Chapter 26

Organizing Life's Diversity

Essential Knowledge

- 1.A.4 – Biological evolution is supported by scientific evidence from many disciplines, including mathematics
- 1.B.1 – Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today
- 1.B.2 – Phylogenetic trees and cladograms are graphical representations (models) of evolutionary history that can be tested
- 1.D.2 – Scientific evidence from many different disciplines supports models of the origin of life

Phylogenies Show Evolutionary Relationships

- Phylogeny = **evolutionary** history of species
- Systematics = classifying organisms and determining evolutionary relationship

- Taxonomy = **naming** and organizing organisms into groups based on set characteristics
- Classification = arranging organisms into groups

- Cladistics = evolutionary classification based on common descent and **shared** (derived) characteristics

So basically…

- We name species
- We group species
- We look at characteristics that can determine evolutionary relationships
- We determine the evolutionary relationship of species
- We set the evolutionary relationship of species

How Classification Began

- Taxonomy is the branch of biology that groups and names organisms
- The first system was developed by Aristotle, he classified things in two main groups
  - Plants
    - Herbs, shrubs, and trees
  - Animals
    - Land-dwelling, air-dwelling, and water-dwelling

How Classification Began

- Carl Linnaeus developed a method of grouping organisms that is still used today, called binomial nomenclature
  - A two-word naming system
- In this system, the first word is the genus and the second word is the species, the two together are called the scientific name
  - Example: *Homo sapien*

How Classification Began

- Scientific names are in Latin because it is a universal language that does not change
- Scientific names eliminate the confusion of common names
- Can you think of a common name that is confusing or misleading?

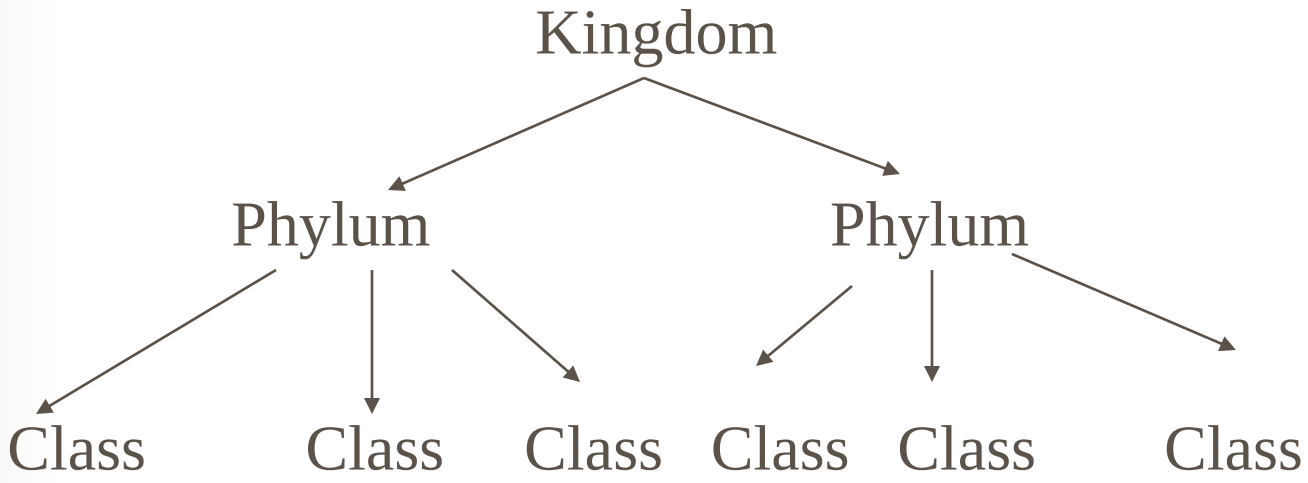
Modern Taxonomy

- Today, species are divided into groups according to evolutionary relationship
- Evolutionary relationship can be determined by looking at:
  - Fossil records, anatomical similarities, embryological similarities, and biochemical similarities

How Living Things are Classified

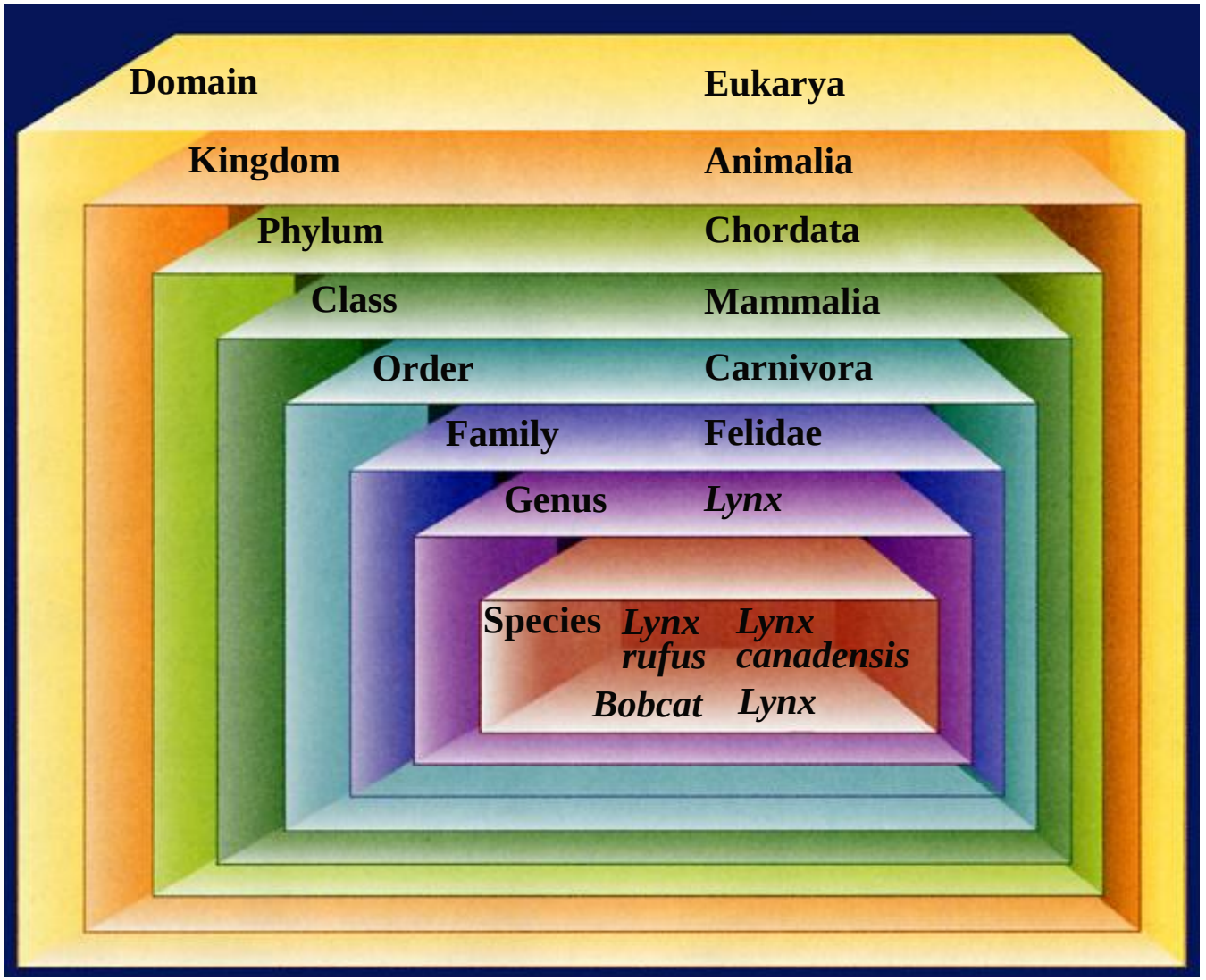
- Organisms are divided into groups called taxa
- The more taxa species have in common, the more closely related they are
  - Domain (largest, least specific group)
  - Kingdom
  - Phylum
  - Class
  - Order
  - Family
  - Genus
  - Species (smallest, most specific group)

How Living Things are Classified



And so on, all the way
down to specific species

How Living Things are Classified



Classification Keys

- A dichotomous key is a tool used to identify a specific organism found in nature
  - Consists of a series of paired statements that are the opposite of each other
- Always start at the beginning of the key and gradually work your way through the statements, deciding which of the pair is true for your specimen, and following the directions given
- When you reach a Latin name, you are done!

Phylogenetic Classification

- Today, organisms are classified based on phylogeny, or evolutionary history
- A cladogram is a diagram which shows phylogeny of organisms

Phylogenetic Trees

- Represents a hypothesis about evolutionary relationships
- Phylogenies are inferred from morphology and molecular homologies
  - Homologous structures
  - Careful about:
    - Convergent evolution and Analogous structures

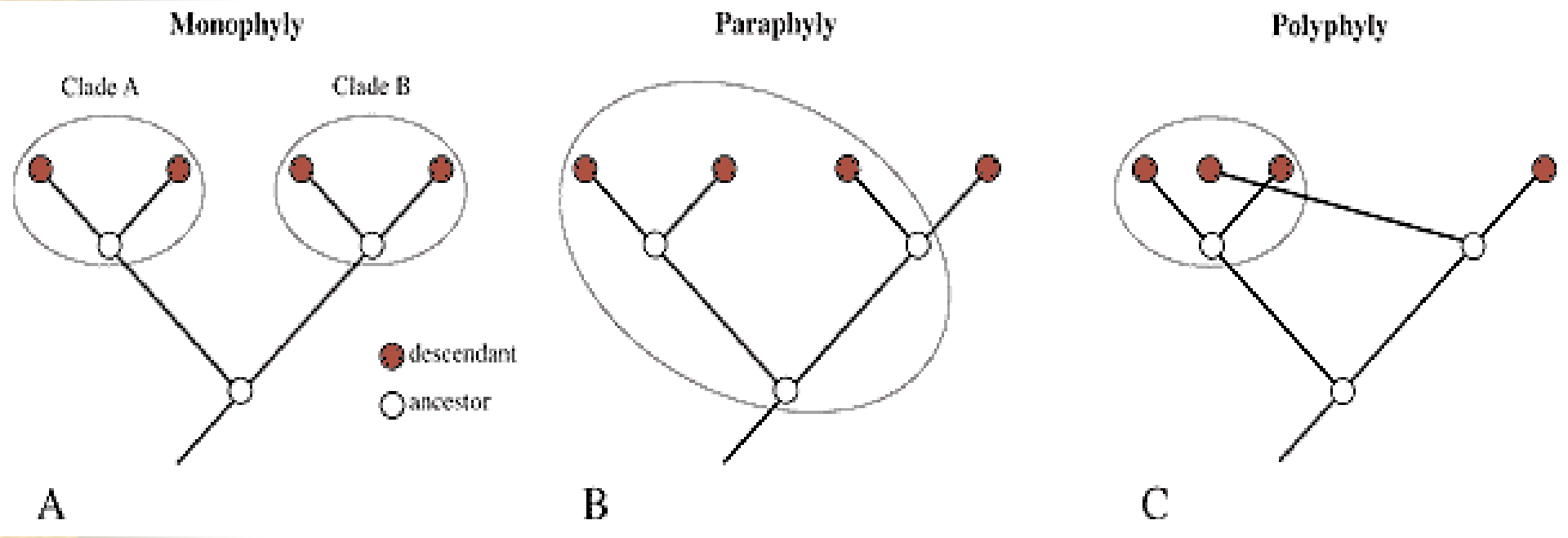
How are phylogenetic trees and cladograms constructed?

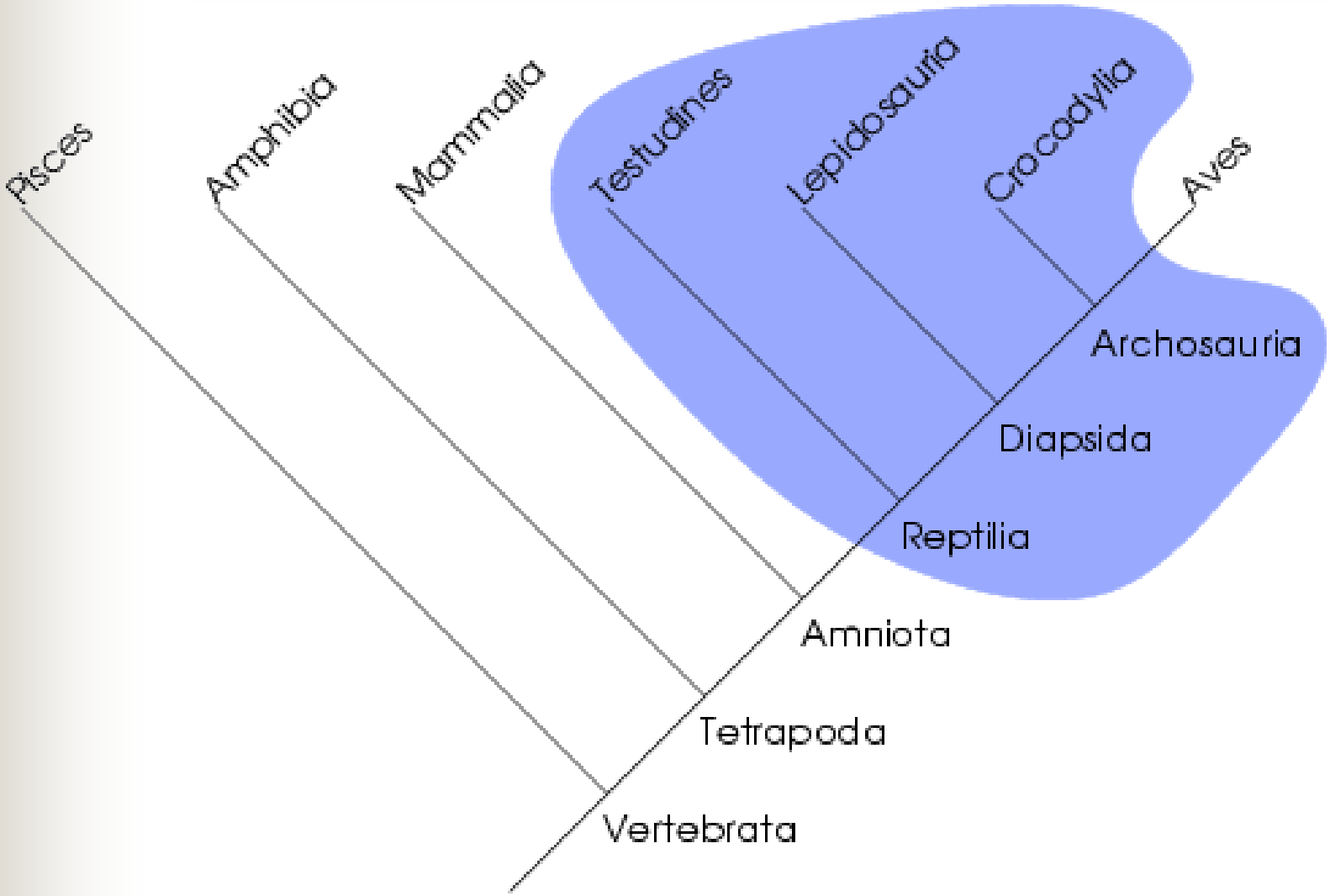
- Morphological similarities – living and fossil species
- DNA and protein sequence similarities
- Breeding behaviors
- Geographical distribution

Cladistics

- Clade = ancestral species and all its descendents

- Monophyletic = clade
- Paraphyletic = excludes some species that share a common ancestor
- Polyphyletic = includes several groups with different ancestors


Monophyly
Clade A
Clade B
descendant
ancestor
A
Paraphyly
B
Polyphyly
C


Pisces
Amphibia
Mammalia
Testudines
Lepidosauria
Crocodylia
Aves
Archosauria
Diapsida
Reptilia
Amniota
Tetrapoda
Vertebrata

Cladistics

- Shared ancestral characters = found in clade but evolved in ancestor not in clade
- Shared derived characters = characters unique to particular clade

- Parsimony = simplest explanation of evolutionary relationship