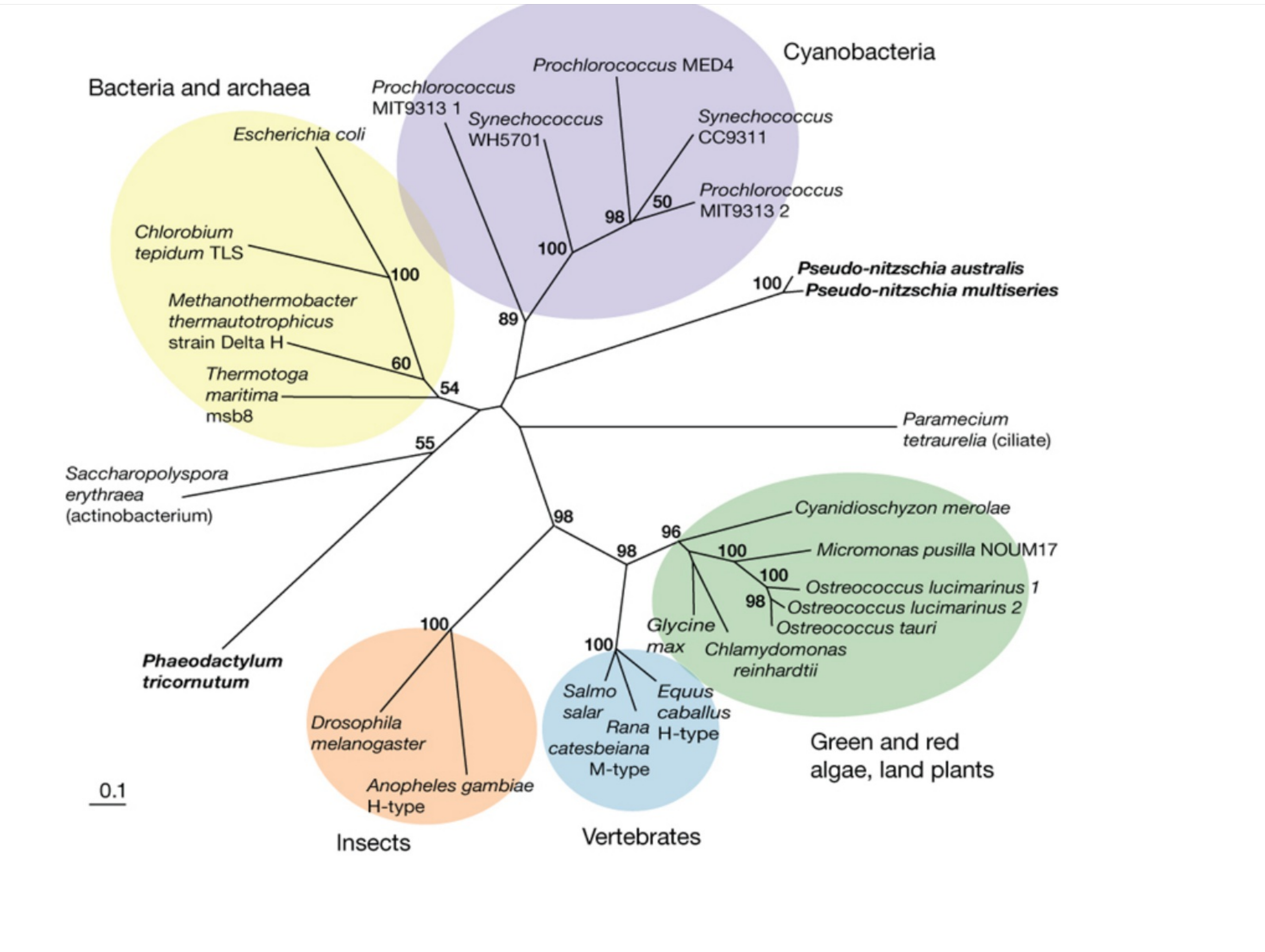
Kickoff: Classify the following works:

Poetry by Edgar A. Poe
Shakespeare's Romeo and Juliet
Biology textbook - Stephen Nowicki
Geometry book - Burger et al.
Book of World Records
2013 Farmers Almanac
J.K. Rowling's Harry Potter and the Sorcerer's Stone
House of the Scorpion - Nancy Farmer

How would you arrange these on a bookshelf at home?
Use an illustration to show the degree of relatedness between the works

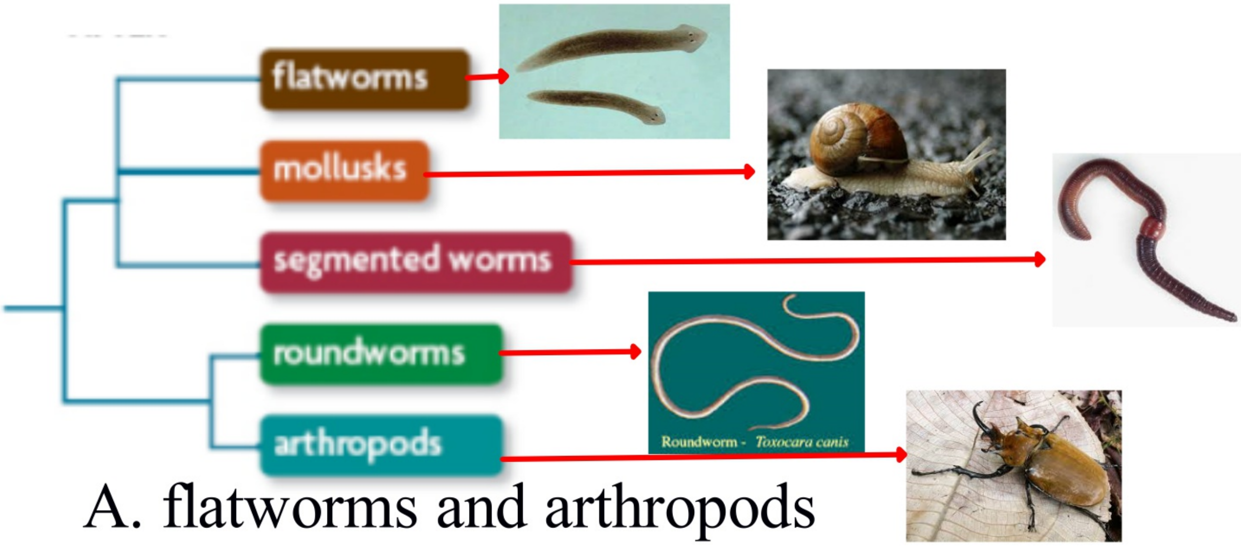

BACTERIA
Green non-sulfur bacteria
Gram + bacteria
Purple bacteria
Cyanobacteria
Flavobacteria
Thermotoga
Aquifex
ARCHAEA
Extreme halophiles
Methanobacterium
Thermoproteus
Thermo-plasma
Methanococcus
Thermo-coccus
Pyrodictium
EUCARYA
Animals
Slime molds
Fungi
Plants
Entamobae
Ciliates
Flagellates
Trichomanads
Microsporidia
Diplomonads



Cyanobacteria
Bacteria and archaea
Prochlorococcus MED4
Prochlorococcus MIT9313 1
Synechococcus WH5701
Synechococcus CC9311
Prochlorococcus MIT9313 2
Escherichia coli
Chlorobium tepidum TLS
Methanothermobacter thermautotrophicus strain Delta H
Thermotoga maritima msb8
Pseudo-nitzschia australis
Pseudo-nitzschia multiseries
Paramecium tetraurelia (ciliate)
Saccharopolyspora erythraea (actinobacterium)
Cyanidioschyzon merolae
Micromonas pusilla NOUM17
Ostreococcus lucimarinus 1
Ostreococcus lucimarinus 2
Ostreococcus tauri
Glycine max
Chlamydomonas reinhardtii
Phaeodactylum tricornutum
Salmo salar
Rana catesbeiana M-type
Equus caballus H-type
Drosophila melanogaster
Anopheles gambiae H-type
Green and red algae, land plants
Insects
Vertebrates
0.1
100
98
50
89
100
100
60
54
55
98
98
96
100
100
98
100
100

Kickoff:

According to the cladogram below, which two organisms are most closely related?



A. flatworms and arthropods

B. roundworms and segmented worms

C. arthropods and roundworms

D. mollusks and arthropods

17.1 The Linnaean System of Classification

KEY CONCEPT

Organisms can be classified based on physical similarities.

17.1 The Linnaean System of Classification

- **Linnaeus developed the scientific naming system still used today.** binomial nomenclature
  - Taxonomy is the science of naming and classifying organisms.

Syntax

White oak:
Quercus alba

Q. alba
Quercus sp.

  - A taxon is a group of organisms in a classification system.

taxa

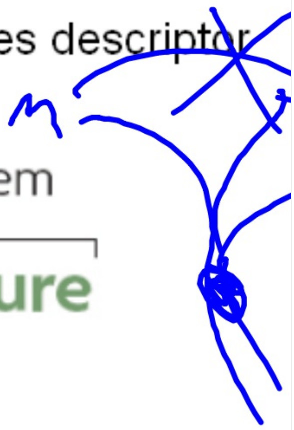
17.1 The Linnaean System of Classification

- Binomial nomenclature is a two-part scientific naming system.
  - uses Latin words
  - scientific names always written in italics
  - two parts are the genus name and species descriptor

two name naming system

bi nomial nomen clature

(1) *Genus* (2) *species*



Homo sapiens

Phylogeny-classification

Domain — 3 : Bacteria
Archaea
Eukarya

increasing likeness

Kingdom (6)
Phylum
Class
Order
Family
Genus
species

Genus species

prokaryote
Archaea
Bacteria

Protist
Fun

Animalia
Plantae

Eukarya

17.1 The Linnaean System of Classification

- A genus includes one or more physically similar species.
  - Species in the same genus are thought to be closely related.
  - Genus name is always capitalized.
- A species descriptor is the second part of a scientific name.
  - always lowercase
  - always follows genus name; never written alone

Canis sp.

Tyto alba

T. alb

17.1 The Linnaean System of Classification

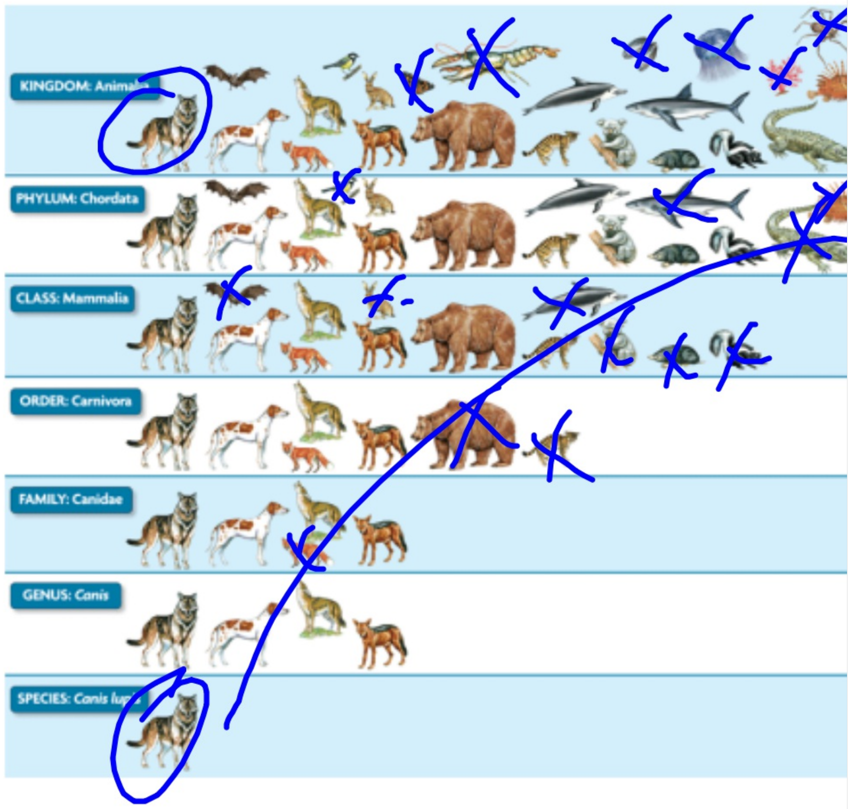
- Scientific names help scientists to communicate.
  - Some species have very similar common names.
  - Some species have many common names.

COMMON NAMES	SCIENTIFIC NAME	
	Genus	**species**
Roly-poly, pill bug, sow bug, potato bug	*Armadillidium*	*vulgare*
Dandelion, Irish daisy, lion's tooth	*Taraxacum*	*officinale*
House sparrow, English sparrow	*Passer*	*domesticus*
Mountain lion, cougar, puma, panther	*Puma*	*concolor*
Red maple, scarlet maple, swamp maple	*Acer*	*rubrum*

17.1 The Linnaean System of Classification

Linnaeus' classification system has seven levels.

- Each level is included in the level above it.
- Levels get increasingly specific from kingdom to species.



17.1 The Linnaean System of Classification

The Linnaean classification system has limitations.

- Linnaeus taxonomy doesn't account for molecular evidence.
  - The technology didn't exist during Linneaus' time.
  - Linnaean system based only on physical similarities.

17.1 The Linnaean System of Classification

- Physical similarities are not always the result of close relationships.
- Genetic similarities more accurately show evolutionary relationships.

Which Family should this belong to?
Procyonidiae
Ursidae
Ailuridae

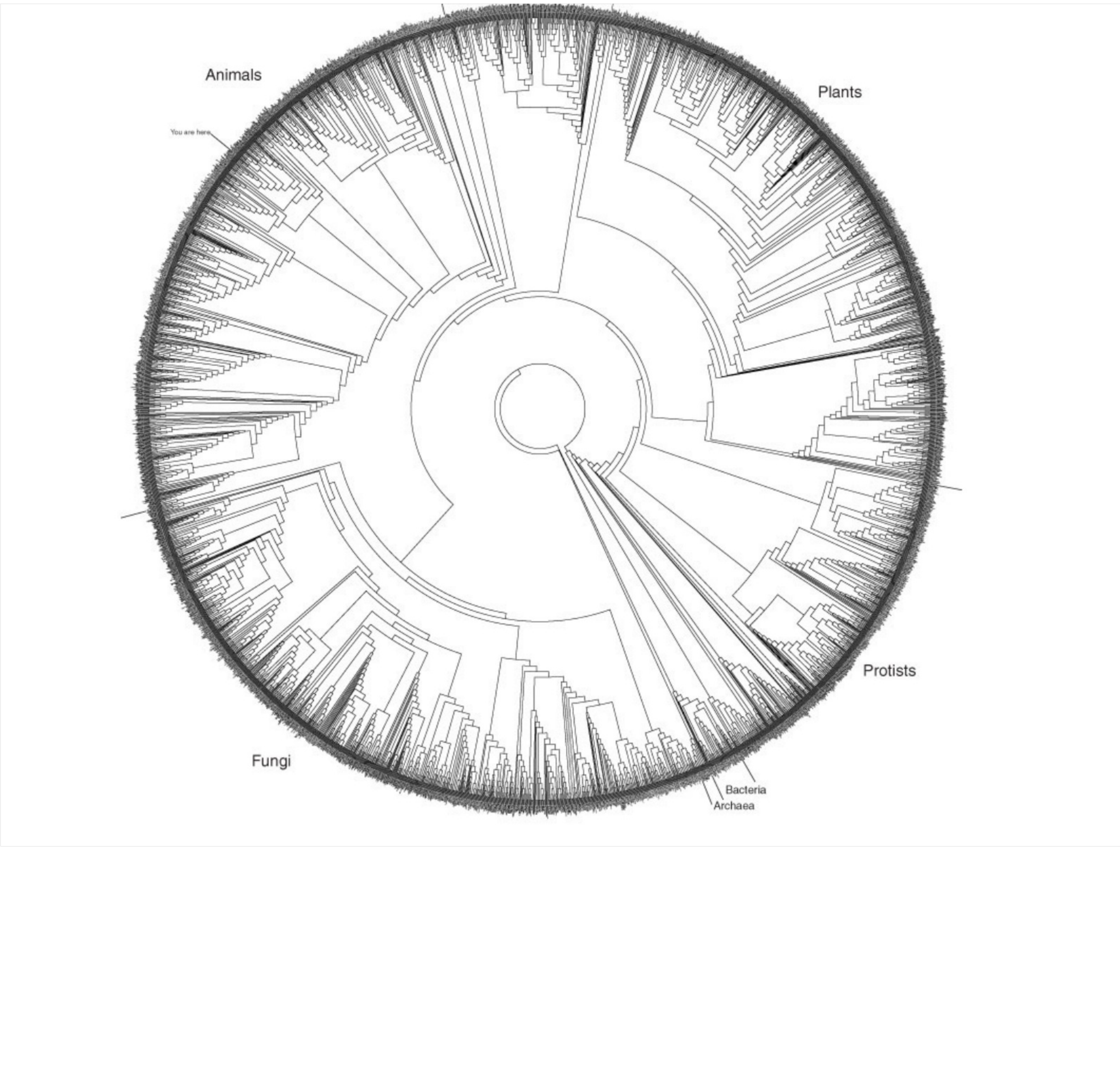
17.2 Classification Based on Evolutionary Relationshi

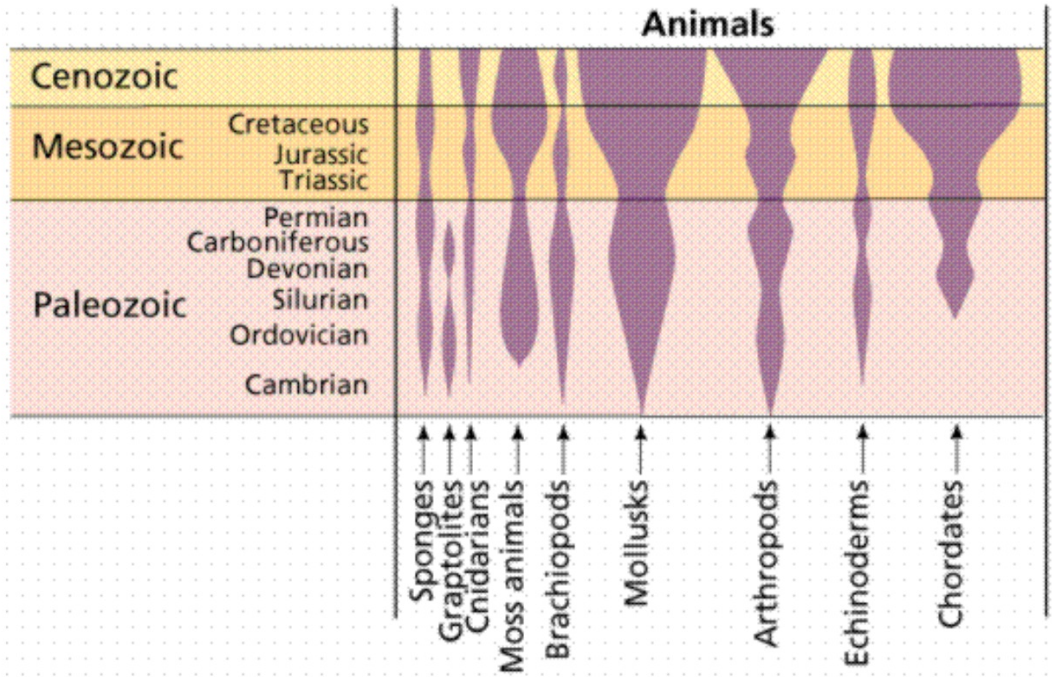
KEY CONCEPT

Modern classification is based on evolutionary relationships.

Kickoff:

List three pieces of evidence that would infer relatedness. Which is the most conclusive?


Animals
You are here
Plants
Protists
Fungi
Bacteria
Archaea

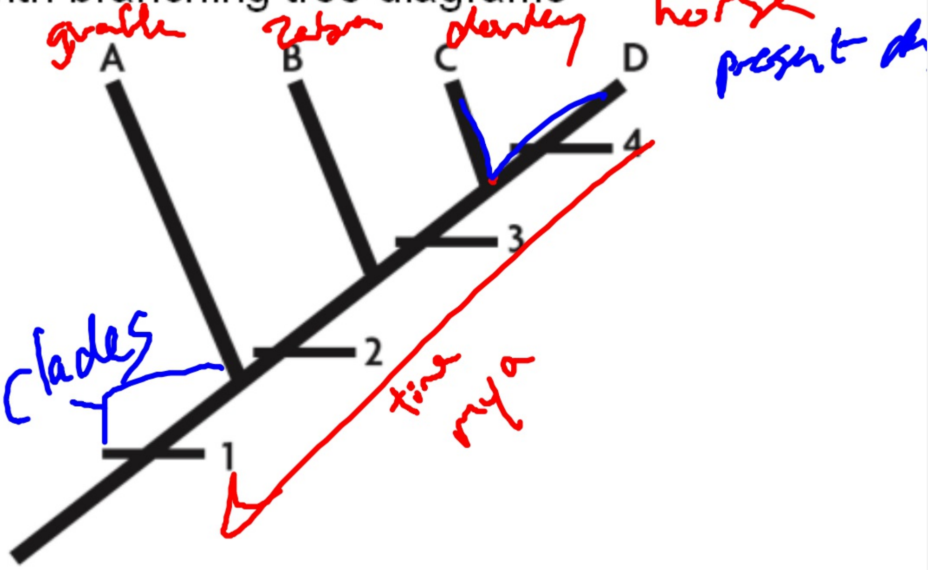


Animals
Cenozoic
Mesozoic
Cretaceous
Jurassic
Triassic
Permian
Carboniferous
Devonian
Silurian
Paleozoic
Ordovician
Cambrian
Sponges
Graptolites
Cnidarians
Moss animals
Brachiopods
Mollusks
Arthropods
Echinoderms
Chordates

17.2 Classification Based on Evolutionary Relationshi

- **Cladistics is classification based on common ancestry.**
  - Phylogeny is the evolutionary history for a group of speci
    - evidence from living species, fossil record, and molecular data
    - shown with branching tree diagrams

Cladogram



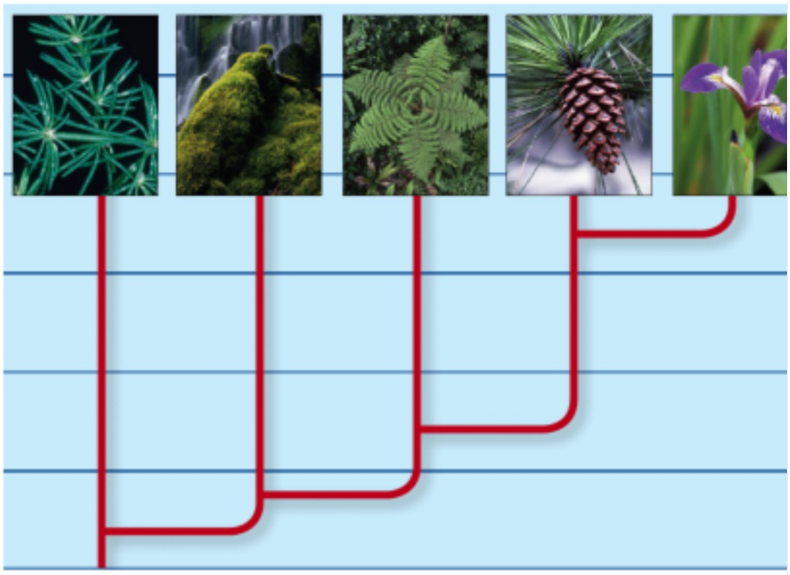
17.2 Classification Based on Evolutionary Relationshi

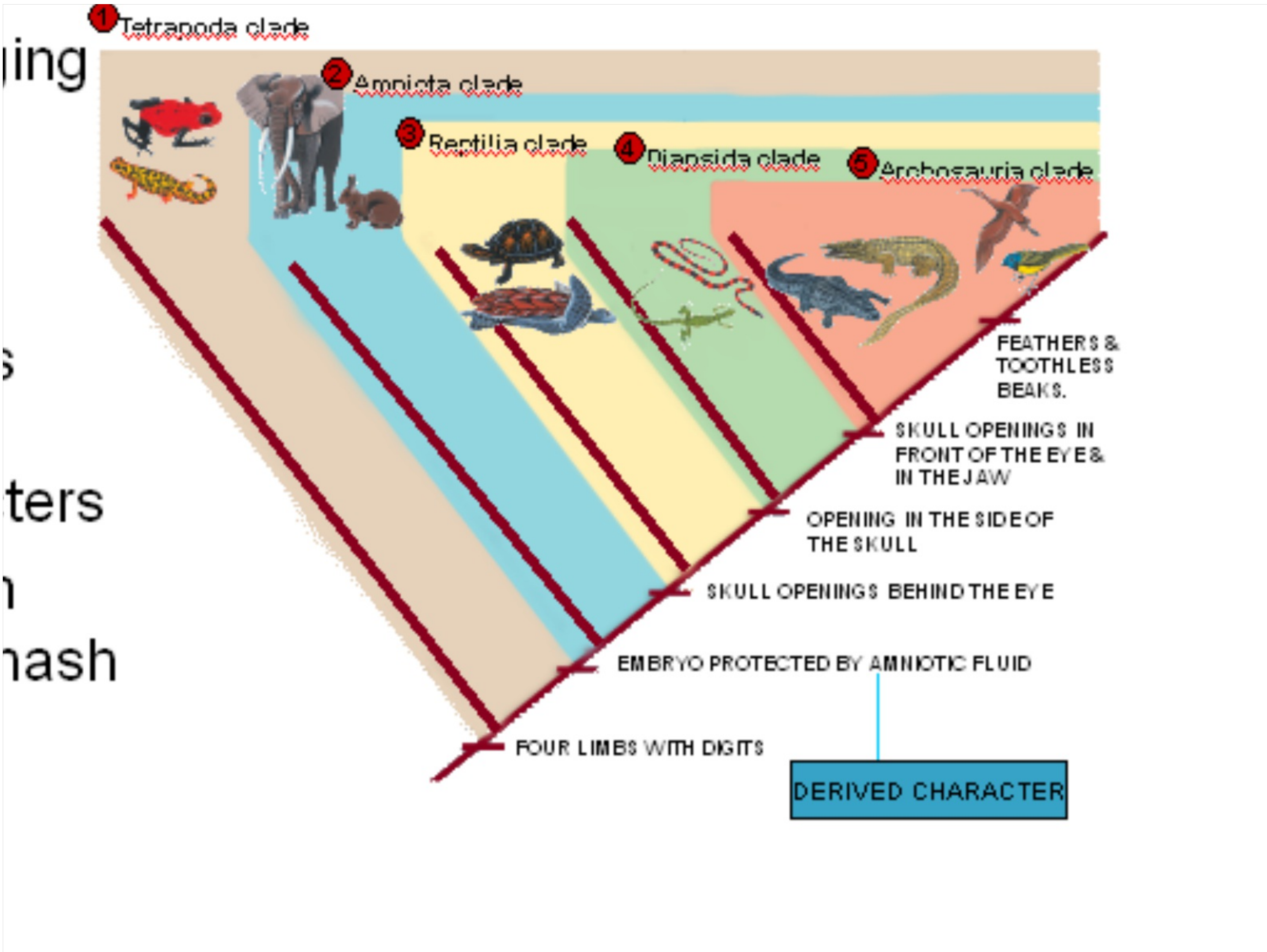
- Cladistics is a common method to make evolutionary tree
  - classification based on common ancestry
  - species placed in order that they descended from common ancestor

pangolin arm

17.2 Classification Based on Evolutionary Relationshi

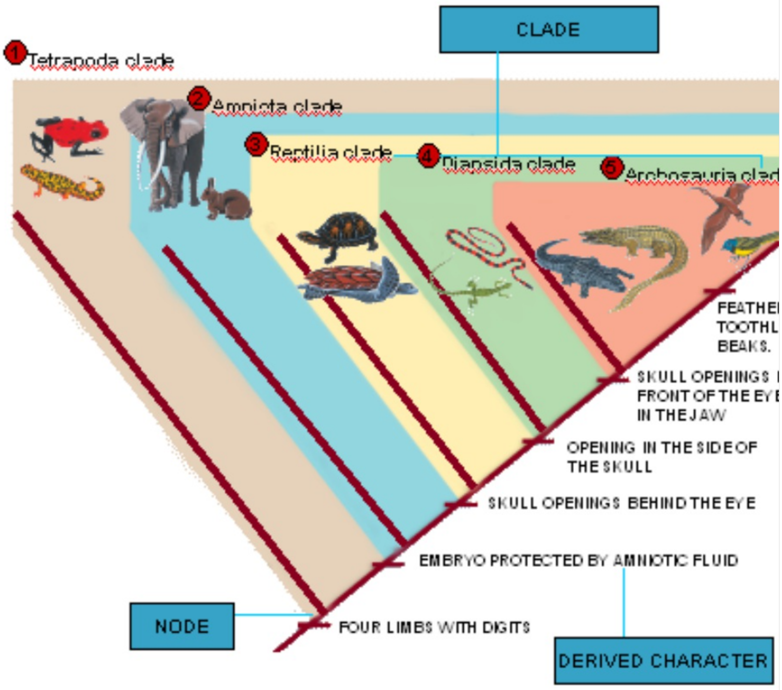
- A cladogram is an evolutionary tree made using cladistic
  - A clade is a group of species that shares a common ancestor.
  - Each species in a clade shares some traits with the ancestor.
  - Each species in a clade has traits that have changed.




1 Tetrapoda clade
2 Amniota clade
3 Reptilia clade
4 Diapsida clade
5 Archosauria clade
FEATHERS & TOOTHLESS BEAKS.
SKULL OPENINGS IN FRONT OF THE EYE & IN THE JAW
OPENING IN THE SIDE OF THE SKULL
SKULL OPENINGS BEHIND THE EYE
EMBRYO PROTECTED BY AMNIOTIC FLUID
FOUR LIMBS WITH DIGITS
DERIVED CHARACTER

17.2 Classification Based on Evolutionary Relationship

- Nodes represent the most recent common ancestor of a clade.
- Clades can be identified by snipping a branch under a node.



17.2 Classification Based on Evolutionary Relationship

Molecular evidence reveals species' relatedness.

- Molecular data may confirm classification based on physical similarities.
- Molecular data may lead scientists to propose a new classification.

- DNA is usually given the last word by scientists.

17.3 Molecular Clocks

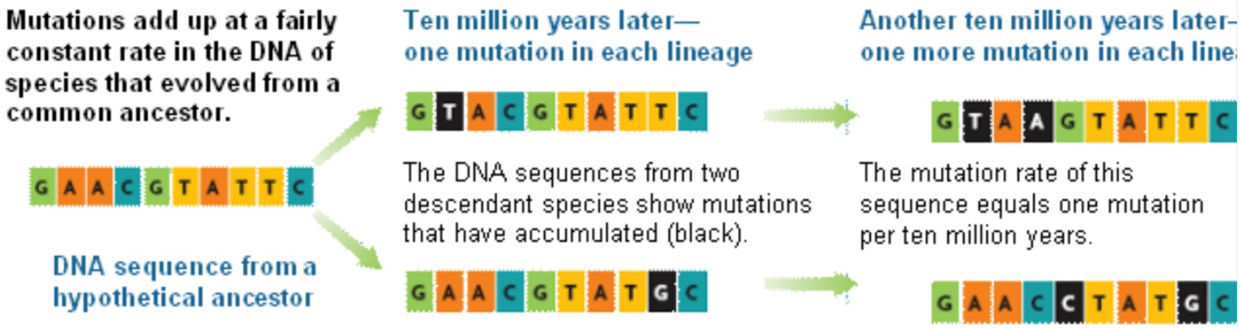
KEY CONCEPT

Molecular clocks provide clues to evolutionary histo

17.3 Molecular Clocks

Molecular clocks use mutations to estimate evolutiona time.

- Mutations add up at a constant rate in related species.
  - This rate is the ticking of the molecular clock.
  - As more time passes, there will be more mutations.



17.3 Molecular Clocks

- Scientists estimate mutation rates by linking molecular d and real time.
  - an event known to separate species
  - the first appearance of a species in fossil record

ANIMAL	AMINO ACID DIFFERENCES COMPARED WITH HUMANS	APPEARANCE IN FOSSIL RECORD (millions of years ago)
Mouse	16	70
Horse	18	70
Bird	35	270
Frog	62	350
Shark	79	450

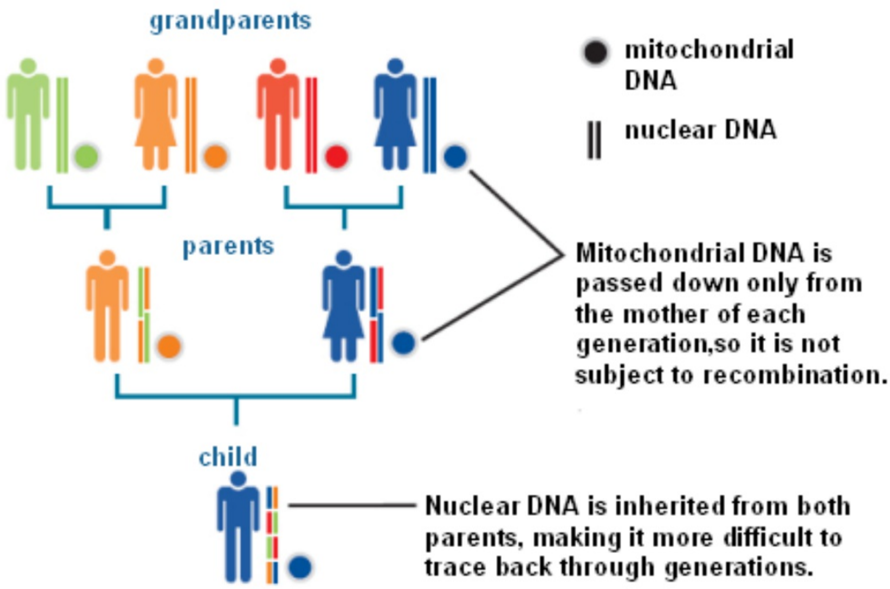
17.3 Molecular Clocks

Mitochondrial DNA and ribosomal RNA provide two typ of molecular clocks.

- Different molecules have different mutation rates.
  - higher rate, better for studying closely related species
  - lower rate, better for studying distantly related specie

17.3 Molecular Clocks

- Mitochondrial DNA is used to study closely related speci
  - mutation rate ten times faster than nuclear DNA
  - passed down unshuffled from mother to offspring



17.3 Molecular Clocks

- Ribosomal RNA is used to study distantly related specie
  - many conservative regions
  - lower mutation rate than most DNA

17.4 Domains and Kingdoms

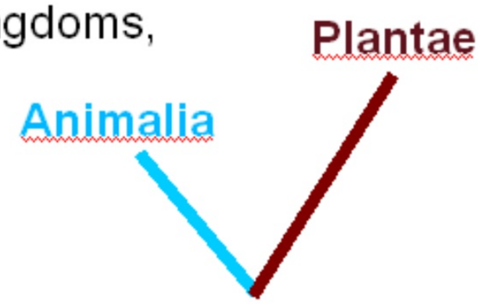
KEY CONCEPT

The current tree of life has three domains.

17.4 Domains and Kingdoms

Classification is always a work in progress.

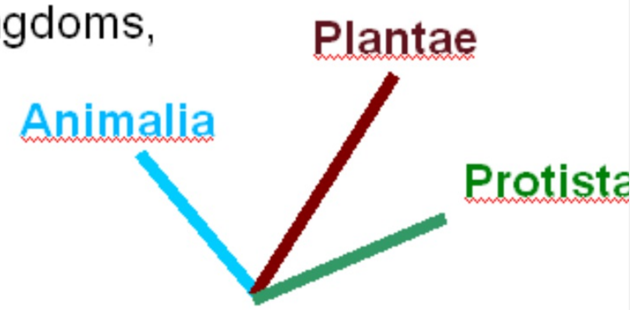
- The tree of life shows our most current understanding.
- New discoveries can lead to changes in classification.
  - Until 1866: only two kingdoms, Animalia and Plantae



17.4 Domains and Kingdoms

Classification is always a work in progress.

- The tree of life shows our most current understanding.
- New discoveries can lead to changes in classification.
  - Until 1866: only two kingdoms, Animalia and Plantae
  - 1866: all single-celled organisms moved to kingdom Protista



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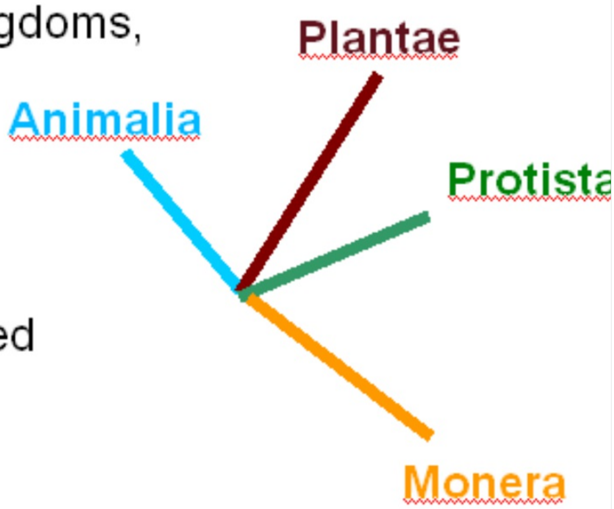
  - 1866: all single-celled organisms moved to kingdom Protista
  - 1938: prokaryotes moved to kingdom Monera



17.4 Domains and Kingdoms

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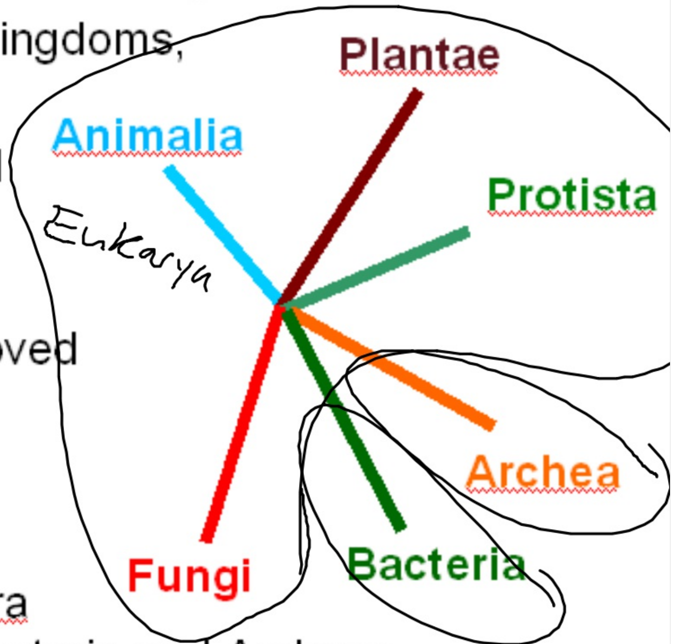
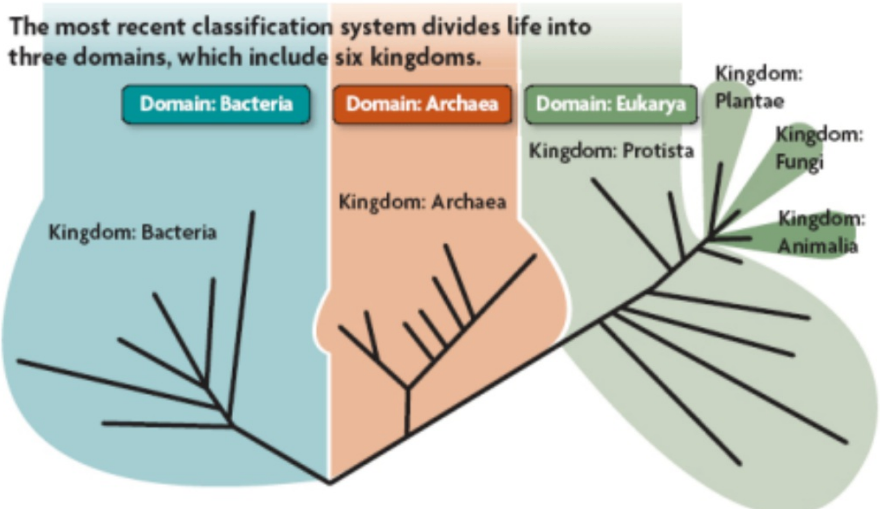
  - Until 1866: only two kingdoms, Animalia and Plantae
  - 1866: all single-celled organisms moved to kingdom Protista
  - 1938: prokaryotes moved to kingdom Monera
  - 1959: fungi moved to own kingdom
  - 1977: kingdom Monera split into kingdoms Bacteria and Archaea



17.4 Domains and Kingdoms

The three domains in the tree of life are Bacteria, Archa and Eukarya.

- Domains are above the kingdom level.
  - proposed by Carl Woese based on rRNA studies of prokaryotes
  - domain model more clearly shows prokaryotic diversit

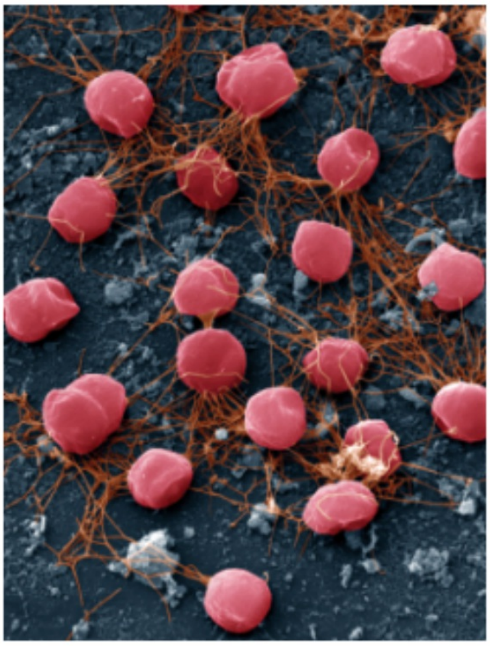


17.4 Domains and Kingdoms

- Domain Bacteria includes prokaryotes in the kingdom Bacteria.
  - one of largest groups on Earth
  - classified by shape, need for oxygen, and diseases caused

17.4 Domains and Kingdoms

- Domain Archaea includes prokaryotes in the kingdom Archaea.
  - cell walls chemically different from bacteria
  - differences discovered by studying RNA
  - known for living in extreme environments



17.4 Domains and Kingdoms

- Domain Eukarya includes all eukaryotes.
  - kingdom Protista

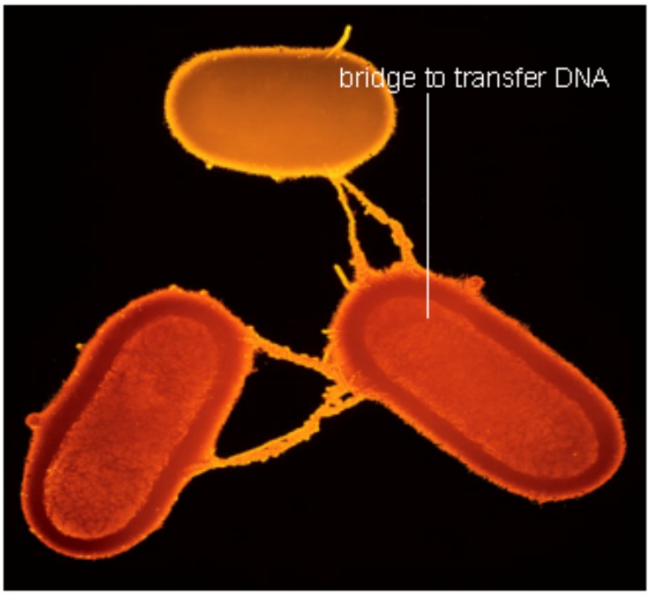
17.4 Domains and Kingdoms

- Domain Eukarya includes all eukaryotes.
  - kingdom Protista
  - kingdom Plantae
  - kingdom Fungi
  - kingdom Animalia

-Phylum Chordata
Class Mammalia
Order
Family
Genus
Species

17.4 Domains and Kingdoms

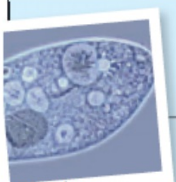
- Bacteria and archaea can be difficult to classify.
  - transfer genes among themselves outside of reproduction
  - blurs the line between "species"
  - more research needed to understand prokaryotes



Appendix A: Classification

Living things are classified into three domains. These domains are further divided into kingdoms, and then phyla. Major phyla are described in the table below, along with important features that are used to distinguish each group.

KINGDOM	COMMON NAME AND DESCRIPTION
DOMAIN ARCHAEA	
ARCHAEA 	**Archaea** Single-celled prokaryotes (no nucleus or other membrane-bound organelles) with distinct rRNA sequences. Lack peptidoglycan cell walls. Reproduce asexually. Live in some of Earth's most extreme environments, including salty, hot, acidic, and the deep ocean. They are often grouped according to where they live. Examples: *Sulfolobus solfataricus, Pyrococcus.*
DOMAIN BACTERIA	
BACTERIA 	**Bacteria** Single-celled prokaryotes (no nucleus or other membrane-bound organelles), most with peptidoglycan cell walls. Live in all types of environments, including the human body. Reproduce by binary fission or budding. Examples: blue-green bacteria (cyanobacteria), *Streptococcus, Bacillus, Escherichia.*

KINGDOM	PHYLUM	COMMON NAME AND DESCRIPTION
DOMAIN EUKARYA		
		Eukaryotes Cells are larger than archaea or bacteria and are eukaryotic (have a nucleus containing DNA, as well as other membrane-bound organelles). Can be single-celled, colonial, or multicellular.
PROTISTA		**Protists** Usually single-celled, but sometimes multicellular or colonial. Many phyla resemble animals, plants, or fungi but are usually smaller or simpler in structure.
Animal-like Protists: Unicellular, heterotrophic, most can move.		
 Paramecium	Ciliophora	**Ciliates** Have many short, hairlike extensions called cilia, which they use for feeding and movement. Example: *Paramecium.*
	Zoomastigophora	**Zooflagellates** Have usually one or two long, hairlike extensions called flagella. Sometimes called Zoomastigina. Example: *Trichomonas.*
	Apicomplexa	**Sporozoans** Parasites that can move by body flexion or gliding. Cause diseases in animals such as birds and humans. Example: *Plasmodium.*

KINGDOM	PHYLUM	COMMON NAME AND DESCRIPTION
PROTISTA (continued)	Rhizopoda	**Rhizopods** Use footlike extensions called pseudopods to move and feed. Phylum sometimes called Sarcodina. Example: *Amoeba.*
	Foraminifera	**Forams** Use footlike extensions called pseudopods to move. Have multi-chambered shells made of organic material. Most are marine. Example: *Rosalina globularis.*
Plantlike Protists: Many are photosynthetic autotrophs, but none have roots, stems, or leaves.		
 Euglena	Euglenozoa	**Euglenoids** Single-celled, with one or two flagella. Most live in fresh water. Some are heterotrophs, others are photosynthetic autotrophs. Examples: *Euglena, Trypanosoma.*
	Dinoflagellata	**Dinoflagellates** Single-celled, with two flagella that allow cell to turn over and change direction. Some species are autotrophic, some are heterotrophic. In great numbers, some species can cause red tides along coastlines. Example: *Noctiluca.*
	Chrysophyta	**Chrysophytes** Also called yellow algae or golden-brown algae. Single-celled. Named for the yellow pigments in their chloroplasts (*chrysophyte*, in Greek, means "golden plant"). Example: *Thallasiosira.*
 Diatom	Bacillariophyta	**Diatoms** Single-celled with glasslike shells made of silica. Shells serve as external skeleton. Example: *Amorpha ovalis.*
	Chlorophyta	**Green algae** May be single-celled, colonial, or multicellular. Contain both chlorophyll-*a* and chlorophyll-*b*, which are the same photosynthetic pigments found in land plants. Examples: *Pediastrum, Ulva, Spirogyra.*

FUNGI		**Fungi** Eukaryotic, heterotrophic, usually multicellular but some are single-celled. Cells have a thick cell wall usually containing chitin. Obtain nutrients through absorption. Often function as decomposers.
	Chytridiomycota	**Chytrids** Oldest and simplest fungi, usually aquatic. Have flagellated spores. Some are decomposers, some are parasitic. Example: chytrid frog fungus.
	Ascomycota	**Sac fungi** Reproduce with spores formed in an ascus. Includes single-celled yeasts as well as morels, truffles, and molds. Example: *Penicillium.*
	Zygomycota	**Bread molds** Obtain food by decomposing dead or decaying matter. Mold hyphae grow into food source and digest it. Some are parasitic. Example: black bread molds.
	Basidiomycota	**Club fungi** Multicellular with club-shaped fruiting bodies. Examples: mushrooms, puffballs, bracket fungi, rusts, smuts.


Sac fungus


Toad stool mushroom

PLANTAE		**Plants** Multicellular photosynthetic autotrophs. Most have adapted to life on land. Cells have thick cell walls made of cellulose.
	Bryophyta	**Mosses** Nonvascular plants. Gametophyte generation is a grasslike plant. Most live in moist environments. Example: sphagnum (peat) moss.
	Hepatophyta	**Liverworts** Nonvascular plants named for the liver-shaped gametophyte generation. Most live in moist environments. Example: *Marchantia*.
	Anthocerotophyta	**Hornworts** Nonvascular plants named for the visible hornlike structures with which they reproduce. Live in moist, cool environments. Example: *Dendroceros*.
	Lycophyta	**Club mosses** Seedless vascular plants. Some resemble tiny pine trees. Live in wooded environments. Example: *Lycopodium* (ground pine).

KINGDOM	PHYLUM	COMMON NAME AND DESCRIPTION
PLANTAE (continued)	Pterophyta	**Ferns, whisk ferns, and horsetails** Seedless vascular plants. Most have fringed leaves. Whisk ferns sometimes classified in phylum Psilotophyta; horsetails sometimes classified in phylum Sphenophyta. Example: *Psilotum* (whisk fern).
 Sago palm	Cycadophyta	**Cycads** Gymnosperms; reproduce with seeds produced in large cones. Slow-growing, palmlike plants that grow in tropical environments. Example: sago palms
	Ginkgophyta	**Ginkgo biloba** Only species in phylum, a tree often planted in urban environments. Gymnosperm; reproduces with seeds that hang from branches.
	Coniferophyta	**Conifers** Gymnosperms; reproduce with seeds produced in cones. Usually evergreen. Examples: pines, spruces, firs, sequoias.
 Foxglove	Anthophyta	**Flowering plants** Also called angiosperms. Reproduce with seeds produced in flowers. Seeds are surrounded by fruit, which is the ripened plant ovary. **CLASS: Monocotyledonae** Monocots. Embryos have one cotyledon. Leaves with parallel veins, flower parts in multiples of three, and vascular bundles scattered throughout the stem. Examples: irises, tulips, grasses. **CLASS: Dicotyledonae** Dicots. Embryos have two cotyledons. Leaves with netlike veins, flower parts in multiples of four or five, and vascular bundles arranged in rings. Examples: roses, daisies, deciduous trees, foxgloves.

ANIMALIA		**Animals** Multicellular, eukaryotic heterotrophs with cells supported by collagen. Cells lack cell walls. Most have cells that are organized into specialized tissues, which make up organs. Most reproduce sexually.
	Porifera	**Sponges** Spend most of their lives fixed to the ocean floor. Feed by filtering water (containing nutrients and small organisms) through their body. Reproduce sexually and asexually. Example: *Euplectella* (Venus's flower basket).
 Giant anemone	Cnidaria	**Cnidarians** Aquatic animals with a radial (spokelike) body shape; named for their stinging cells (cnidocytes). Have two basic body forms: the polyp and the medusa. May produce sexually and asexually. **CLASS: Hydrozoa** Alternate between polyp and medusa stages. Medusas reproduce sexually, polyps reproduce asexually. Example: hydras. **CLASS: Scyphozoa** Dominant medusa form. Example: jellyfish. **CLASS: Anthozoa** Dominant polyp form; there is no medusa stage. May be colonial or solitary. Central body surrounded by tentacles. Examples: sea anemones, corals. **CLASS: Cubozoa** Dominant cube-shaped medusa form with well-developed eyes. Examples: tropical box jellyfish, sea wasps.

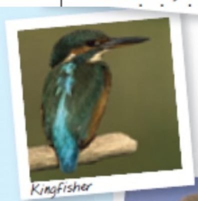
KINGDOM	PHYLUM	COMMON NAME AND DESCRIPTION
	Ctenophora	**Comb jellies** Resemble jellyfish; named for the comblike rows of cilia (hairlike extensions) that are used for movement. Example: *Pleurobrachia*.
 Flatworm	Platyhelminthes	**Flatworms** Thin, flattened worms with simple tissues and sensory organs. Includes planaria and tapeworms, which cause diseases in humans and other hosts. **CLASS: Turbellaria (turbellarians)** Free-living carnivores or scavengers that move with cilia. Example: planarians. **CLASS: Trematoda (flukes)** Internal parasites; life cycle often includes alternation of hosts. Example: *Schistosoma*. **CLASS: Cestoda (tapeworms)** Internal parasites; segmented body and head with suckers or hooks for attaching to host. Example: dog tapeworm.
 Nautilus	Mollusca	**Mollusks** Soft-bodied aquatic animals that usually have an outer shell. **CLASS: Gastropoda (gastropods)** Use muscular foot for movement. Have a distinct head and complete digestive tract. Most have a chambered shell. Examples: snails and slugs. **CLASS: Pelecypoda (bivalves)** Soft body protected by two hard shells that are hinged together. Most are filter feeders. Examples: clams, oysters, mussels, scallops. **CLASS: Cephalopoda (cephalopods)** Carnivores with well-developed eyes and nervous systems. Examples: squids, octopuses, nautiluses.

 Leeches	Annelida	**Segmented worms** Body is made of many similar segments. **CLASS: Polychaeta (polychaetes)** Marine worms with a pair of appendages on each segment. Have many setae. Examples: fan worms, featherduster worms. **CLASS: Oligochaeta (oligochaetes)** Earthworms; live in soil or fresh water. Have no appendages. Have few setae. Example: *Tubifex tubifex* (sludge worm). **CLASS: Hirudinea (leeches)** Most live in fresh water. Have flattened body with no appendages. Suckers at both ends; carnivores or blood-sucking parasites. Example: *Macrobdella decora* (medicinal leech).
	Nematoda	**Roundworms** Small, round worms; many species are parasites, causing diseases in humans, such as trichinosis and elephantiasis. Example: *Trichinella.*

KINGDOM	PHYLUM	COMMON NAME AND DESCRIPTION
ANIMALIA (continued)  Scorpion  Dragonfly	Arthropoda	Animals with an outer skeleton called an exoskeleton, and jointed appendages such as legs or wings. **SUBPHYLUM: Trilobita (trilobites)** Includes the trilobites, which are all extinct. Important part of the Paleozoic marine ecosystems for 300 million years. Bodies divided into three lobes. Bottom feeders. **SUBPHYLUM: Crustacea (crustaceans)** Live in all of the oceans, freshwater streams, and on land. Have chewing mouthparts and two pairs of antennae. Examples: crabs, lobsters, copepods, pill bugs. **SUBPHYLUM: Chelicerata (chelicerates)** First pair of appendages specialized as daggerlike mouthparts that are used for tearing food; no antennae. Examples: horseshoe crabs, scorpions, spiders, mites, ticks. **SUBPHYLUM: Uniramia** Most live on land. Have one pair of antennae and chewing mouthparts. **CLASS: Insecta (insects)** Have three body segments with three pairs of legs attached to second segment. Examples: ants, bees, butterflies, cockroaches, flies, mosquitoes. **CLASS: Chilopoda (centipedes)** Body divided into many segments with one pair of legs per segment. Carnivores; first pair of legs bears fangs for capturing prey. Example: *Scutigera coleoptrata* (common house centipede). **CLASS: Diplopoda (millipedes)** Body divided into many segments with two pairs of legs per segment. Most are herbivores. Example: *Glomeris* (pill millipede).

 Sea star	Echinodermata	Adults are slow-moving marine animals with radial symmetry; larvae have bilateral symmetry. Have an internal skeleton, a water vascular system, and a complete digestive system. Some can regenerate limbs. **CLASS: Crinoidea (crinoids)** Filter feeders that remain attached to a surface such as the ocean floor. Examples: feather stars, sea lilies. **CLASS: Asteroidea (sea stars)** Star-shaped bottom dwellers that may be suspension feeders, opportunistic feeders, or carnivorous predators. Example: *Acanthaster planci* (crown-of-thorns starfish). **CLASS: Ophiuroidea** Most have five long spindly arms that they use to help move and feed; tube feet lack suckers. Examples: brittle stars, basket stars. **CLASS: Echinoidea** Have a five-part body plan but no arms; body covered with projections or spines. Most graze for food on ocean floor. Examples: sea urchins, sea biscuits, sand dollars. **CLASS: Holothuroidea (sea cucumbers)** Fleshy animals with long, cylindrical shape. Tentacles are used to capture food; also feed on sediment from ocean floor. Example: *Holothuria*.

KINGDOM	PHYLUM	COMMON NAME AND DESCRIPTION
 Sea squirt  Stingray  Salamander 	Chordata	**Chordates** Have bilateral symmetry, a notochord, a hollow nerve tube, pharyngeal slits, and a tail at some point in development. **SUBPHYLUM: Urochordata (tunicates)** Marine animals whose larvae have features of phylum chordata. Some adults are free-swimming, others are sessile. Example: sea squirts. **SUBPHYLUM: Cephalochordata (lancelets)** Eel-like marine animals with no internal skeleton. Spend much of life buried in sand; filter feeders. Example: *Branchiostoma.* **SUBPHYLUM: Vertebrata (vertebrates)** Have an internal skeleton, usually including a backbone made of vertebrae, which protects the nerve cords. Distinct head with well-developed brain encased in hard skull. **CLASS: Myxini (hagfish)** Part of superclass Agnatha. Jawless with lungs. Ectothermic. Examples: frogs, toads, salamanders. **CLASS: Reptilia (reptiles)** Adapted to life on land, although some live in water. Breathe using lungs at all stages. Have dry skin covered in scales. Lay amniotic eggs that are fertilized internally. Ectothermic. Examples: snakes, lizards, turtles, crocodiles, dinosaurs (extinct).

 Kingfisher  Elephant		**CLASS: Reptilia (reptiles)** Adapted to life on land, although some live in water. Breathe using lungs at all stages. Have dry skin covered in scales. Lay amniotic eggs that are fertilized internally. Ectothermic. Examples: snakes, lizards, turtles, crocodiles, dinosaurs (extinct). **CLASS: Aves (birds)** Body mostly covered with feathers. Forelimbs modified into wings, most often used for flight. Hollow, lightweight bones, well-developed lungs and air sacs. Lay shelled, amniotic eggs. Four-chambered heart. Endothermic. Examples: robins, eagles, ducks, penguins, owls, chickens. **CLASS: Mammalia (mammals)** Have hair on part of body. Young nourished with milk from mother's mammary glands. Jaw allows for chewing of food. Middle ear contains three bones. Breathe using lungs. Have four-chambered heart. Endothermic. Three main groups include monotremes, which lay eggs; marsupials, or pouched mammals; and eutherian mammals, which give birth to live young. Examples: duckbill platypus (monotreme); koala (marsupial); bats, squirrels, rabbits, whales, bears, monkeys, elephants, pigs, horses, humans (eutherian).