Biological Diversity of Life Forms

– Introduction

– History of Classification

– Diversity of Life Forms: the three domains of life

Biological Diversity (Biodiversity)

Biodiversity refers to all of the variety of life that exists on Earth



Need for Classification

- People have been trying to classify the tremendous diversity of life on Earth for more than two thousand years
  - **Classification** is the process of **arranging organisms** into groups based on similar characteristics
  - **Taxonomy** is the science of **naming and classifying** organisms
  - **Systematics** **classifies** organisms and **determines their evolutionary relationships**. Systematists use fossil, molecular, and genetic data to infer evolutionary relationships.
- Classification is an important step in understanding the present diversity and past evolutionary history of life on Earth. It helps make sense of the overwhelming diversity of living things

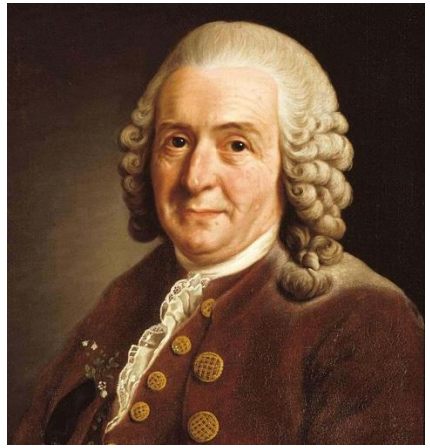
History of Classification

Linnaean Classification

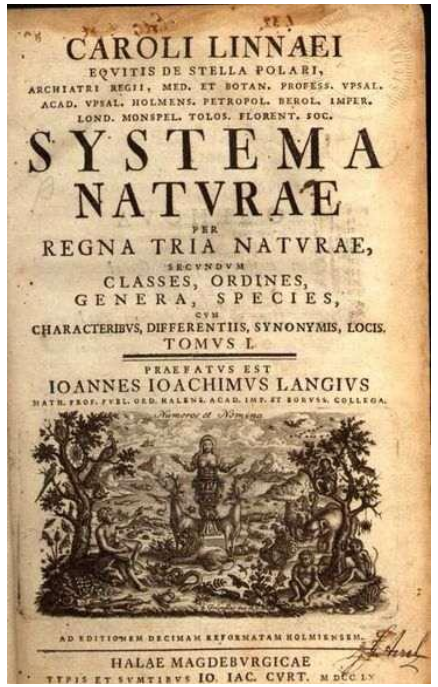
Phylogenetic Classification

1. Linnaean Classification

- All modern classification systems have their roots in the Linnaean classification system



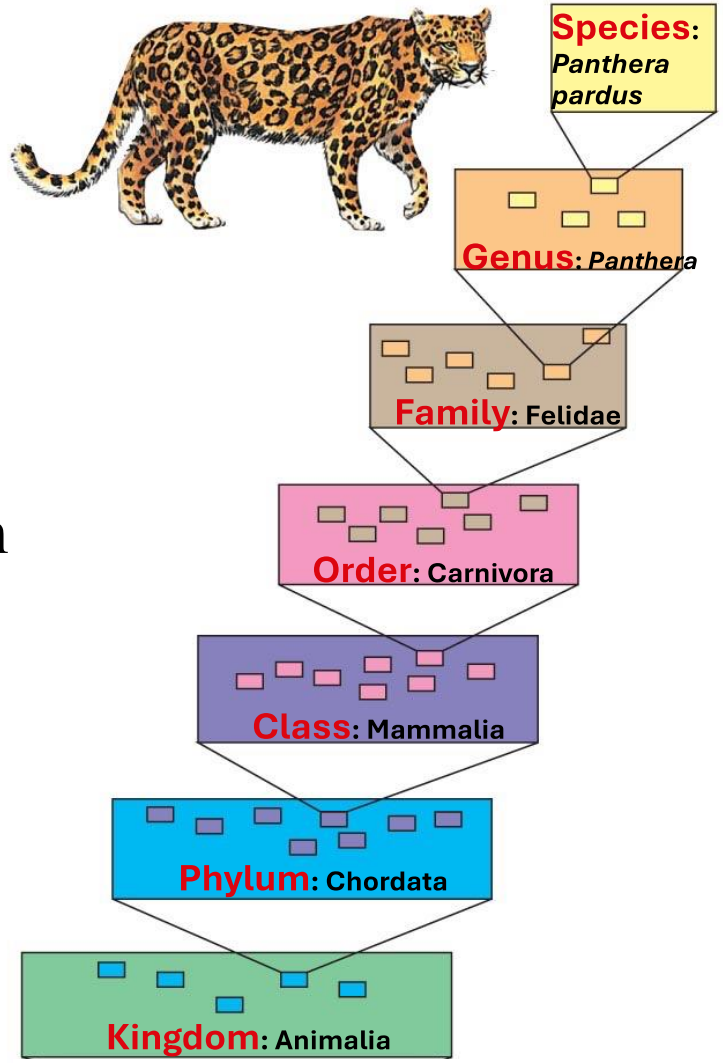
- It was developed by Swedish botanist Carolus Linnaeus in the 18th century. He published a system of taxonomy based on resemblances



- He tried to classify all living things that were known at his time. He **grouped together organisms that shared obvious morphological traits**, such as the number of legs or shape of leaves

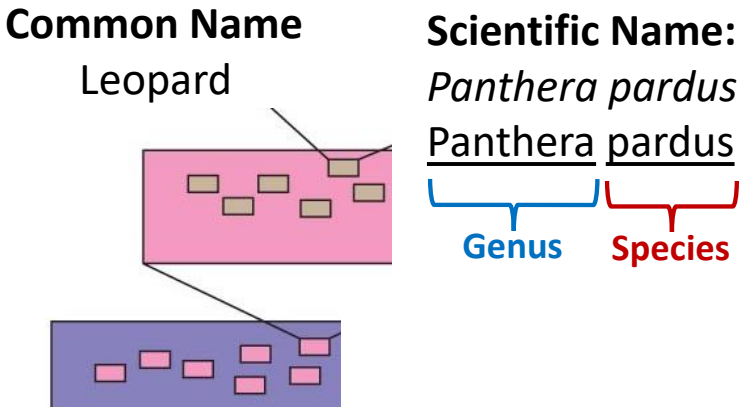
1. Linnaean Classification: Hierarchical Classification

- Linnaeus introduced a **system for grouping** species in increasingly broad categories **based on morphology** (organisms were grouped together if they looked alike)
- The taxonomic groups **from broad to narrow** are kingdom, phylum, class, order, family, genus, and species
  - The kingdom is the largest and most inclusive grouping which consists of organisms that share just a few basic similarities
  - The species is the smallest and most exclusive grouping which consists of organisms that are similar enough to interbreed
- A taxonomic unit at any level of hierarchy is called a taxon



1. Linnaean Classification: Binomial Nomenclature

- Perhaps the single greatest contribution Linnaeus made to science was his method of naming species called **binomial nomenclature**
- Binomial nomenclature gives each species a unique, **two-word Latin** name consisting of the **genus name followed by a specific species identifier**. The first letter of the genus is capitalized, and the entire species name is italicized
- Using scientific names helps scientists **avoid the confusion** that can arise when referring to an organism by its common, or everyday, name



1. Linnaean Classification: Revisions (The Domain)

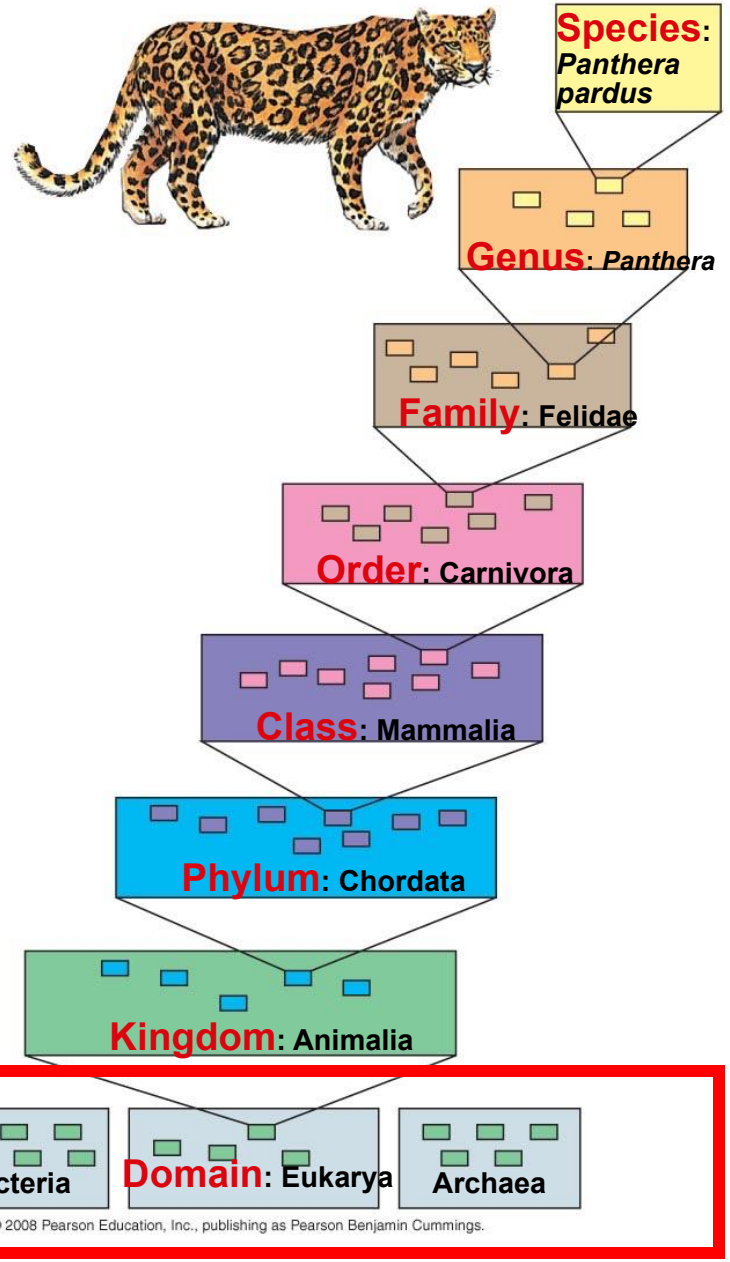
- Many changes have led to **revisions** in the original Linnaean system of classification since Linnaeus published his classification system:
  1. Many **new species** have been discovered
  2. Scientists can also now classify organisms based on their **biochemical and genetic similarities and differences** rather than just their morphology
- A major change to the Linnaean system is the **addition of a new taxon called the domain**
- The domain is a taxon that is **larger and more inclusive** than the kingdom, which includes three domains of life on Earth: Bacteria, Archaea, and Eukarya

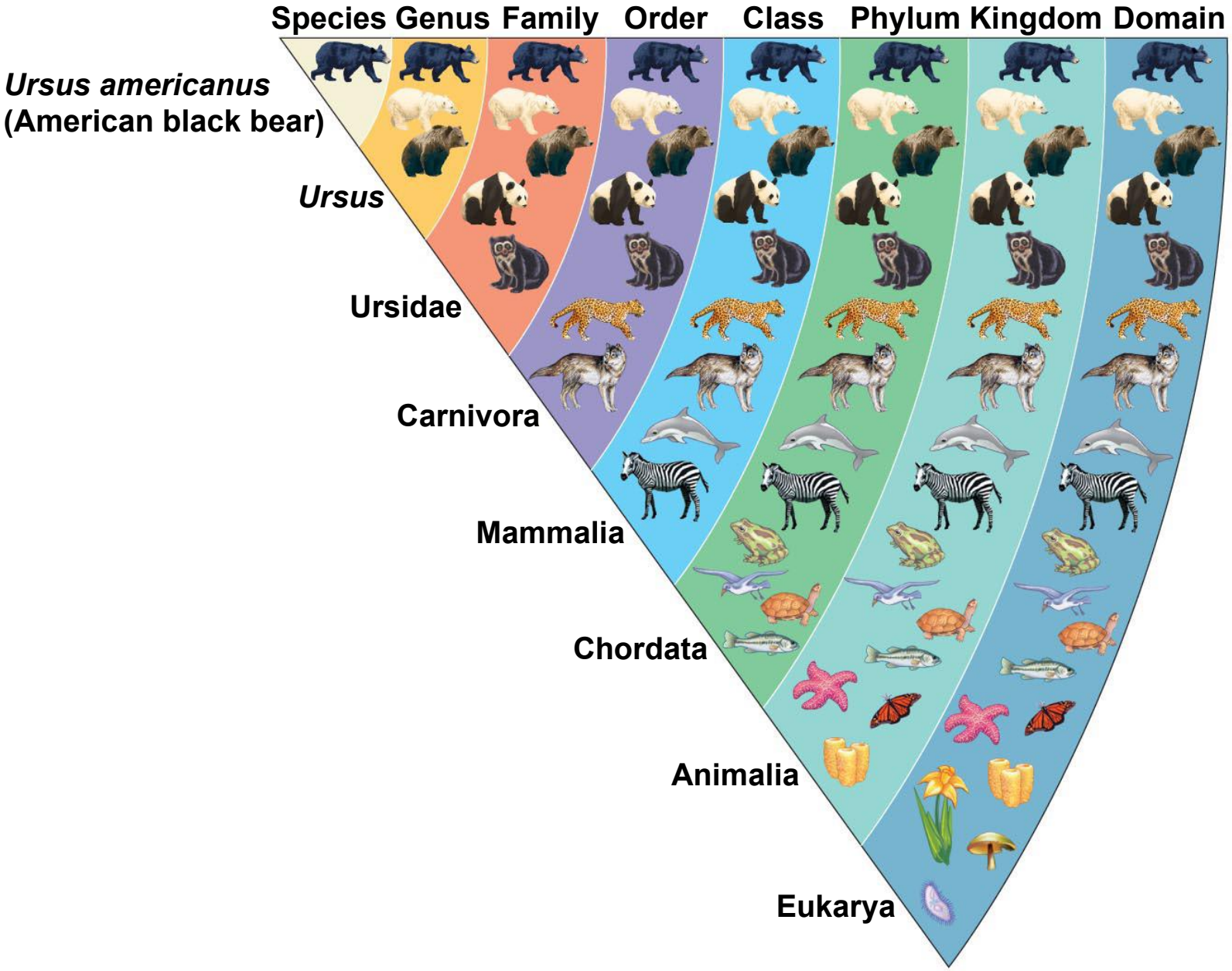
THREE DOMAINS
(Carl Woese, 1977)

ARCHAEA
(Extremophiles)
Methanogens, Halophiles, Thermoacidophiles

BACTERIA
Cyanobacteria & Eubacteria, beneficial& pathogenic

EUKARYA
(Eukaryotes)
Protista, Fungi, Plants and Animals

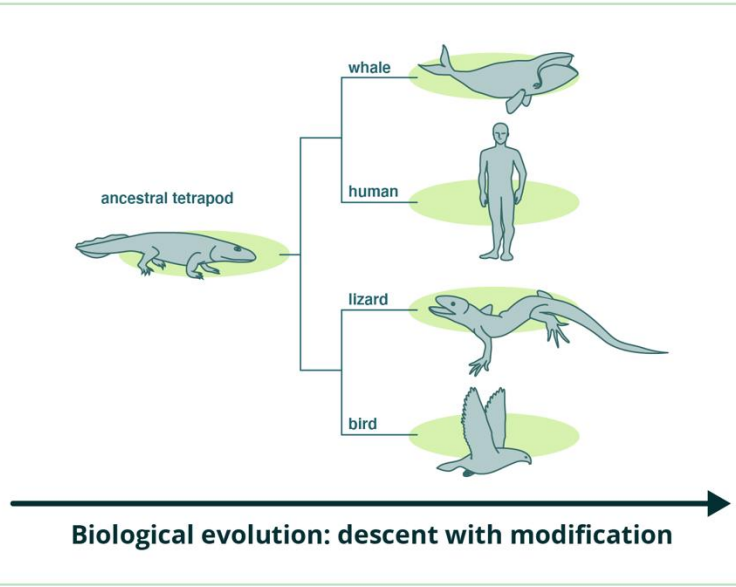



Species
Genus
Family
Order
Class
Phylum
Kingdom
Domain
Ursus americanus
(American black bear)
Ursus
Ursidae
Carnivora
Mammalia
Chordata
Animalia
Eukarya

2. Phylogenetic Classification

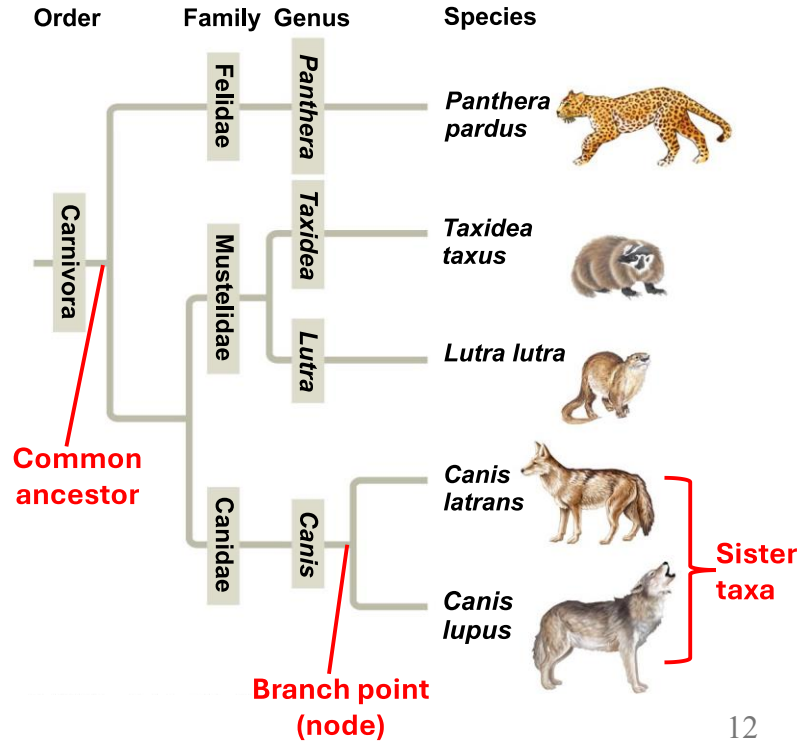
- After Darwin published his theory of evolution, scientists looked for a way to **classify organisms that took into account Phylogeny** (evolutionary relationships)
- According to Darwin's theory:
  - Evolution is descent with inherited modification
  - All life on Earth shares a common ancestor (just as you and your cousins share a common grandmother)
  - Through the process of evolution (descent with modification), this common ancestor gave rise to the diverse species that we see documented in the fossil record and around us today
  - Evolution means that we're all distant cousins: humans and oak trees, hummingbirds and whales





2. Phylogenetic Classification

- Phylogeny is the **evolutionary history** of a group of related organisms. It is represented by a phylogenetic tree
- A phylogenetic tree is a **diagram that represents evolutionary relationships** among organisms. You can interpret the degree of relationship between two organisms, and also map out the evolutionary history of life on Earth from common ancestors
- An Example: This phylogenetic tree (in your right) shows evolutionary relationships between some of the taxa within order Carnivora, itself a branch of class Mammalia. *Canis latrans* and *C. Lupus* are sister taxa that share a common ancestor. They are more related to each other than to *Lutra lutra*

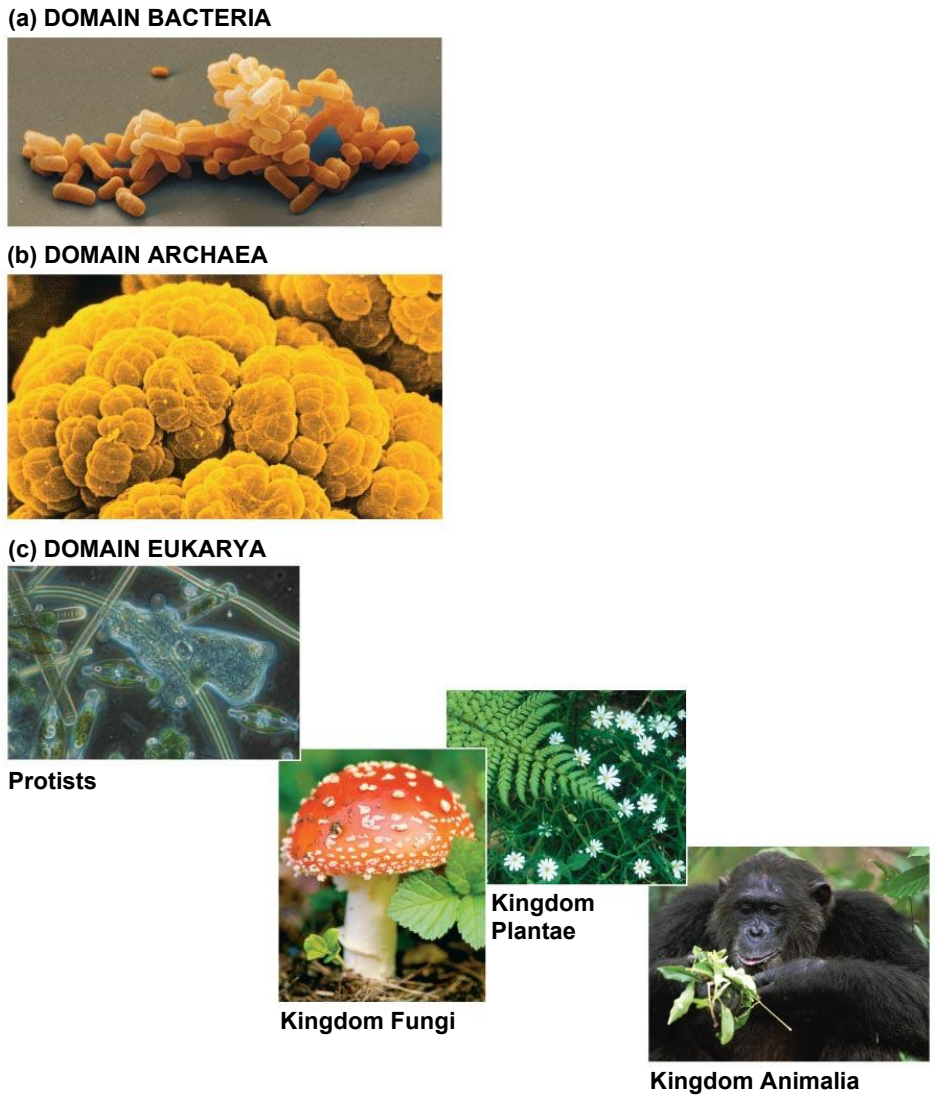


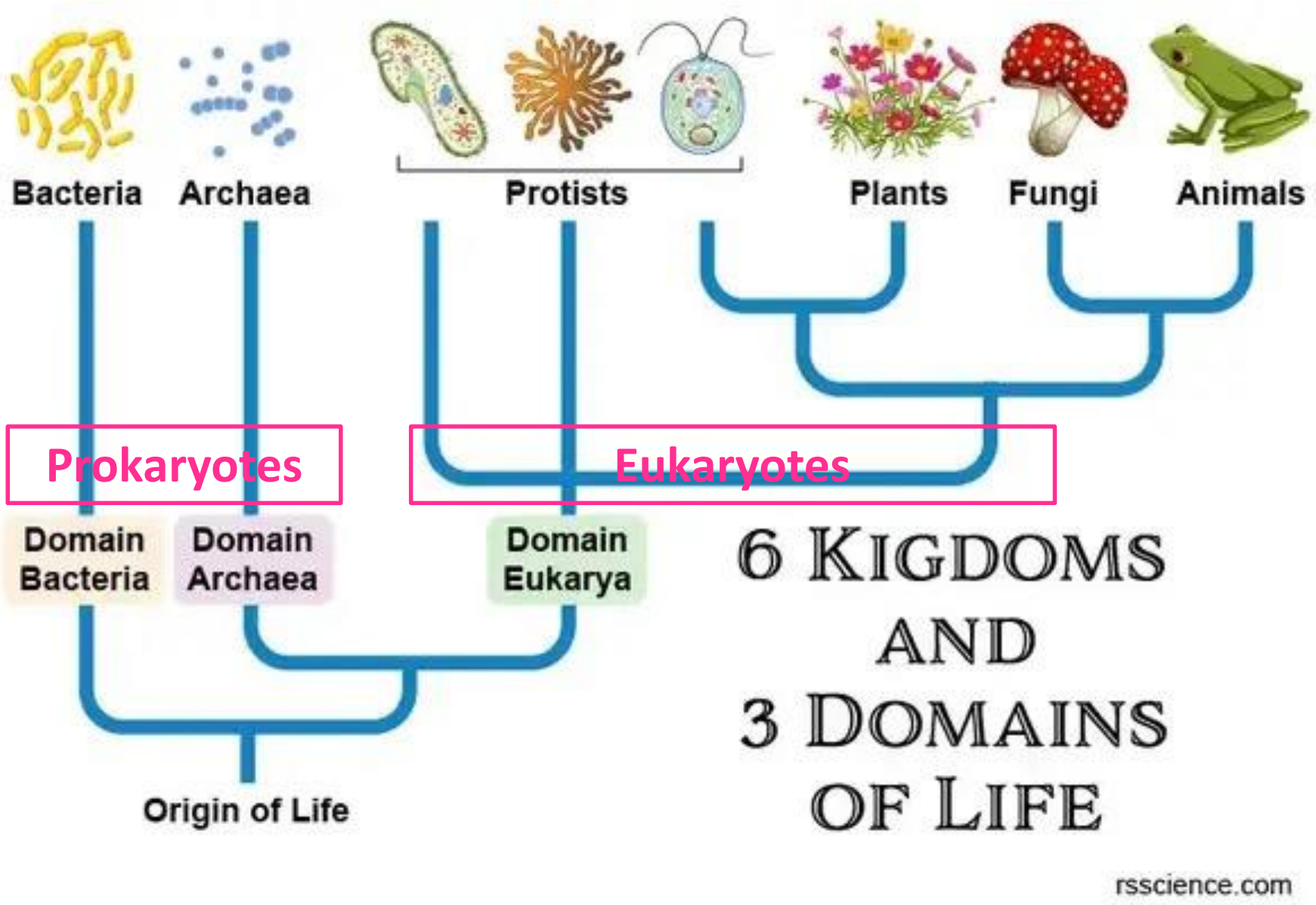
Diversity of Life Forms

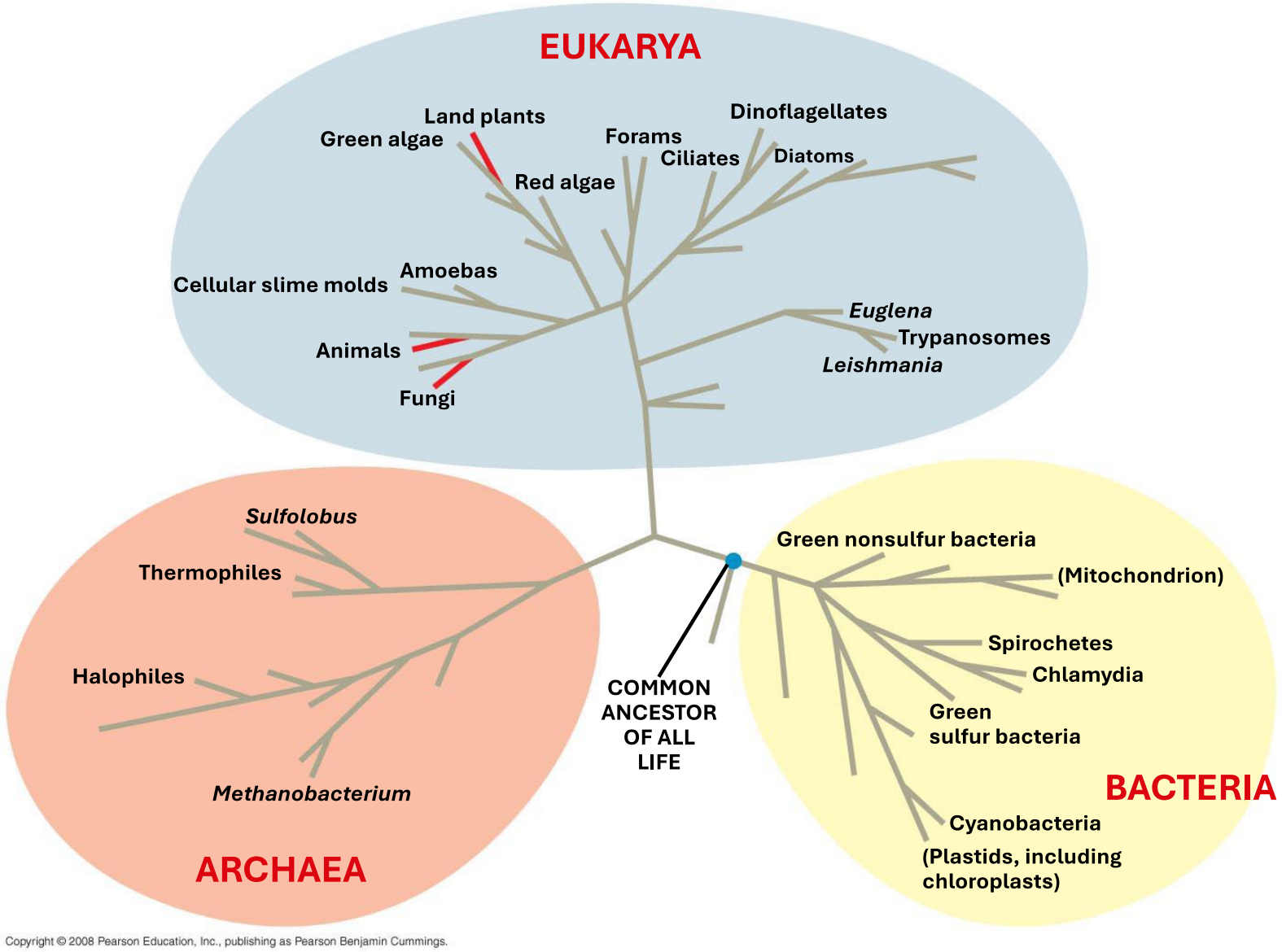
The Three Domains System

The Three Domains of Life

- Consequently, biologists have long used careful comparisons of structure, function, and other obvious features to classify forms of life into groups.
- In the last few decades, **new methods of assessing species relationships**, such as comparisons of DNA sequences, have led to a reevaluation of the classification of life
- The three-domain system is currently used:
  - **Domain Bacteria** and **domain Archaea** comprise the single-celled prokaryotes
  - **Domain Eukarya** includes all eukaryotic organisms. The Eukarya domain is made up of both single-celled and multicellular organisms This domain includes four subgroups: kingdom Plantae, kingdom Fungi, kingdom Animalia, and the protists




Bacteria
Archaea
Protists
Plants
Fungi
Animals
Prokaryotes
Eukaryotes
Domain Bacteria
Domain Archaea
Domain Eukarya
Origin of Life
6 KIGDOMS AND 3 DOMAINS OF LIFE
rsscience.com

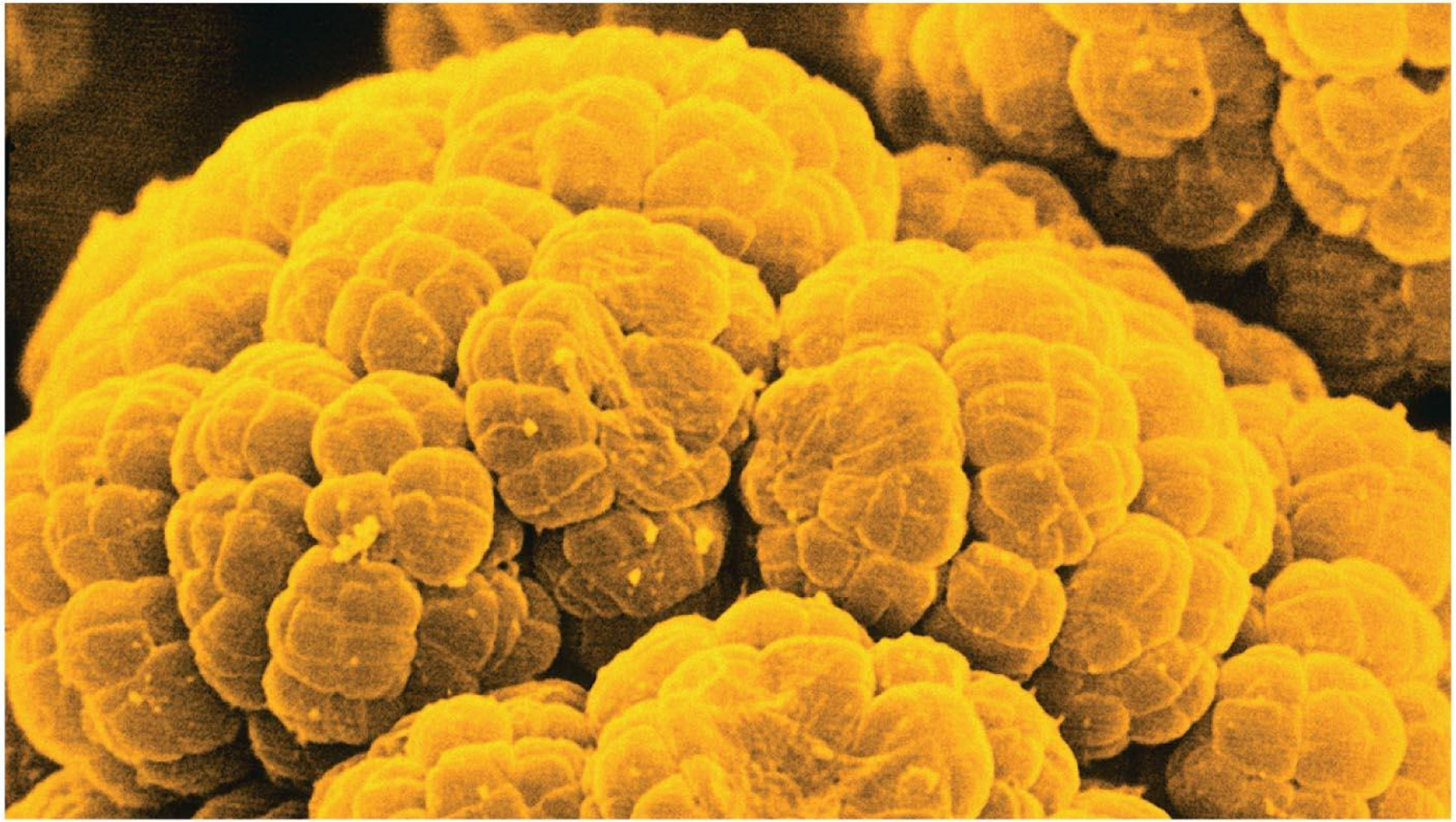


Copyright © 2008 Pearson Education, Inc., publishing as Pearson Benjamin Cummings.



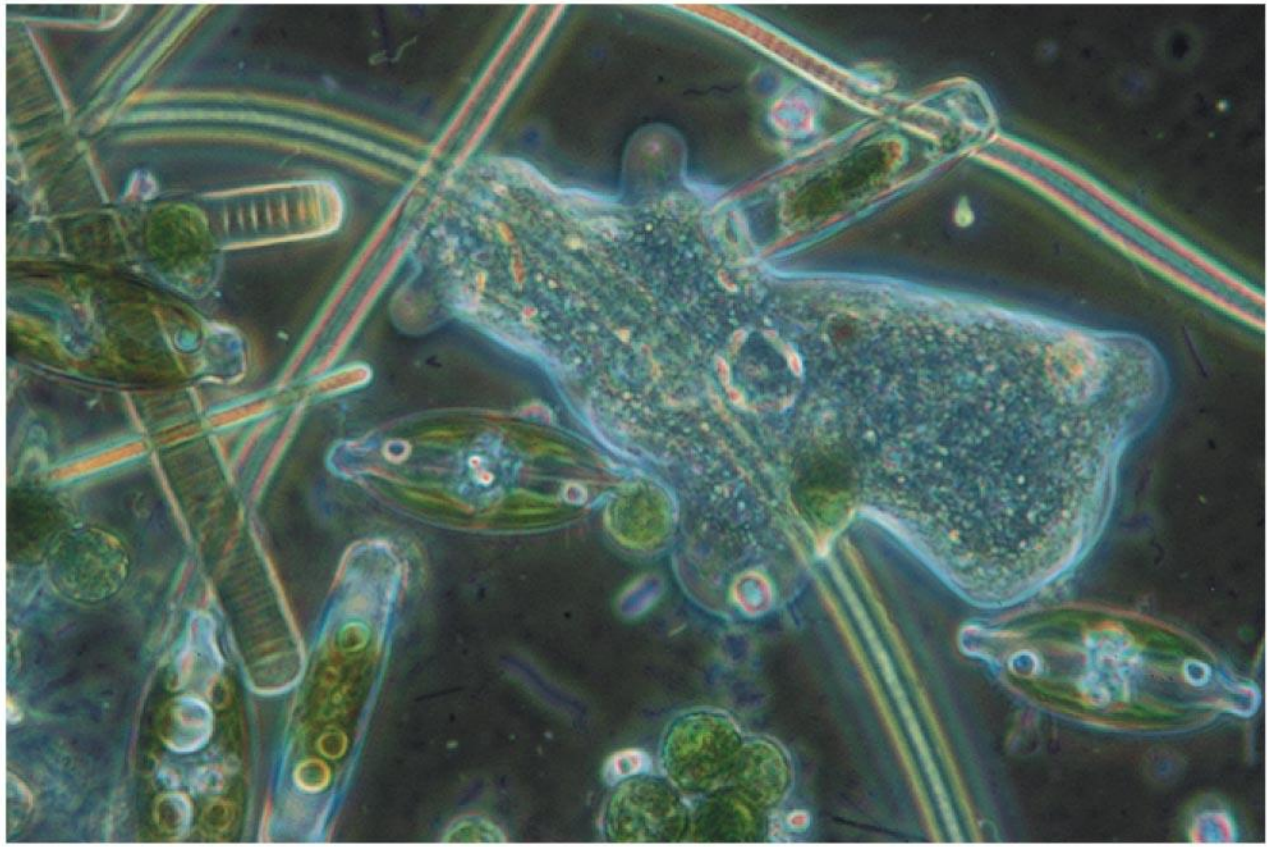
(a) DOMAIN BACTERIA .....Kingdom Bacteria

Copyright © 2008 Pearson Education, Inc., publishing as Pearson Benjamin Cummings.



(b) DOMAIN ARCHAEA…… Kingdom Archaea

Copyright © 2008 Pearson Education, Inc., publishing as Pearson Benjamin Cummings.



(c) DOMAIN EUKARYA……Kingdom Protists

Copyright © 2008 Pearson Education, Inc., publishing as Pearson Benjamin Cummings.



(c) DOMAIN EUKARYA…… Kingdom Fungi

Copyright © 2008 Pearson Education, Inc., publishing as Pearson Benjamin Cummings.



(c) DOMAIN EUKARYA…… Kingdom Plantae

Copyright © 2008 Pearson Education, Inc., publishing as Pearson Benjamin Cummings.



(c) DOMAIN EUKARYA…… Kingdom Animalia

Copyright © 2008 Pearson Education, Inc., publishing as Pearson Benjamin Cummings.