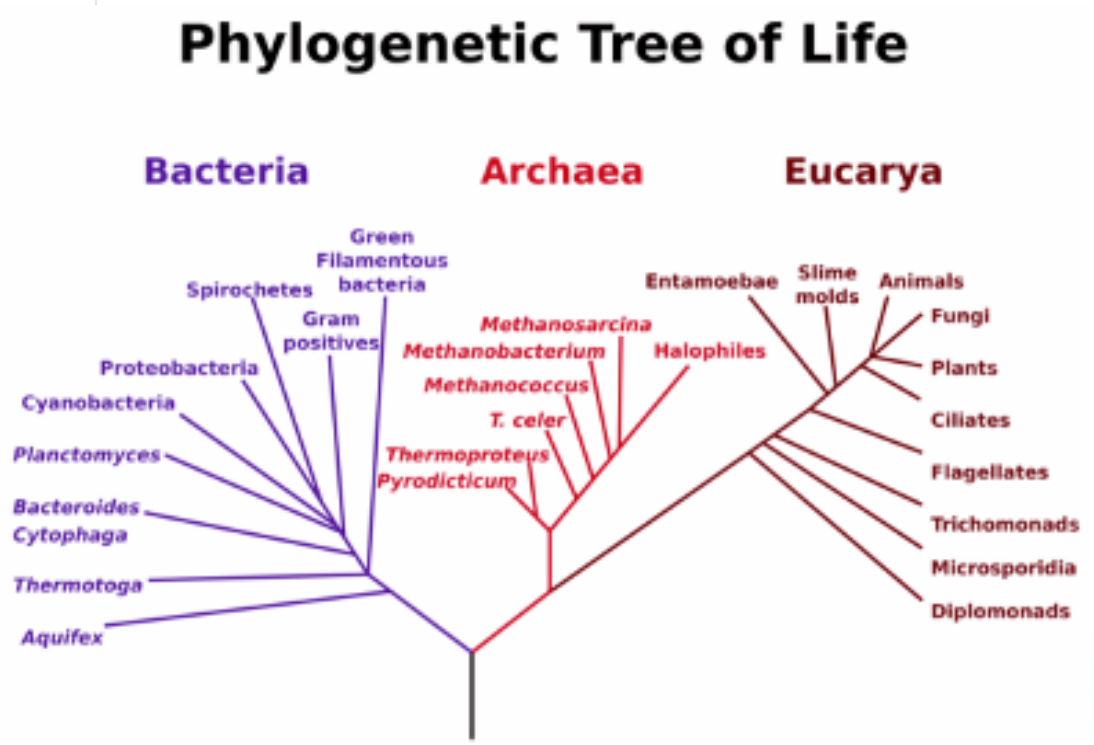
Finding Order in Diversity

Warm up:



The “tree of life” shown to the left was constructed by comparing rRNA sequences from all of the organisms shown. Why did researchers compare rRNA sequences? Would they get the same result if they compared something else?

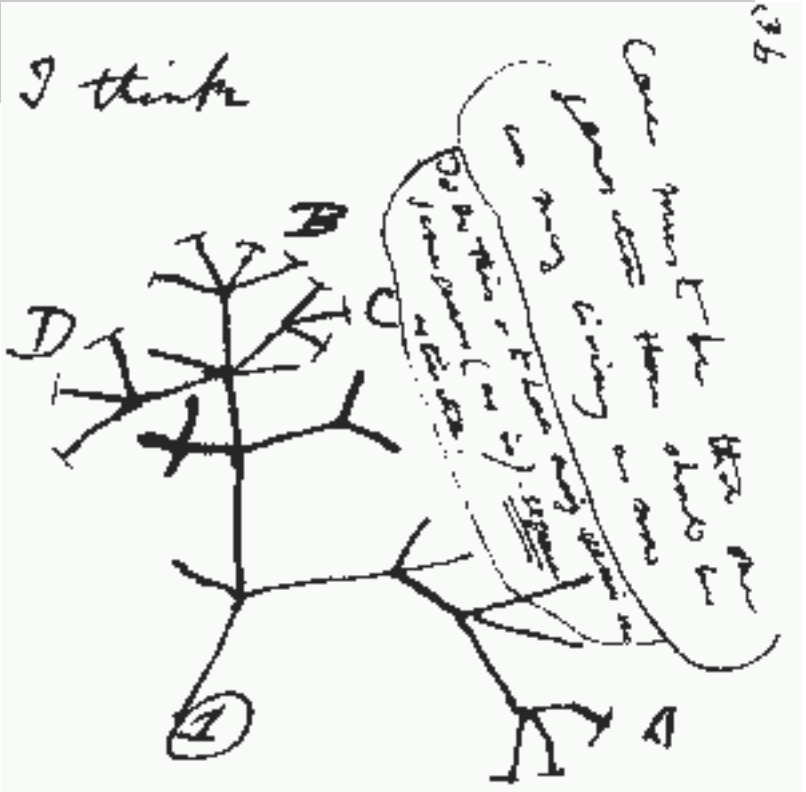
Learning Objectives

- Describe the goals of binomial nomenclature and systematics.
- Identify the taxa in the classification system devised by Carl Linnaeus.

Systematics:

The study of the diversification of living forms, both past and present, and the relationships among living things through time. Relationships are visualized as evolutionary trees.

1837



Binomial nomenclature (2 names)

Arum maculatum

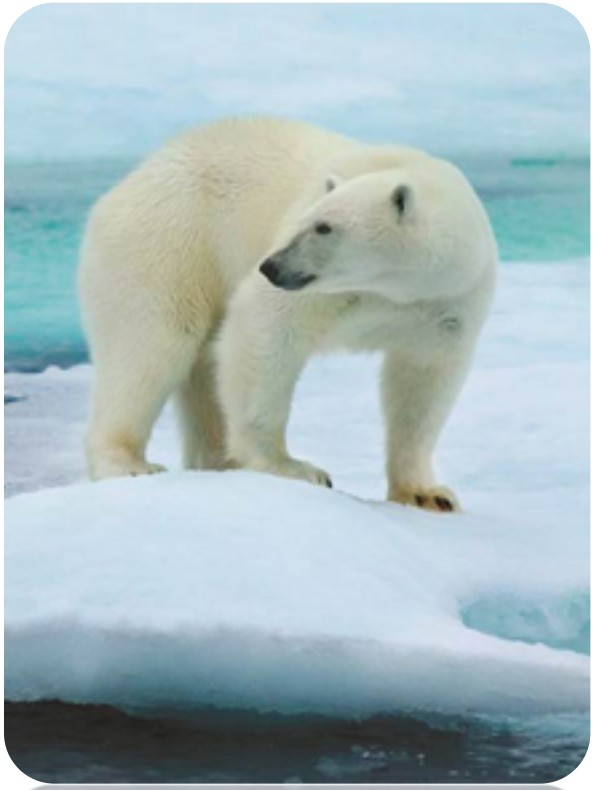
- Lords-and-ladies
- Cuckoo-pint
- Devils and angels
- Cows and bulls
- Willy lily and snake's meat

- Comida de culebra
- Alcatrax
- Barba de aron
- Dragontia manor
- Hojas de fuego
- Yerba del quemado

Assigning Scientific Names

The Linnaean Classification System

Binomial Nomenclature



Ursus maritimus

Genus species

Acer rubrum

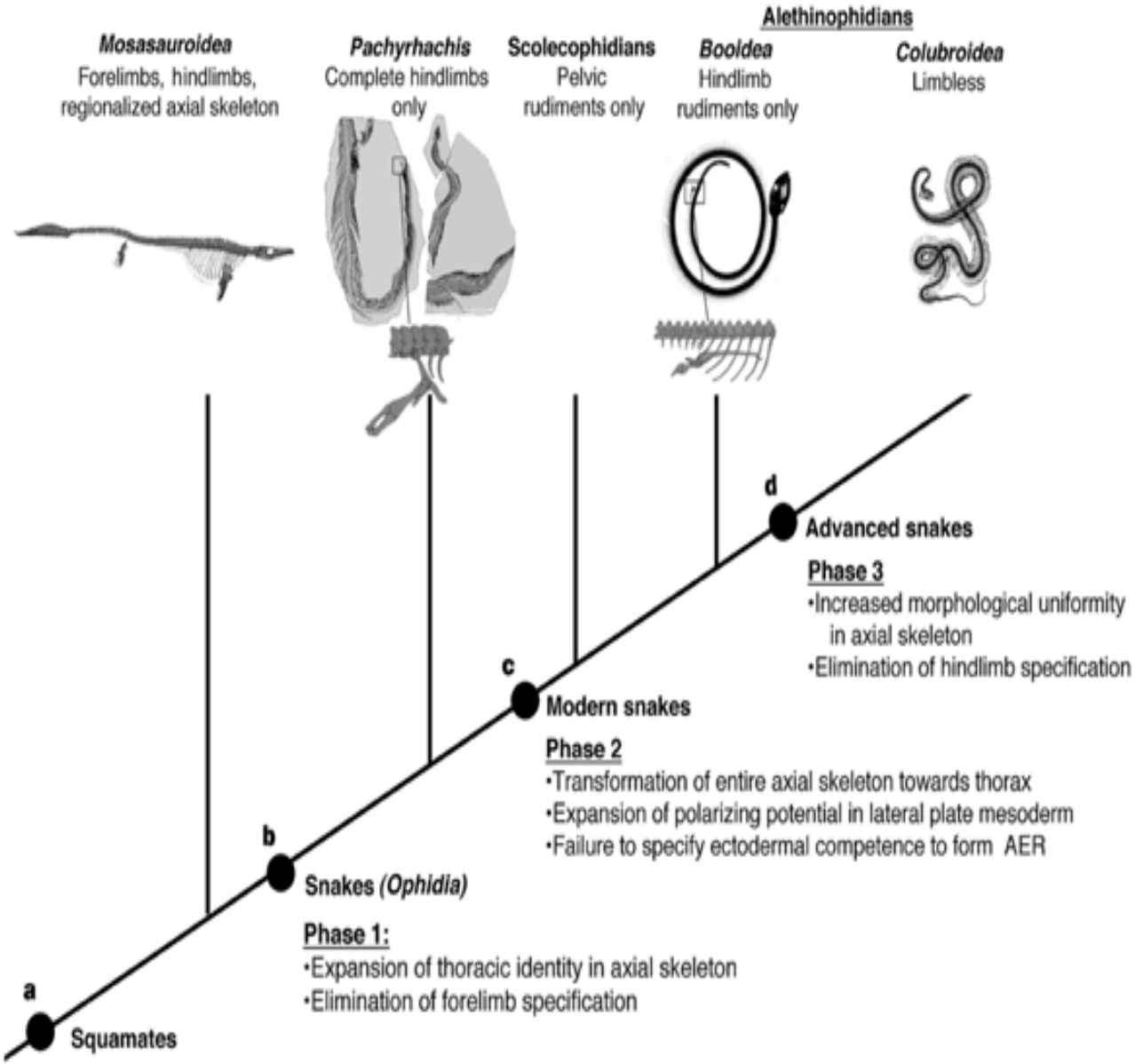
Genus species

Parastratiosphecomyia stratiosphecomyioides

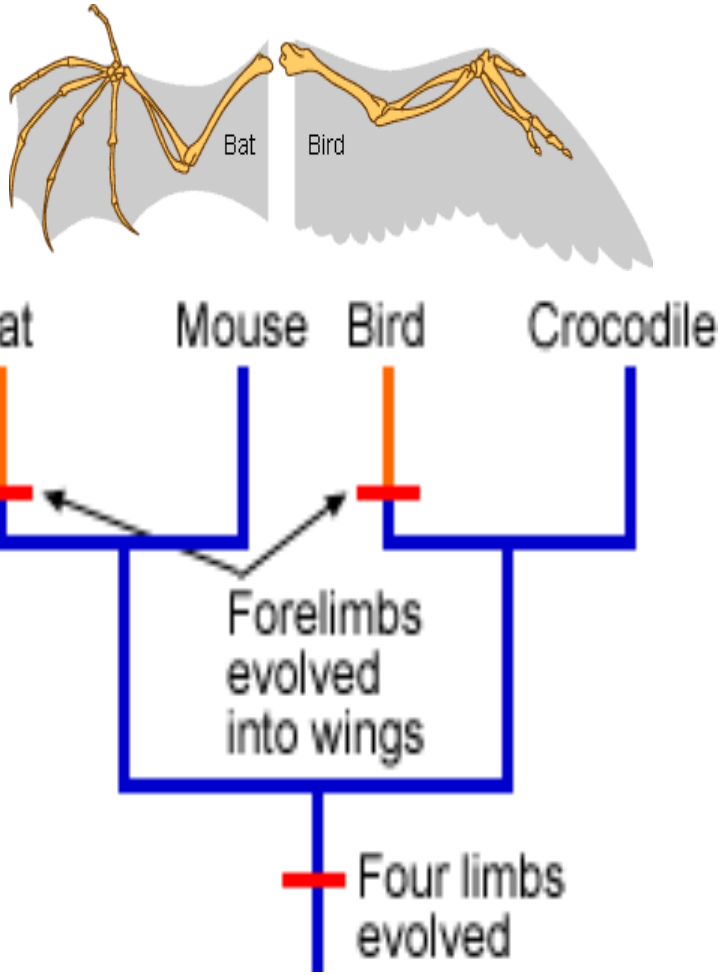
Spongiforma squarepantsii

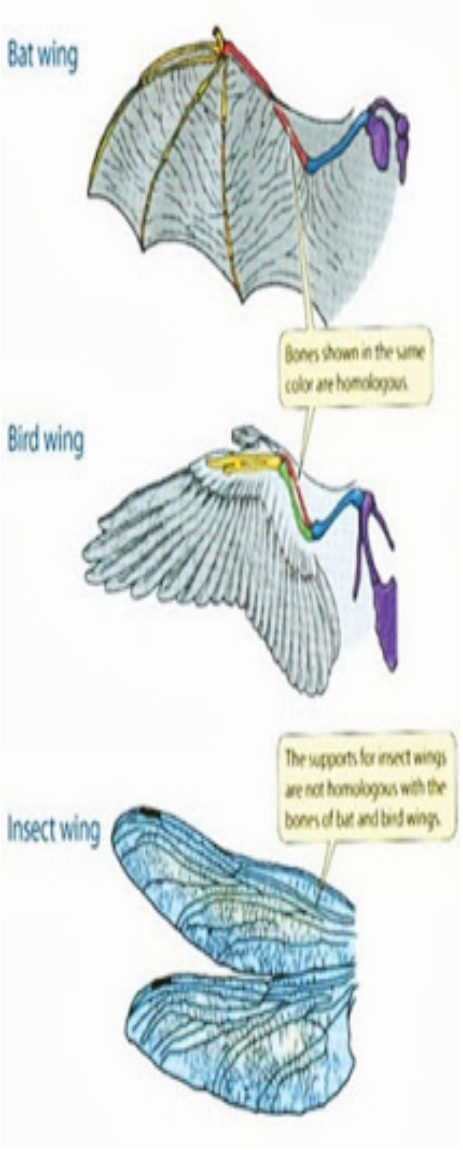
Agathidium vaderi

Agra schwarzeneggeri

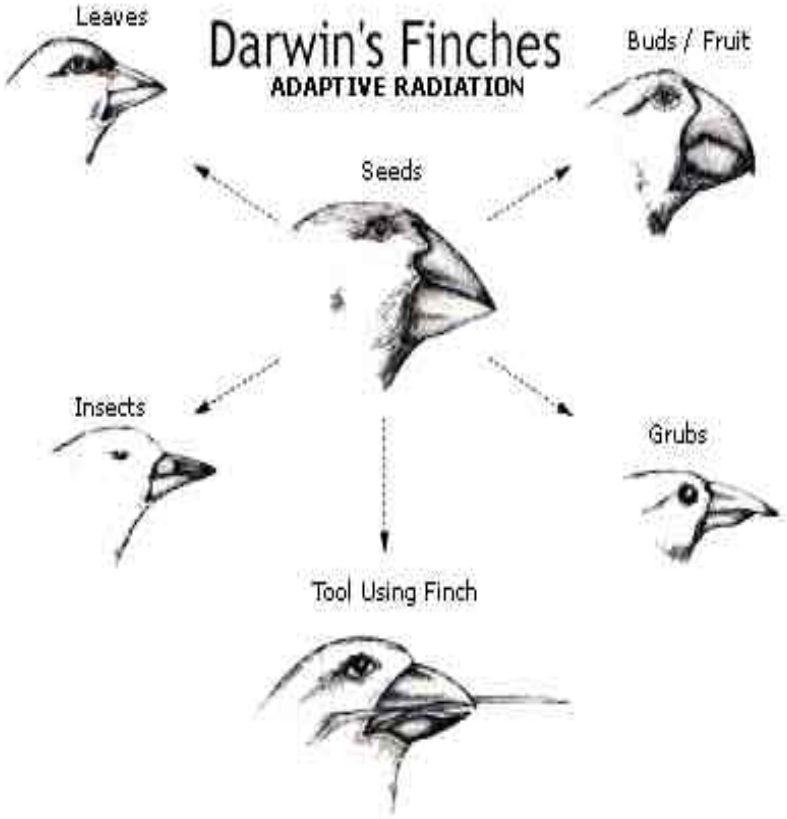

Alethinophidians
Mosasauroidea
Forelimbs, hindlimbs, regionalized axial skeleton
Pachyrhachis
Complete hindlimbs only
Scolecophidians
Pelvic rudiments only
Booidea
Hindlimb rudiments only
Colubroidea
Limbless
d
Advanced snakes
Phase 3
•Increased morphological uniformity in axial skeleton
•Elimination of hindlimb specification
c
Modern snakes
Phase 2
•Transformation of entire axial skeleton towards thorax
•Expansion of polarizing potential in lateral plate mesoderm
•Failure to specify ectodermal competence to form AER
b
Snakes (Ophidia)
Phase 1:
•Expansion of thoracic identity in axial skeleton
•Elimination of forelimb specification
a
Squamates

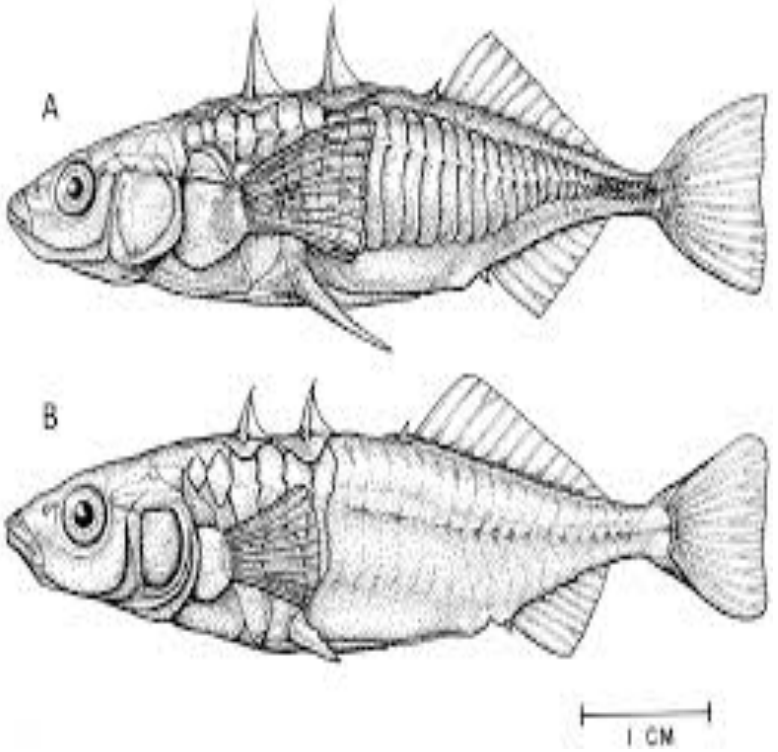
Convergent Evolution-distantly related species appear superficially similar





Adaptive radiation-closely related organisms can appear different





Dichotomous Keys

Step	Leaf Characteristics	
1a	Compound leaf (leaf divided into leaflets)	Go to Step 2
1b	Simple leaf (leaf not divided into leaflets)	Go to Step 4
2a	Leaflets all attached at a central point	**Buckeye**
2b	Leaflets attached at several points	Go to Step 3
3a	Leaflets tapered with pointed tips	**Pecan**
3b	Leaflets oval with rounded tips	**Locust**
4a	Veins branched out from one central point	Go to Step 5
4b	Veins branched off main vein in the middle of the leaf	Go to Step 6
5a	Heart-shaped leaf	**Redbud**
5b	Star-shaped leaf	**Sweet gum**
6a	Leaf with jagged edges	**Birch**
6b	Leaf with smooth edges	**Magnolia**

From Species to Kingdom

Species *Camelus bactrianus*

Genus *Camelus*

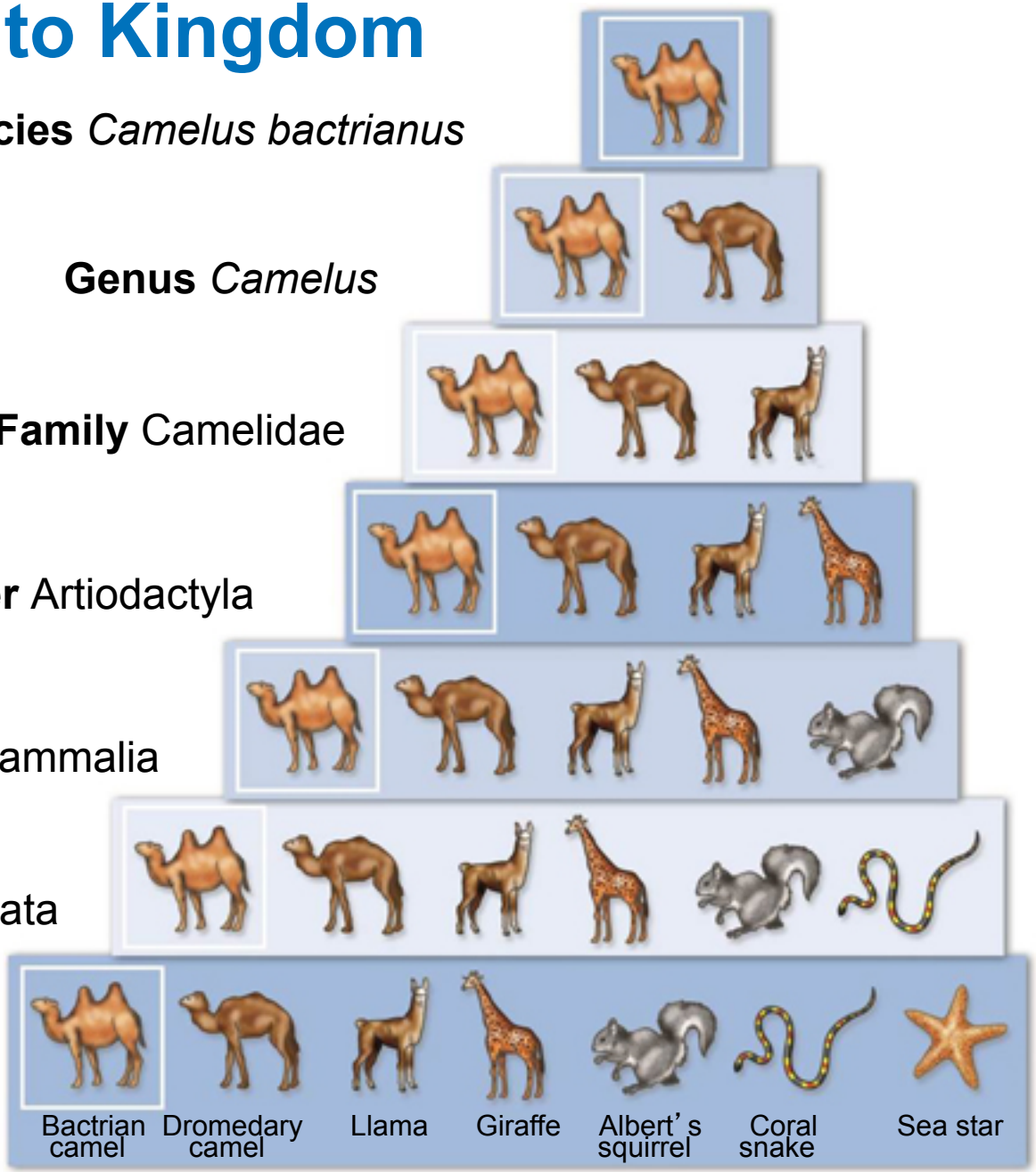
Family Camelidae

Order Artiodactyla

Class Mammalia

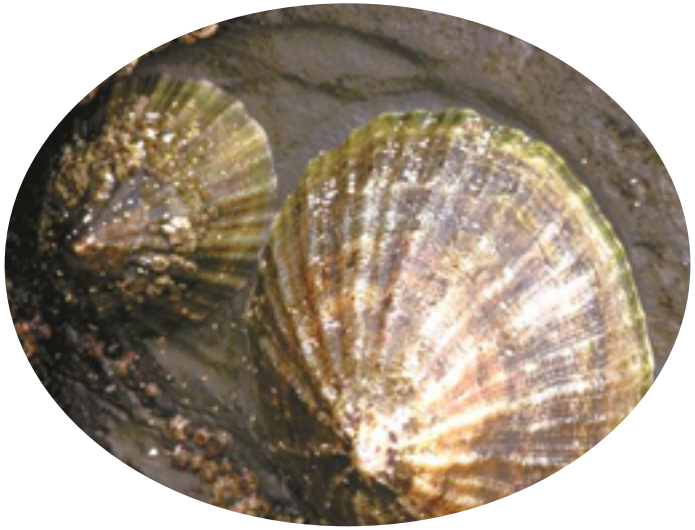
Phylum Chordata

Kingdom Animalia



New Discoveries Change Classifications

Barnacles



Limpets

Crab

Modern Evolutionary Classification

Learning Objectives

- Explain the difference between evolutionary classification and Linnaean classification.
- Describe how to make and interpret a cladogram.
- Explain the use of DNA sequences in classification.

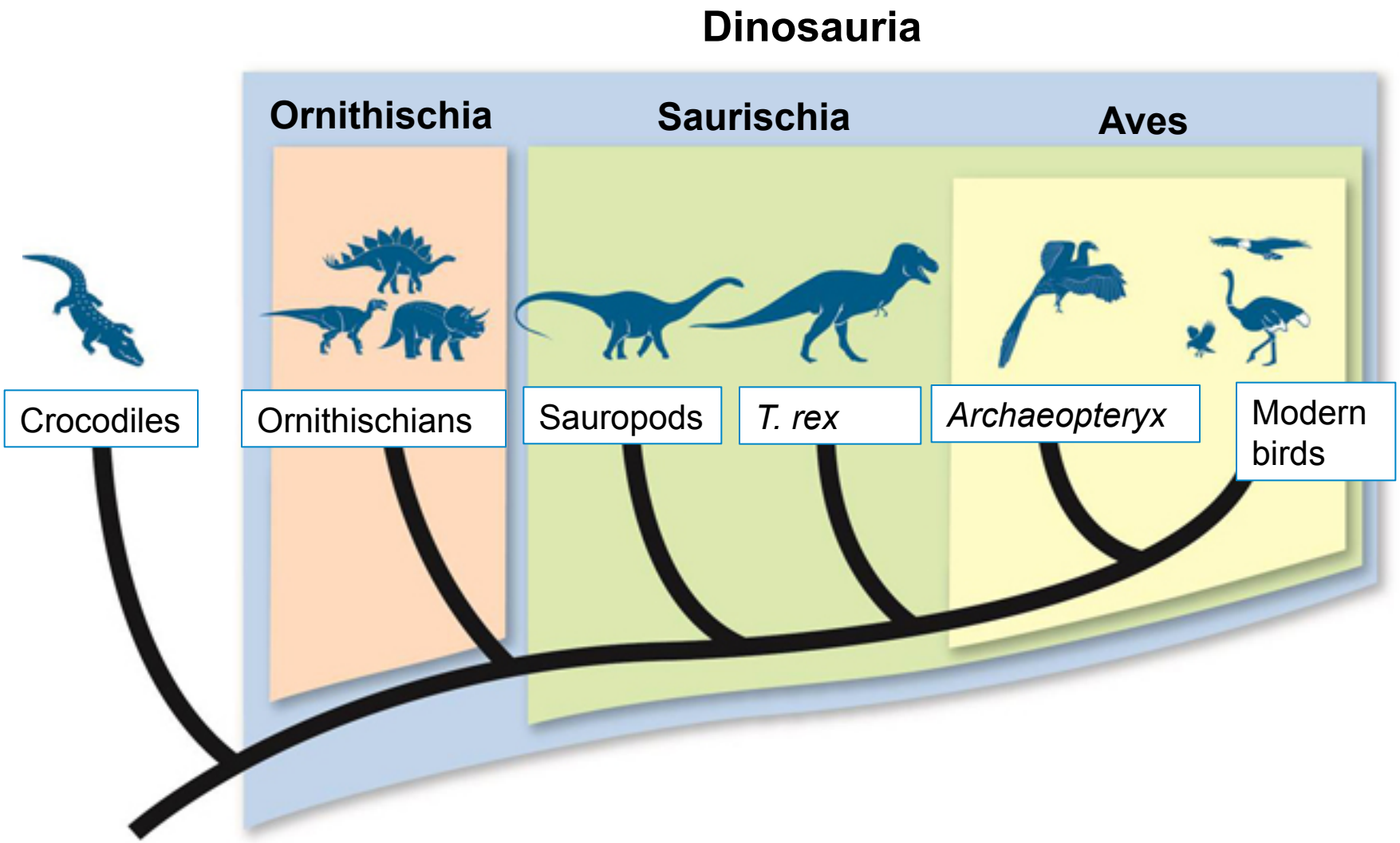
Phytophthora infestans

- Causative agent of potato blight. Has hyphae (strands) and was classified as a fungus. Molecular biology suggests that this organisms may belong to a different kingdom.

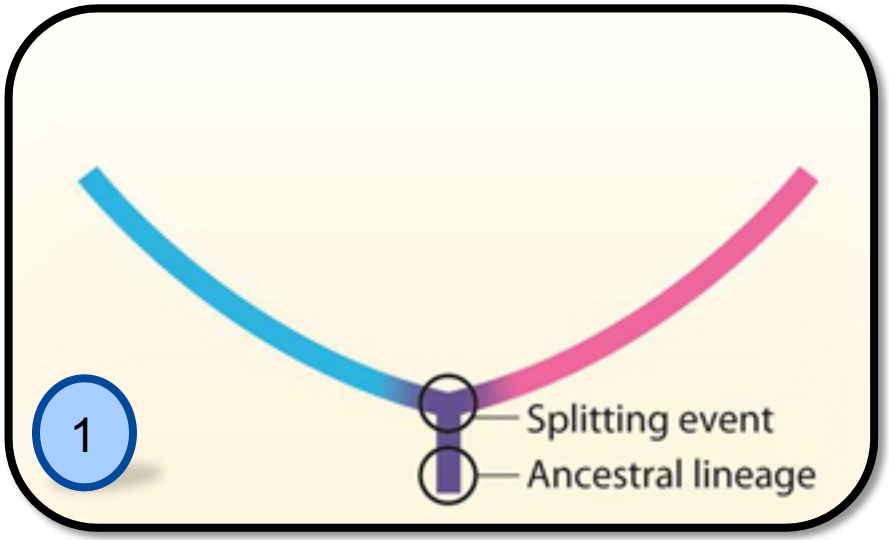
- Researchers have found that the disease is difficult to control using fungicides.

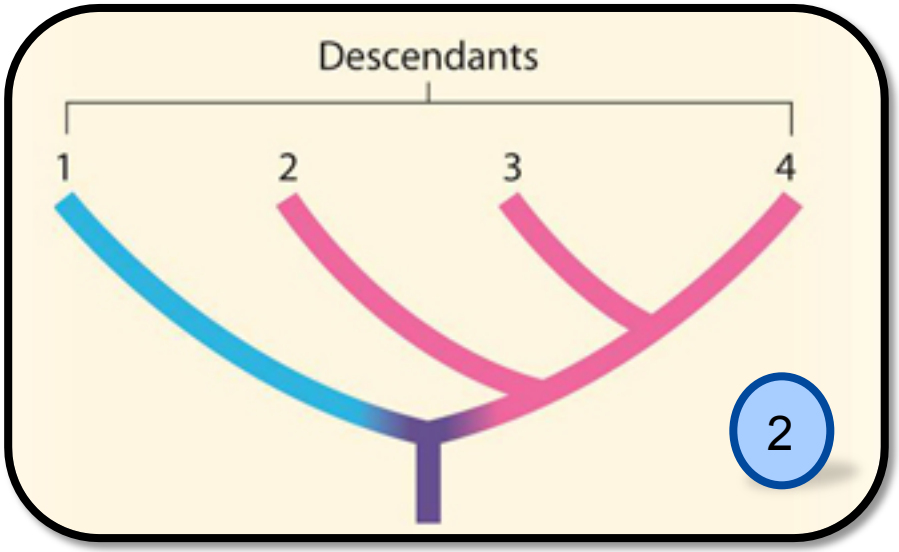
- Discuss these observations.

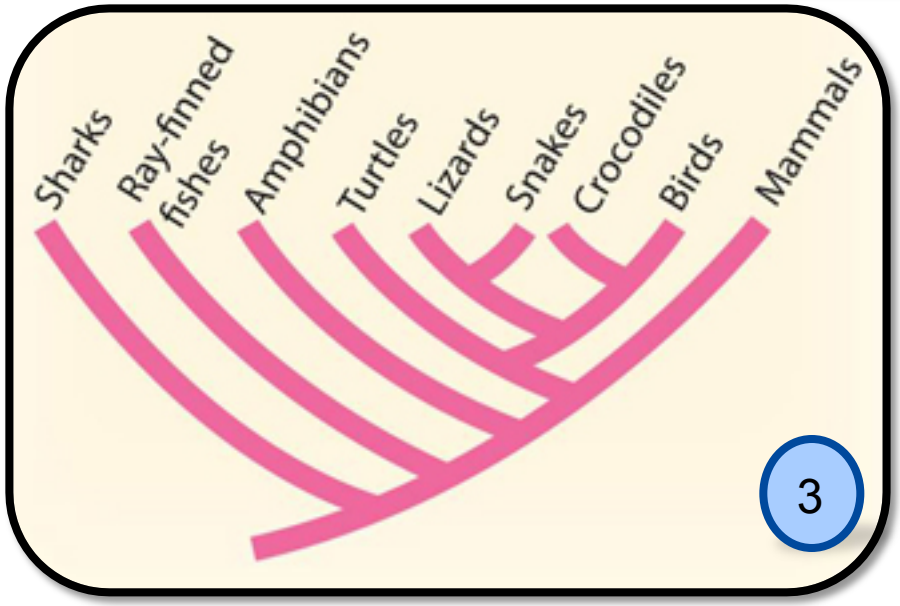
Evolutionary Classification



Cladograms


1
Splitting event
Ancestral lineage

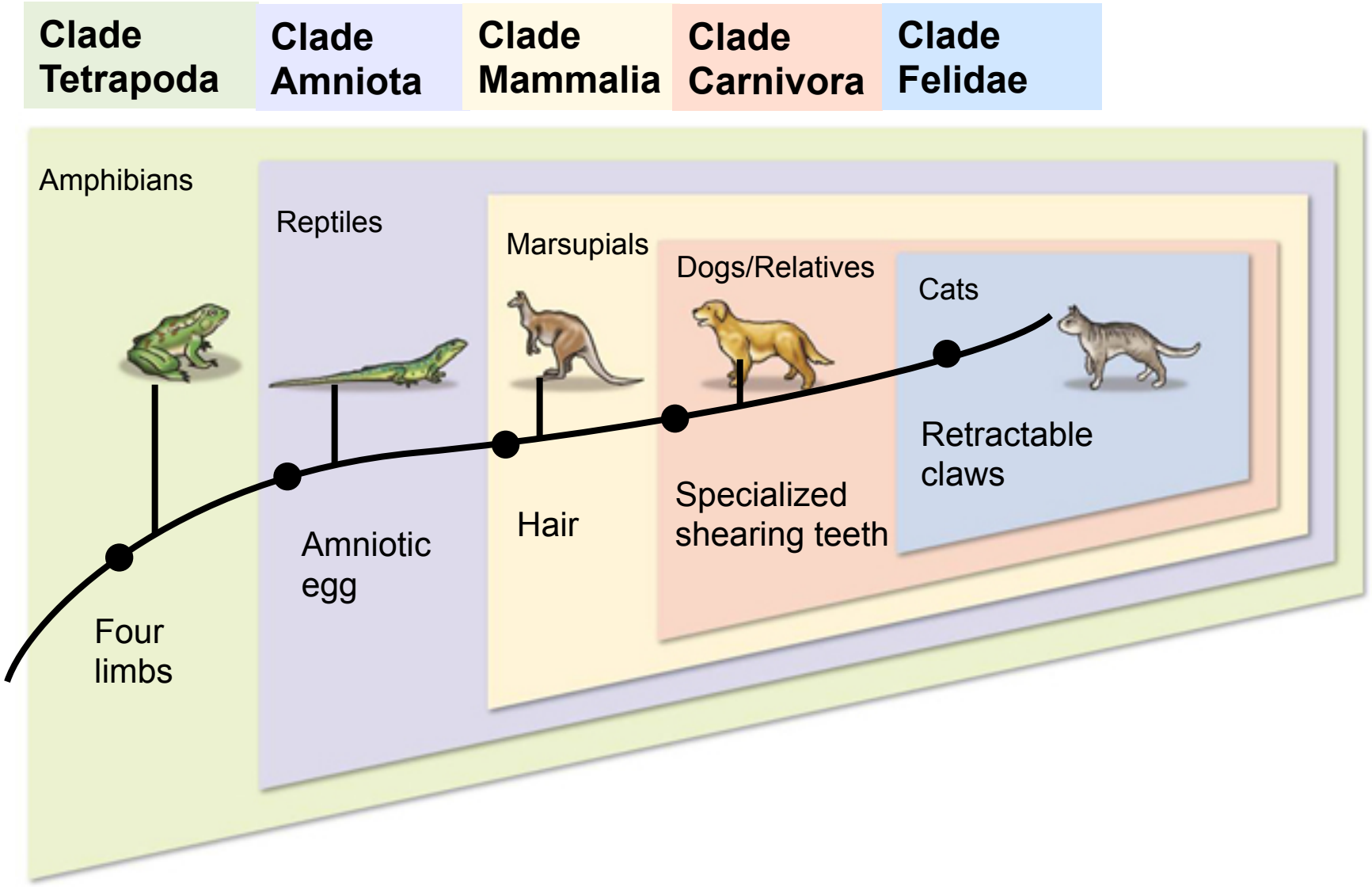

Descendants
1
2
3
4
2


Sharks
Ray-finned fishes
Amphibians
Turtles
Lizards
Snakes
Crocodiles
Birds
Mammals
3

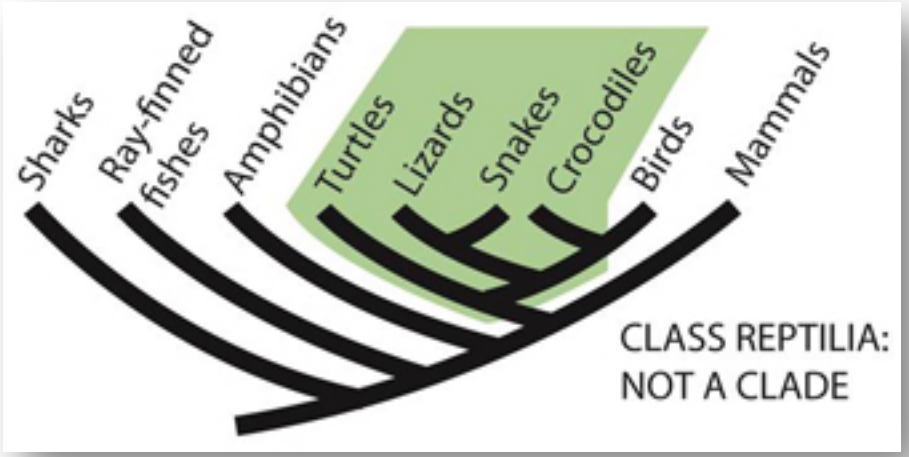
Derived Characters

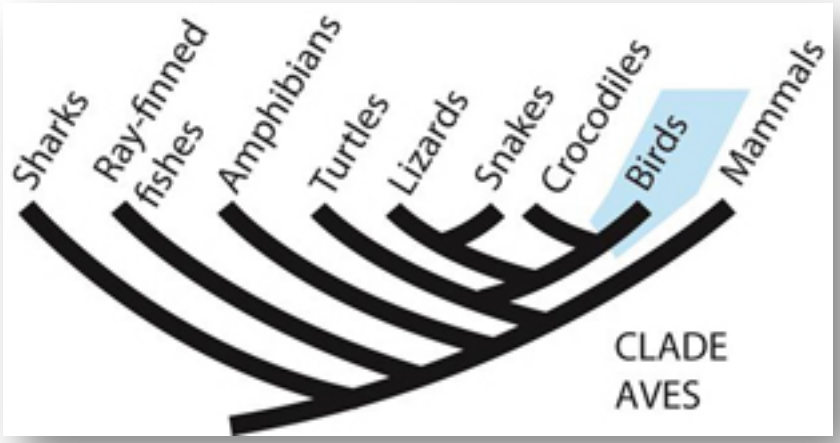
Hair
Four limbs
Retractable claws
Specialized shearing teeth

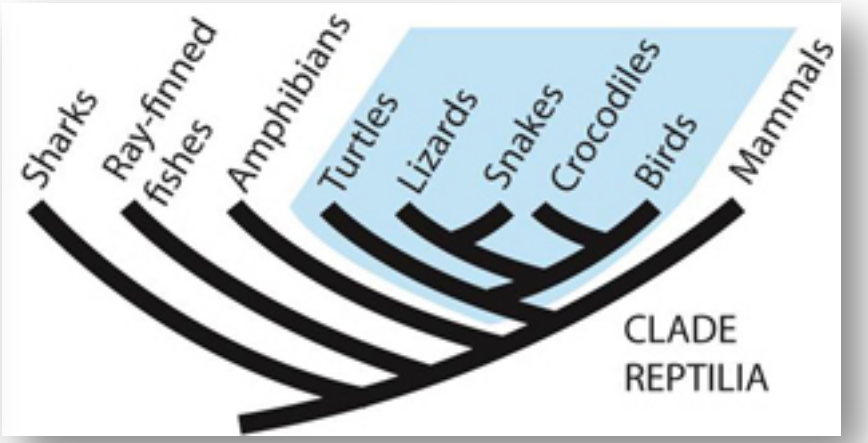
Interpreting a Cladogram



Clades and Traditional Taxonomic Groups







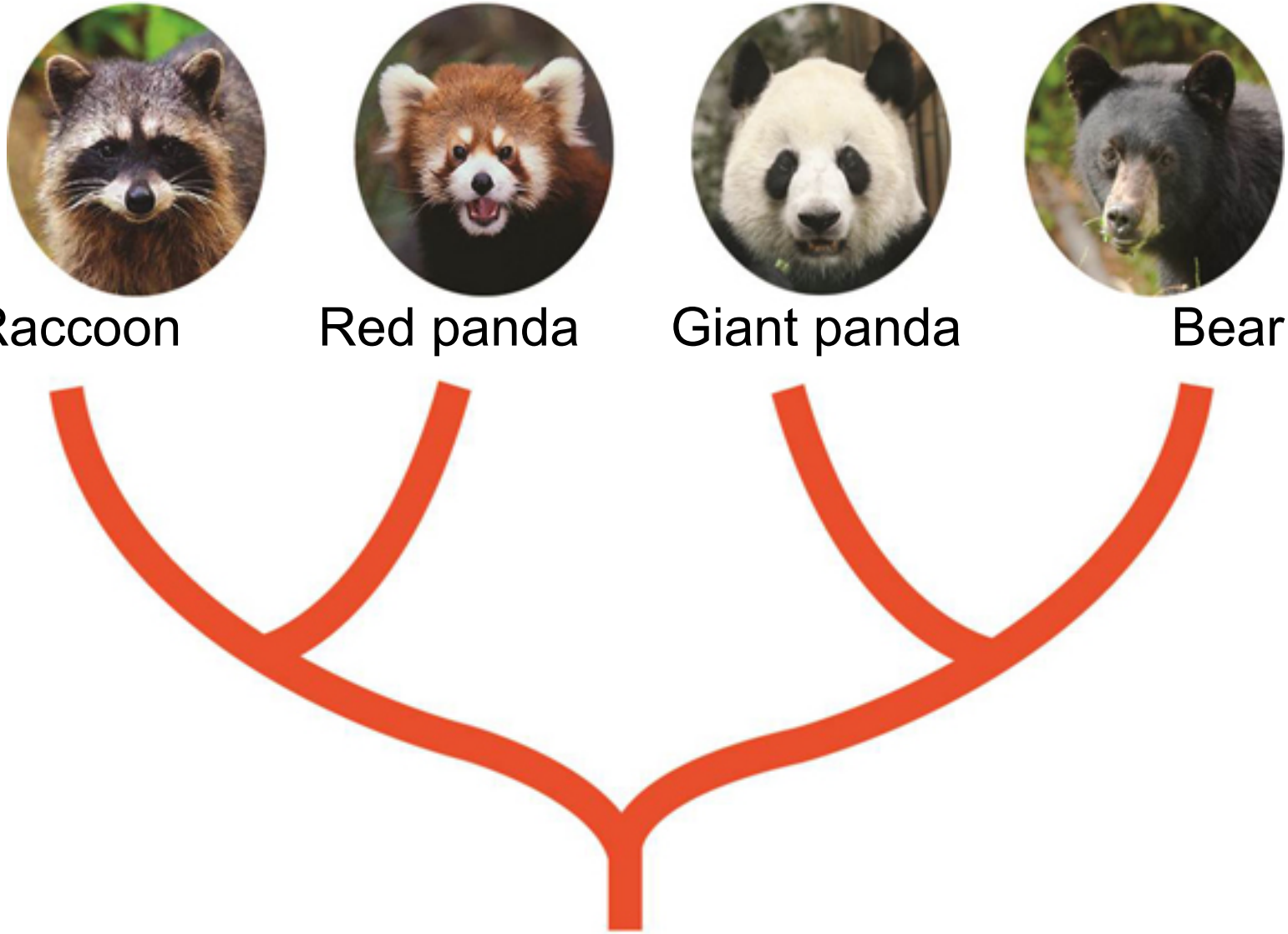
DNA in Classification

Hooded vulture

Stork

American vulture

Classification of Pandas



Constructing a Cladogram

Derived Characters in Organisms			
Organism	**Derived Character**		
	Backbone	**Legs**	**Hair**
Earthworm	Absent	Absent	Absent
Trout	Present	Absent	Absent
Lizard	Present	Present	Absent
Human	Present	Present	Present

Building the Tree of Life

Learning Objectives

- Name the six kingdoms of life as they are currently identified.
- Explain what the tree of life represents.

Changing Ideas About Kingdoms

Kingdoms of Life, 1700s–1990s

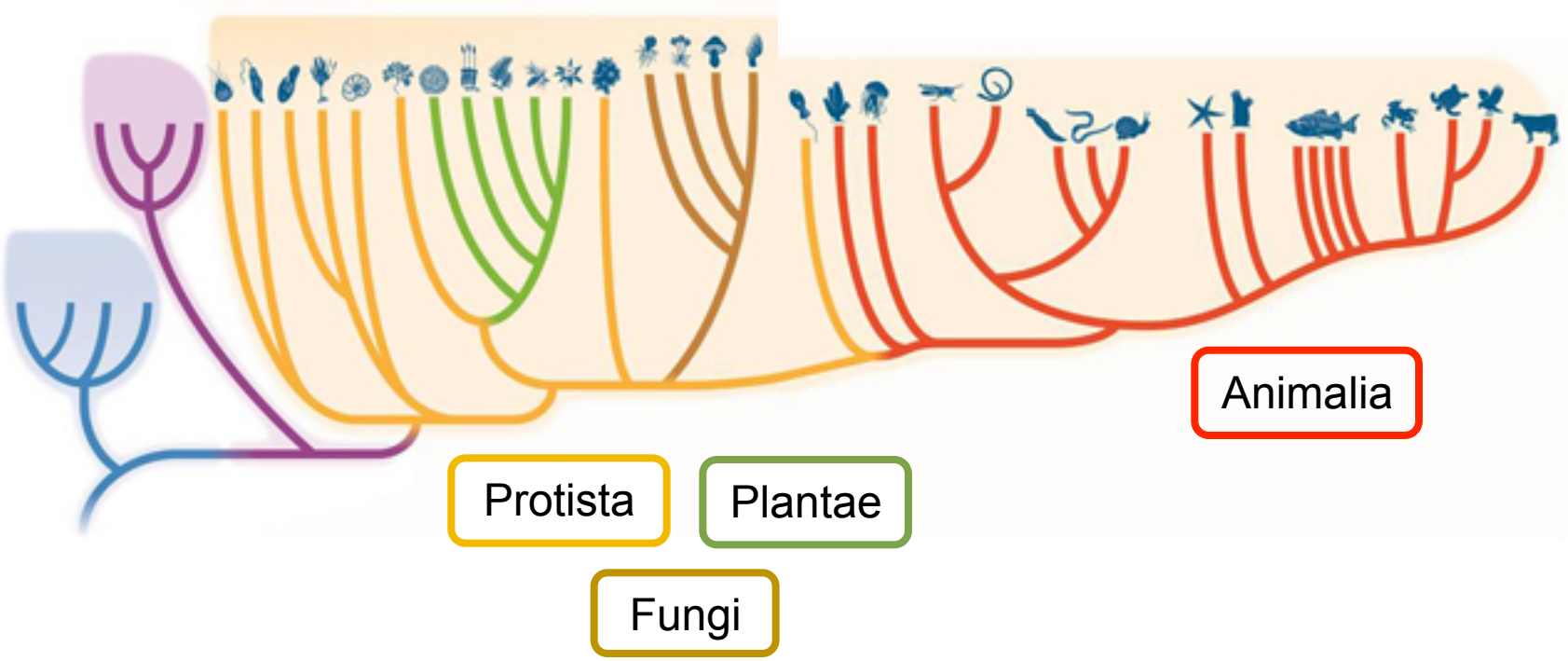
First Introduced	Names of Kingdoms					
1700s	Plantae					Animalia
Late 1800s	Protista			Plantae		Animalia
1950s	Monera		Protista	Fungi	Plantae	Animalia
1990s	Eubacteria	Archaebacteria	Protista	Fungi	Plantae	Animalia

Classification of Living Things

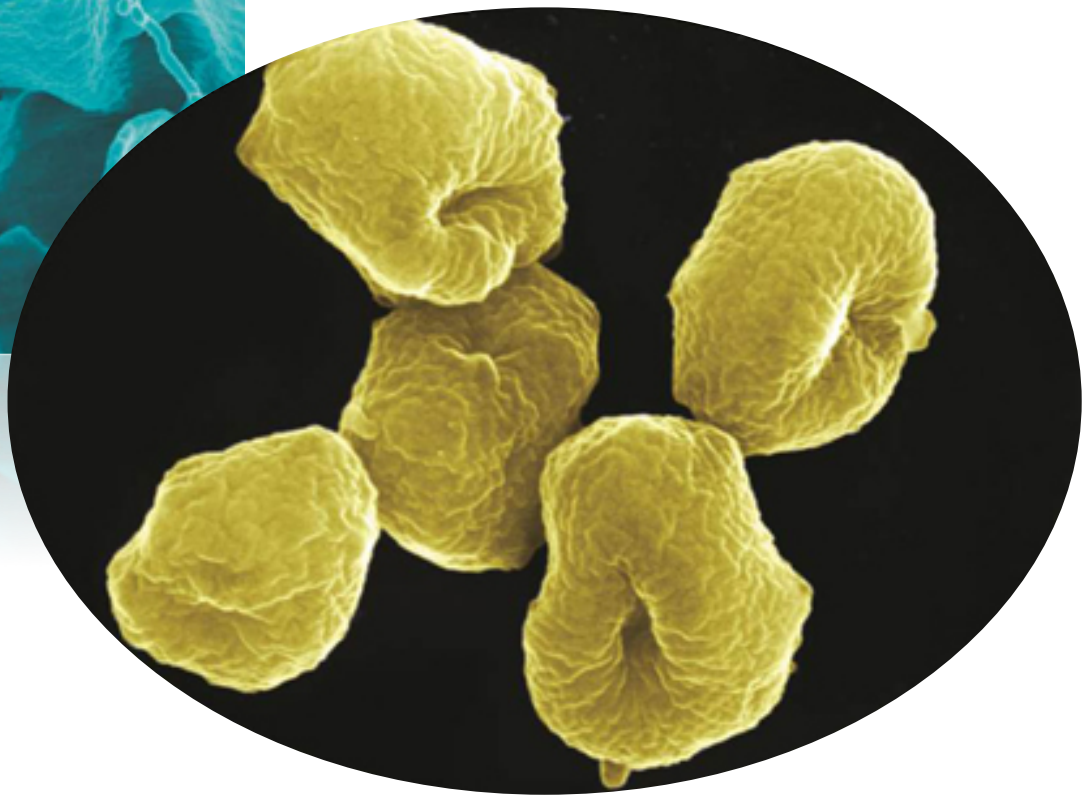
Domain	Bacteria	Archaea	Eukarya			
Kingdom	Eubacteria	Archae-bacteria	"Protista"	Fungi	Plantae	Animalia
Cell type	Prokaryote	Prokaryote	Eukaryote	Eukaryote	Eukaryote	Eukaryote
Cell structures	cell walls with peptidoglycan	cell walls without peptidoglycan	cell walls of cellulose in some; some have chloroplasts	cell walls of chitin	cell walls of cellulose; chloroplasts	no cell walls or chloroplasts
Number of cells	unicellular	unicellular	most unicellular; some colonial; some multicellular	most multicellular; some unicellular	most multicellular: some green algae unicellular	multicellular
Mode of nutrition	autotroph or heterotroph	autotroph or heterotroph	autotroph or heterotroph	heterotroph	autotroph	heterotroph
Examples	Streptococcus, Escherichia coli	methanogens, halophiles	Amoeba, Paramecium, slime molds, giant kelp	mushrooms, yeasts	mosses, ferns, flowering plants	sponges, worms, insects, fishes, mammals

The Tree of All Life

Bacteria **Archaea** **Eukarya**



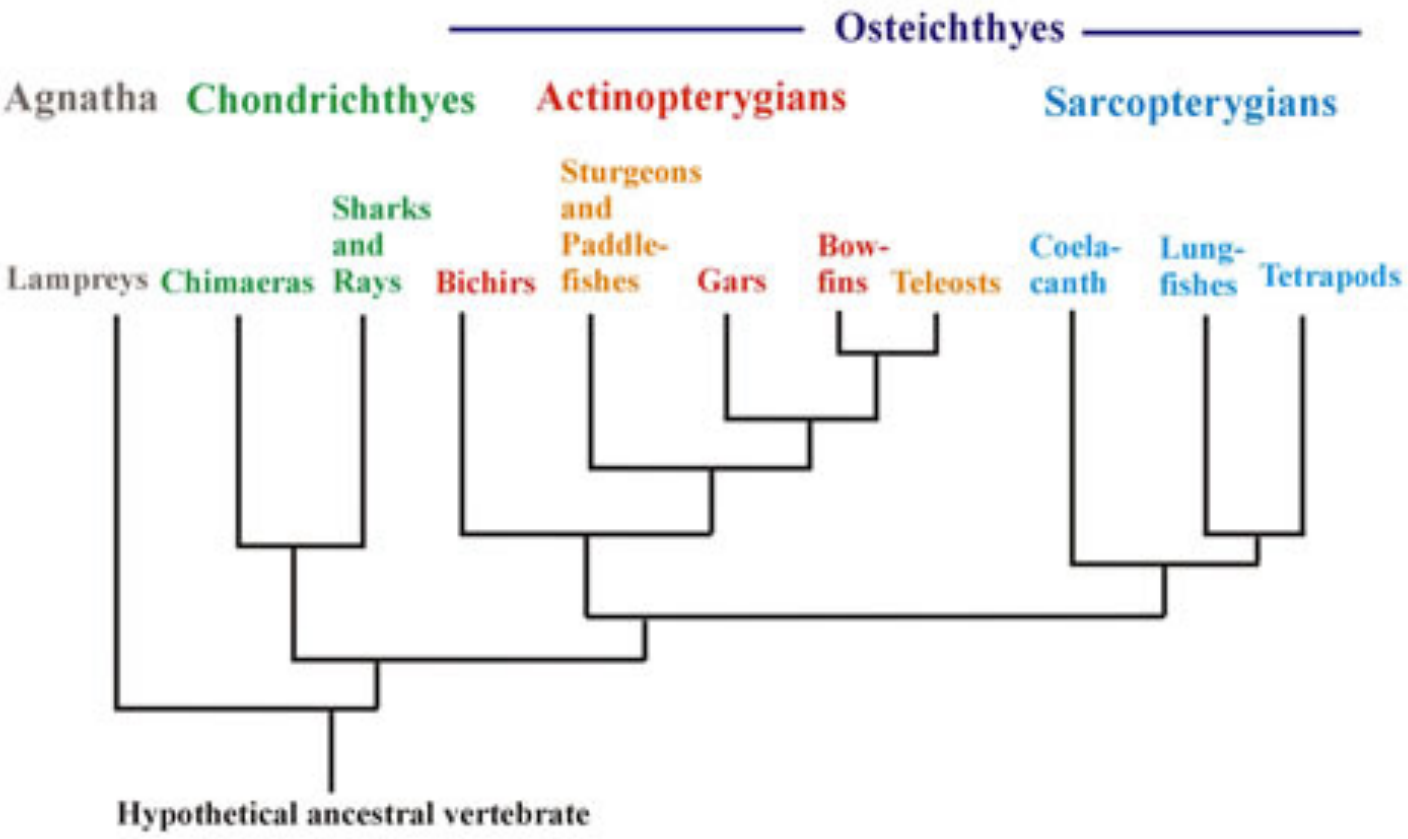
Domains Bacteria and Archaea



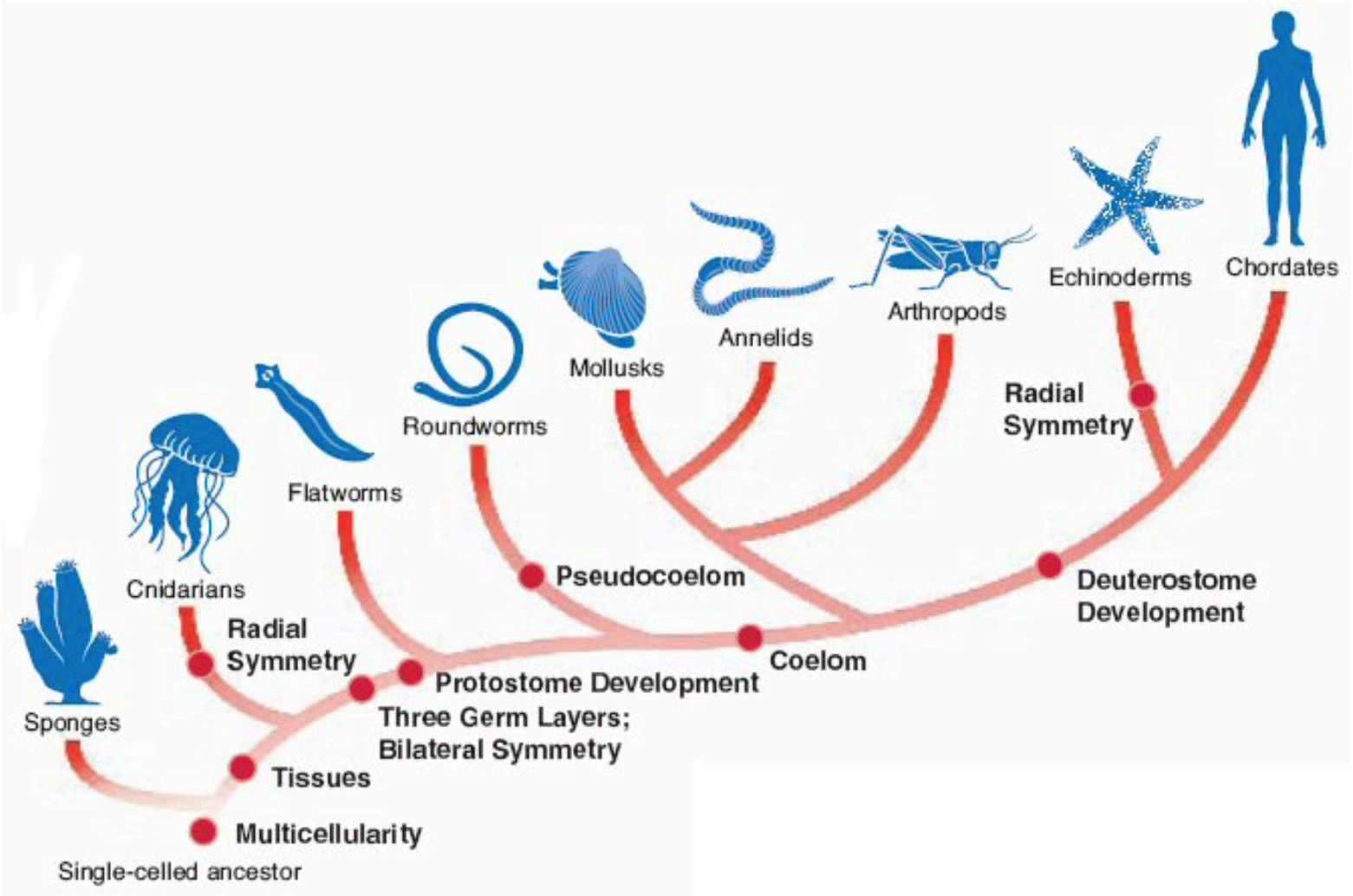
Domain Eukarya: “Protists” and Fungi

Domain Eukarya: Plantae and Animalia

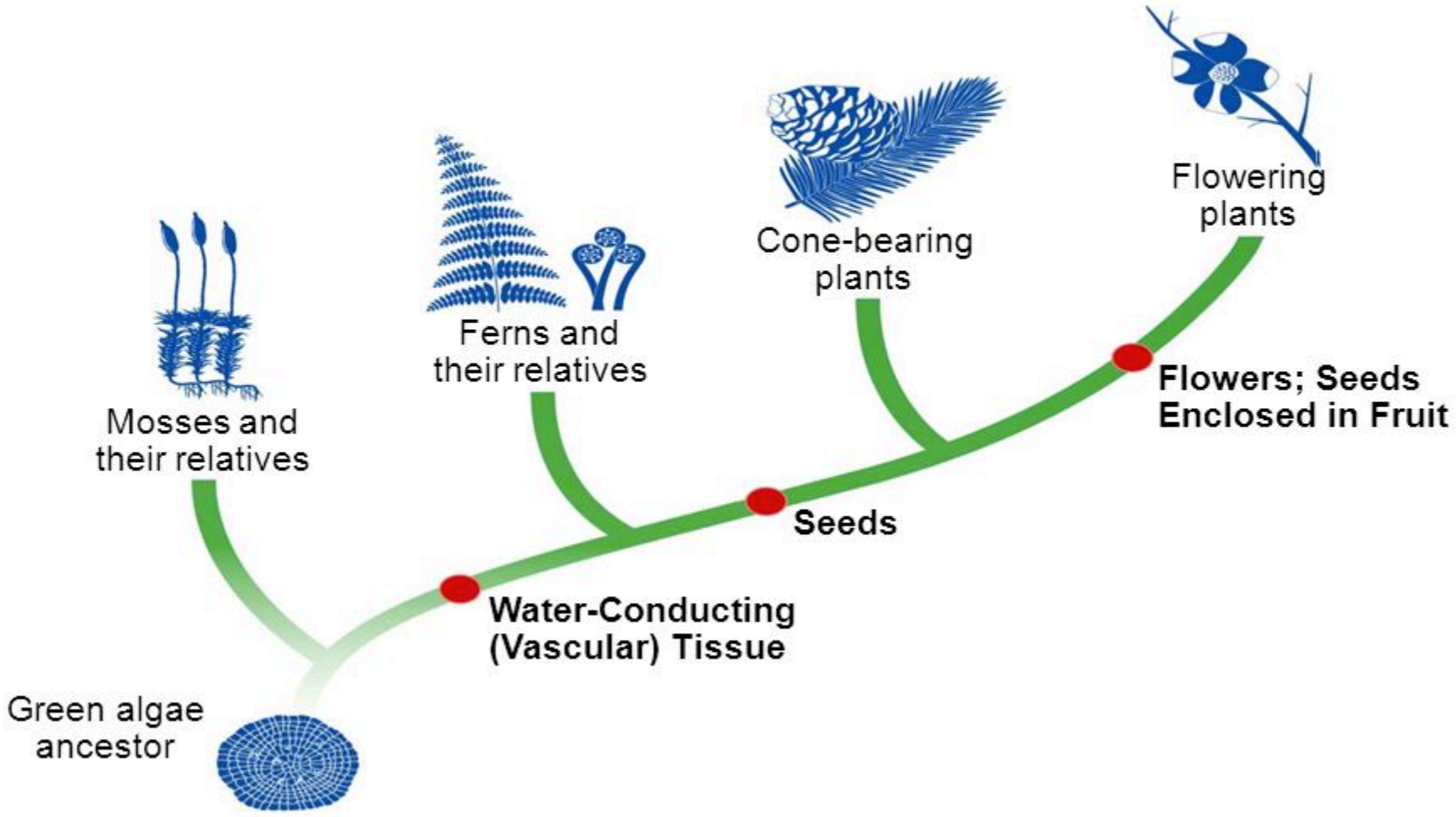
TravelerFolio.com


Osteichthyes
Agnatha
Chondrichthyes
Actinopterygians
Sarcopterygians
Lampreys
Chimaeras
Sharks and Rays
Bichirs
Sturgeons and Paddle-fishes
Gars
Bow-fins
Teleosts
Coela-canth
Lung-fishes
Tetrapods
Hypothetical ancestral vertebrate

Animal Kingdom Cladogram



Plant kingdom cladogram



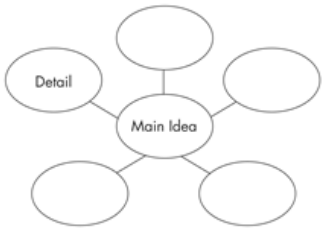
Thought Question: What is the evolutionary advantage associated with each of the derived characters shown in the cladogram below?

Student Worksheet Answers

Name _____ Class _____ Date _____

Building the Tree of Life

Organize A concept map helps you organize concepts, using visual relationships and linking words. Creat a concept map, similar to the one shown, for the classification of organisms.



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