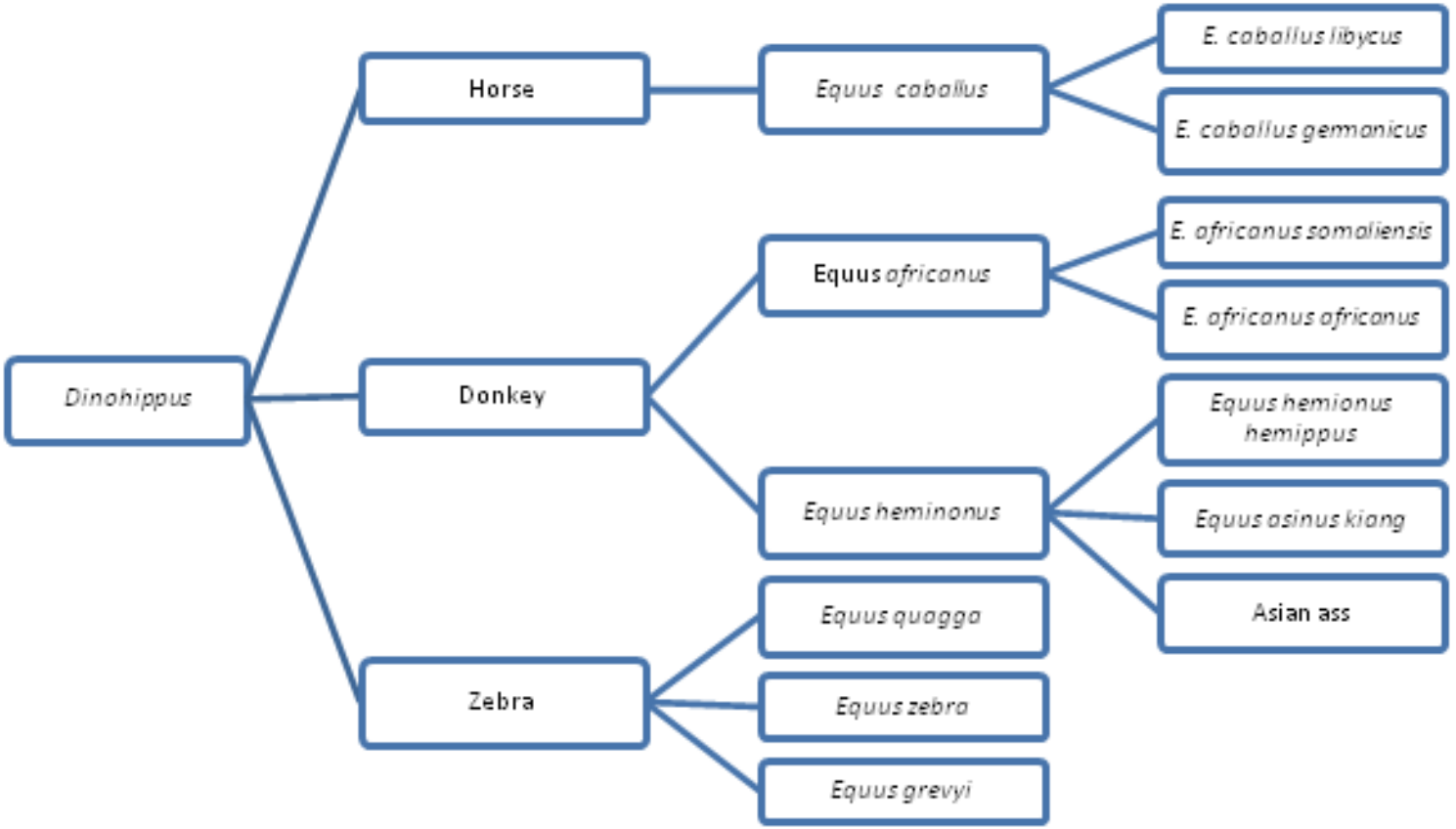
Classification

Essential Question

Why is it important to place living things into categories?

Compare and contrast

Taxonomy comparison

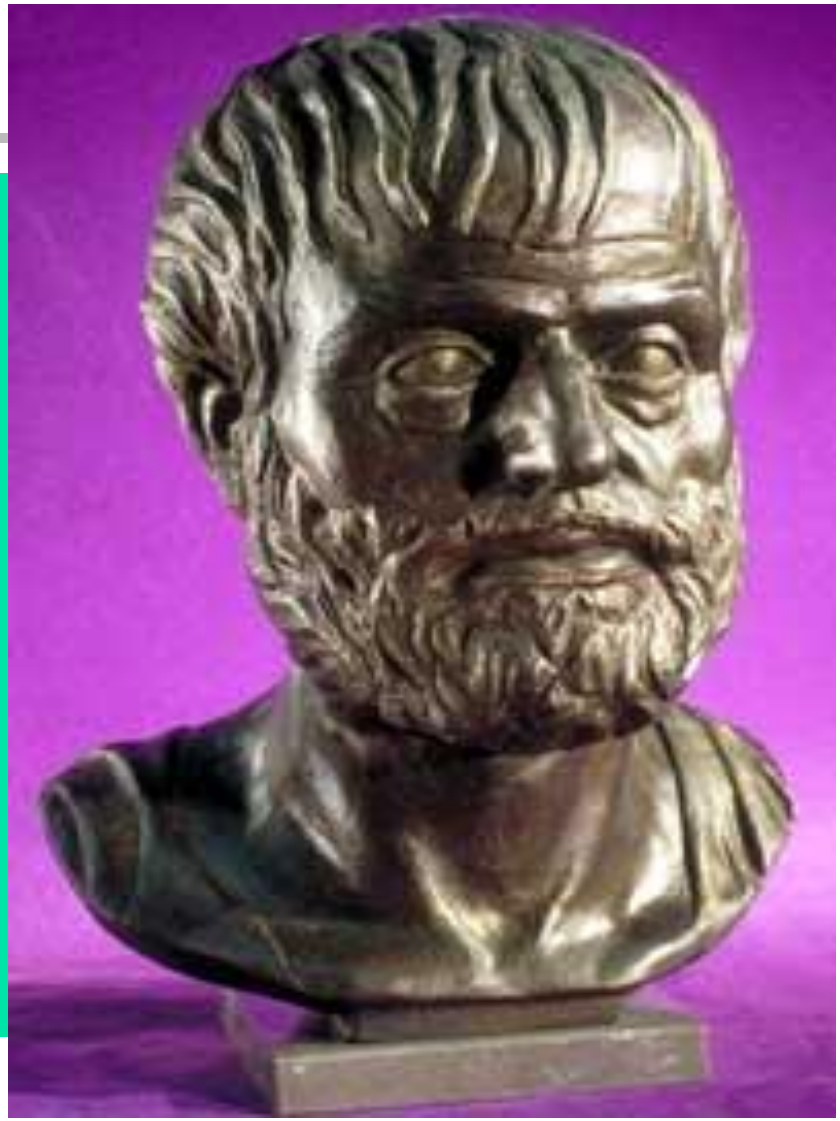


18.1 History of Taxonomy Objectives

- Describe Aristotle's classification system, and explain why it was replaced.
- Explain Linnaeus's system of classification, and identify the main criterion he used to classify organisms.
- What are the seven levels of organization that Linnaeus used to categorize organisms?
- What criterion do modern taxonomists use to classify an organism?
- What are two reasons that species names are more precise than common names?

Early System of Classification

- **Taxonomy is the branch of biology that names and groups organisms according to their characteristics and evolutionary history.**
- **Organisms were first classified more than 2,000 years ago by the Greek philosopher Aristotle.**



Early System of Classification

- **Organism's were grouped into land dwellers, water dwellers, and air dwellers.**
- **Plants were placed into three categories based on the differences in their stems.**
- **As new organism's were discovered, his system became inadequate.**
  - **Categories were not specific enough.**
  - **Common names did not describe a species accurately.**
  - **Names were long and hard to remember.**

Modern System:Hierarchy Seven Levels of Organization

- **Carolus Linnaeus (mid-1700')s was a Swedish biologist who established a simple system for classifying and naming organisms.**
- **He developed a Hierarchy (a ranking system) for classifying organisms that is the Basis for Modern Taxonomy.**
- **For this reason, he is considered to be "father" of modern taxonomy.**

Modern System a Nested Hierarchy- Seven Levels of Organization

- **Linnaeus used an organisms morphology (form and structure), to categorize it.**
- **His system is still being used today.**
- **His system allowed organisms to be grouped with similar organisms.**
- **He first divided all organisms into two Kingdoms, Plantae (Plants) AND Animalia (animals).**
- **This was the same as Aristotle's main categories.**

Modern System a Nested Hierarchy- Seven Levels of Organization

- **Modern System:**
  - **Each kingdom (plant and animal) was divided into a phylum* (division for plants)**
  - **Each phylum into a smaller groups called class.**
  - **Each class was divided into an order.**
  - **Each order was divided into family (families).**
  - **Each family was divided into a genus (plural- genera)**
  - **Each genus was divided into a species. (scientific name)**

***Note: Phyla and family were not in Linnaeus's classification system but were added by modern scientists.**

Levels of Classification

- **Remember: King Philip Came Over For Grandma's Soup.**

Kingdom

Phylum

Class

Order

Family

Genus

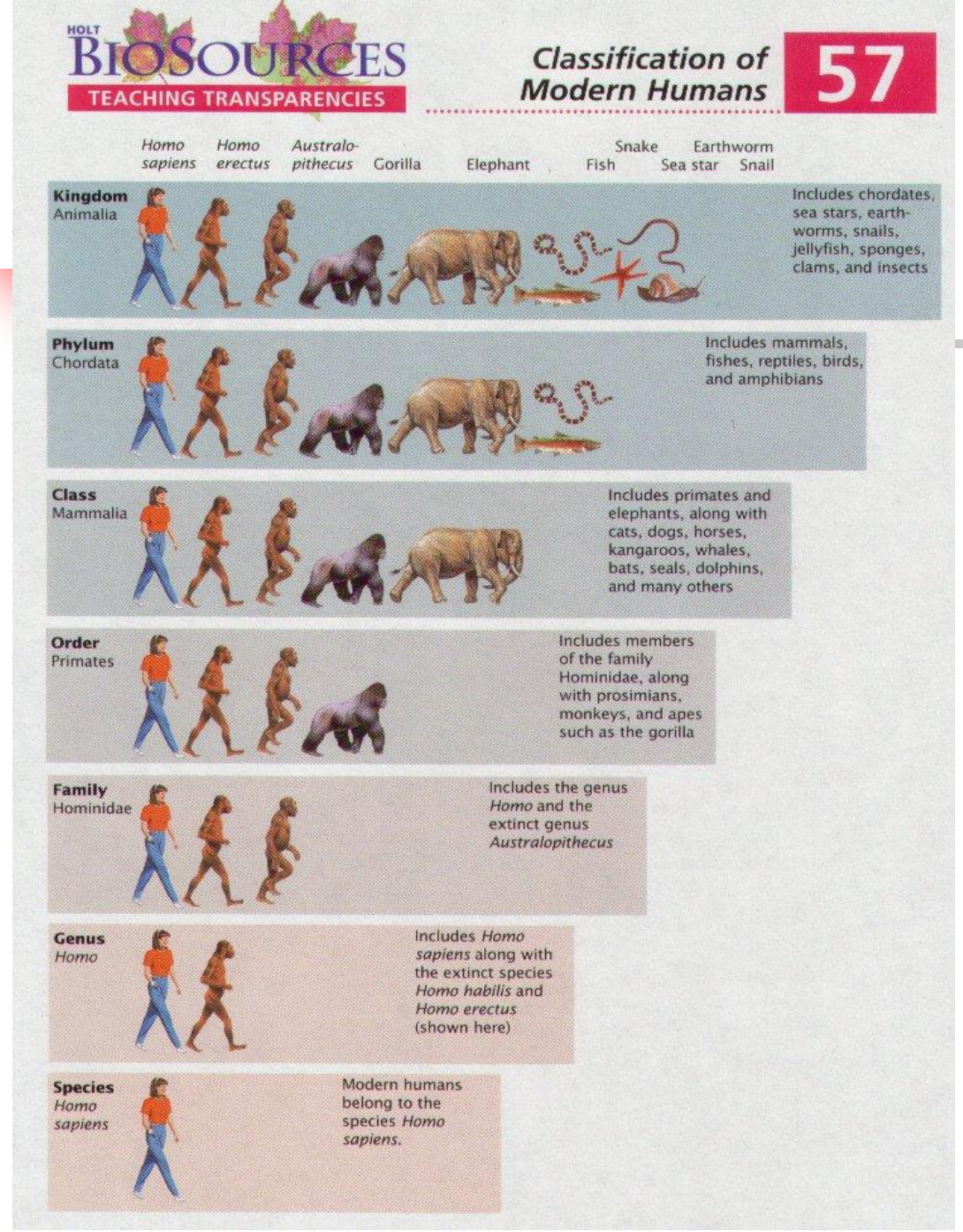
Species

See Table 18-1 on page 338 :Classification Hierarchy of Organisms

Classification Hierarchy of Organisms

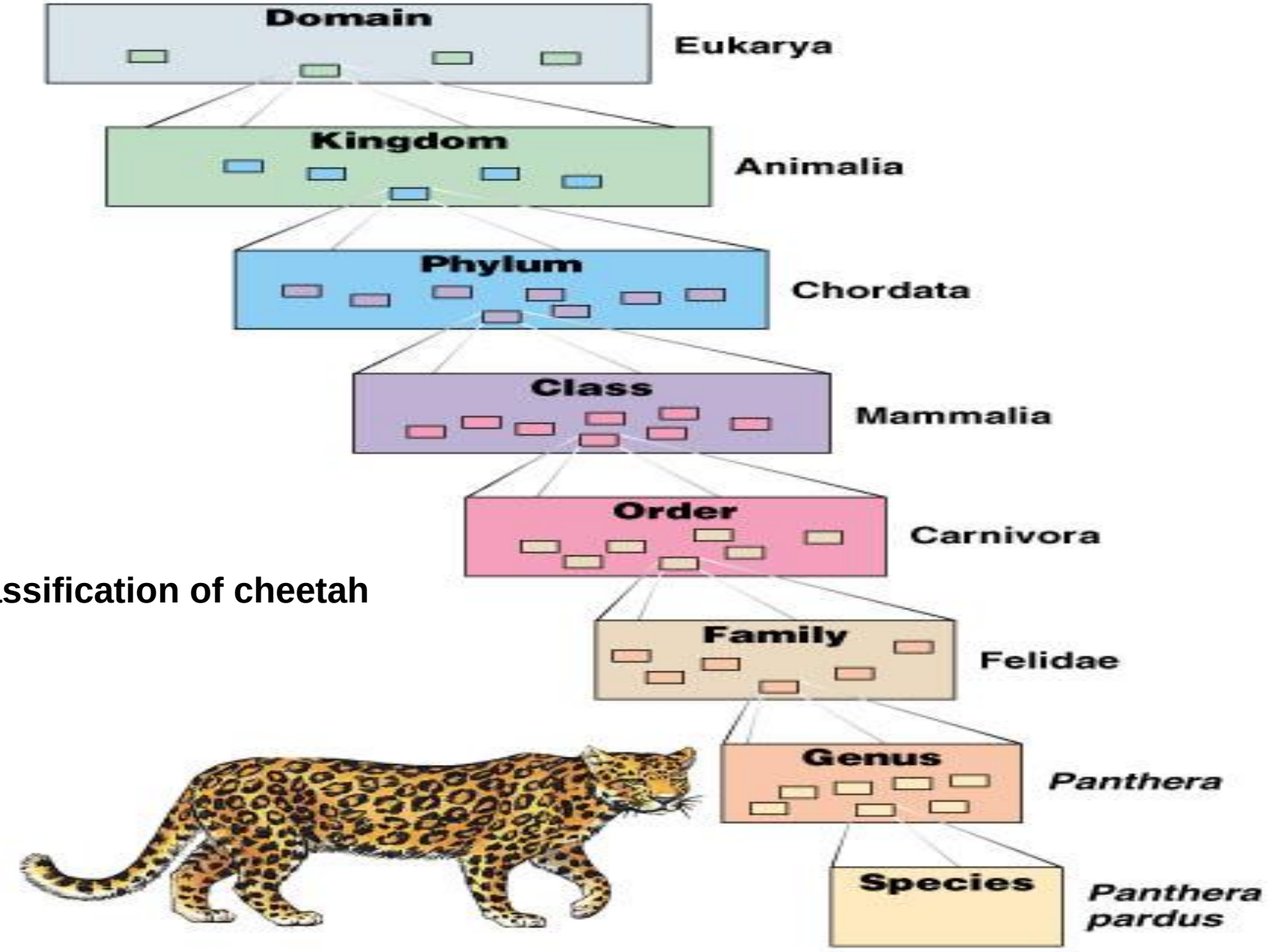
TABLE 18-1 *Classification Hierarchy of Organisms*

	Bobcat	Lion	Shaggy mane mushroom
Kingdom	Animalia	Animalia	Fungi
Phylum/division	Chordata	Chordata	Basidiomycota
Class	Mammalia	Mammalia	Homobasidiomycetae
Order	Carnivora	Carnivora	Agaricales
Family	Felidae	Felidae	Copricaceae
Genus	*Lynx*	*Panthera*	*Coprinus*
Species	*Lynx rufus*	*Panthera leo*	*Coprinus comatus*



Classification of Modern Humans

Classification of cheetah



Modern Taxonomists

- **Taxonomists split species into subsets called varieties.**
  - **Zoologists refer to variations of a species that occur in different geographic areas called subspecies.**
- **To classify organisms, modern taxonomist consider the phylogeny (evolutionary history) of the organism.**

Additional Levels of Organization

- **Botanist sometimes split species into subsets known as VARIETIES.**
  - **Peaches and nectarines are a different variety of the peach tree, *Prunus persica***

peach

Binomial Nomenclature

- Names were based on Latin or Ancient Greek words - scientist everywhere understood these languages.
- The FIRST word of the Scientific Name (Species Name) is the name of the genus to which the organism belongs.
  - The Genus name refers to the relatively small group of organisms to which a particular type of organism belongs.
- The SECOND word of the name is the species. (Species identifier)
  - The Species name is usually a Latin description of some important characteristic of the organism.

Binomial Nomenclature: Rules for Writing Scientific Names

- When we use the Latin name for an organism, we ALWAYS capitalize the Genus (first part) but NOT the species identifier (second part).
- We also print the name in Italics or Underline them. For example:
  - *Acer rubrum* (scientific name) - red maple tree (common name) or <u>Acer rubrum</u>
    - *Acer* is the Latin name for Maple (genus)
    - *rubrum* is the Latin word for Red (species)
  - OR the name can be abbreviated as: A. rubrum
- Humans are named: *Homo sapiens*
  - Homo because of our large brain and upright posture.
  - sapiens because of our intelligence and ability to speak.

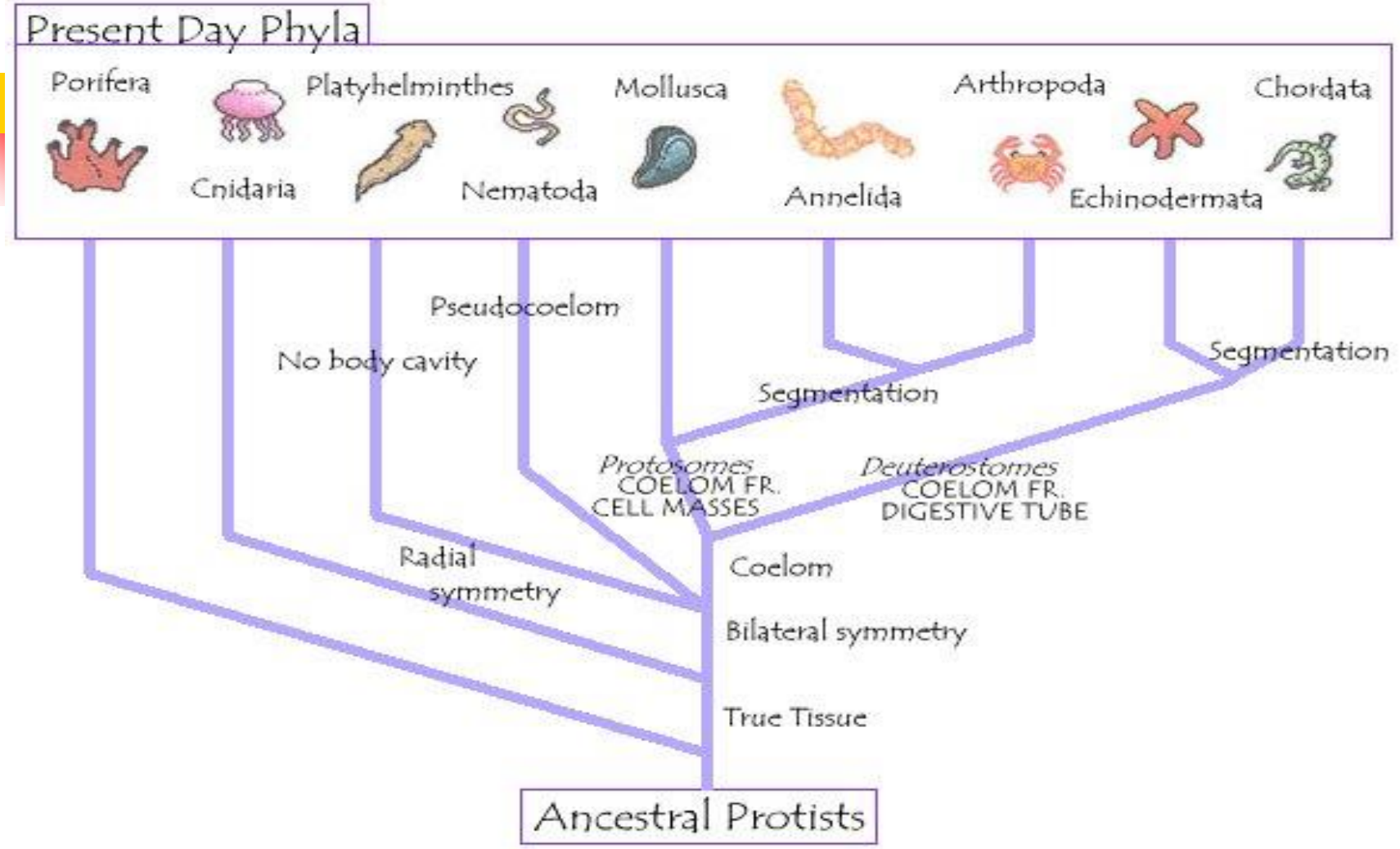
18.2 Modern Phylogenetic Taxonomy

Objectives

- **Explain what information can be gathered from a phylogenetic tree.**
- **What is systematic taxonomy, and what are four kinds of evidence used organize organisms?**
- **How can the embryological evidence be used to show phylogenetic relationships that are not evident from either the study or morphology or the study of the fossil record?**
- **Explain cladistic taxonomy and identify one conclusion that is in conflict with classical systematic taxonomy.**
- **What are two flaws of the molecular clock model on determining relatedness between species?**

Systematics

- **Systematics is a system that organizes the tremendous diversity of organisms into a phylogenetic tree.**
  - **A phylogenetic tree is a family tree that's shows the evolutionary relationships thought to exist between organisms.**
  - **It represents a hypothesis that is based on lines of evidence such a the fossil record, morphology, embryological patterns of development, and chromosomes and macromolecules.**



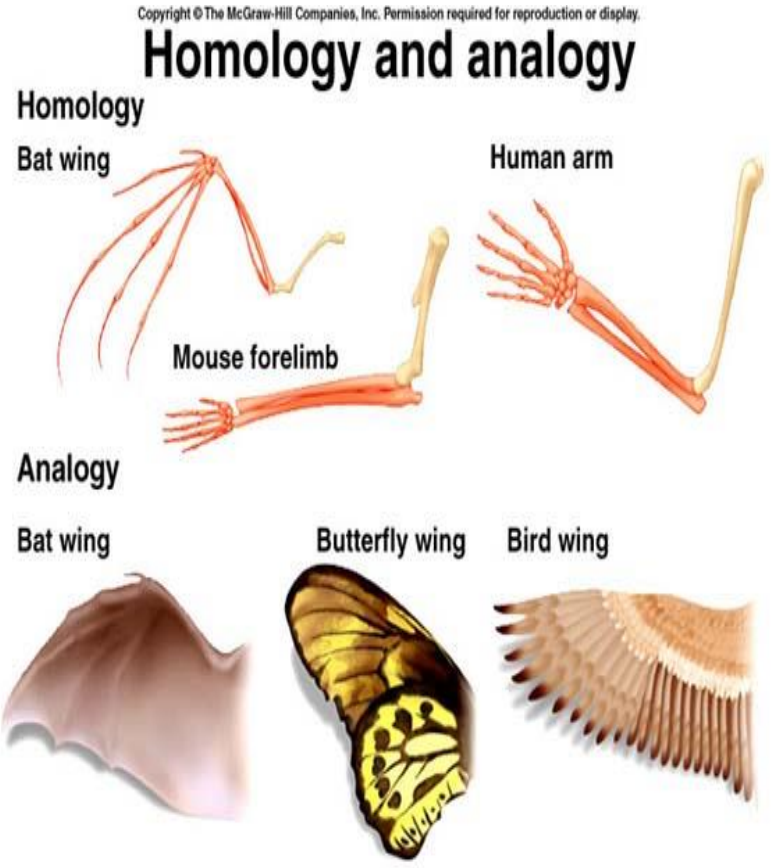
Phylogenetic Tree of *KINGDOM ANIMALIA*

The Fossil Record

- The fossil record often provides clues to evolutionary relationships
- It can not be read like a story book because some fossil records are incomplete
- Systematic taxonomists consider other evidence to confirm information contained within the fossil record with other lines of evidence, like…

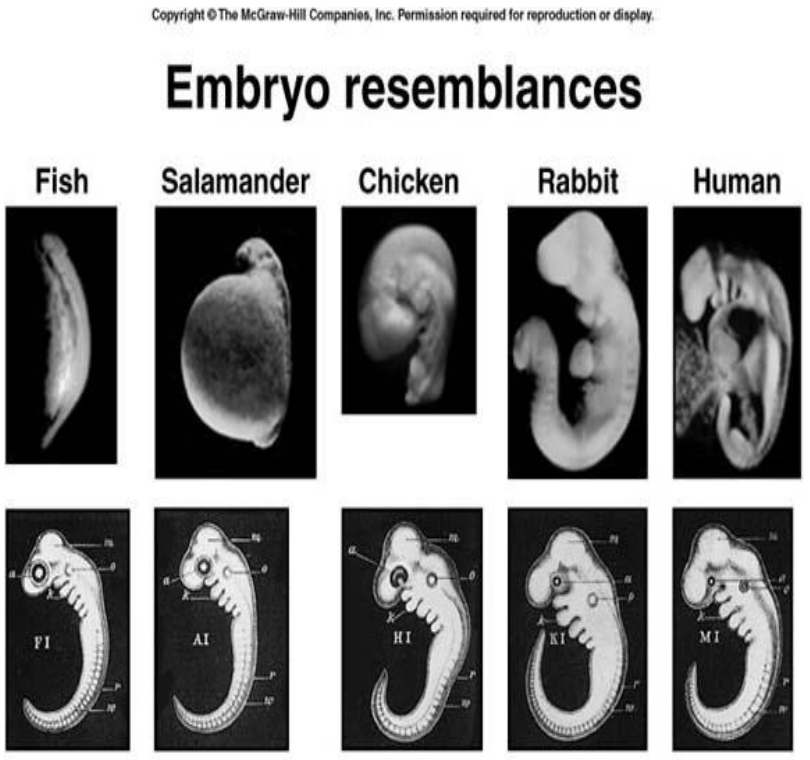
Morphology

- Taxonomists study an organism's morphology and compare it to other living organisms.
  - Homologous features are important but it is important to separate features that are truly homologous with those the seem homologous but are actually analogous.
  - The more homologous features two organisms share, the more closely related they are thought to be.



Embryological Patterns of Development

- Early pattern in embryological development provide evidence of phylogenetic relationships.
- They also provide means of testing hypotheses about relationships that have developed from other lines of evidence



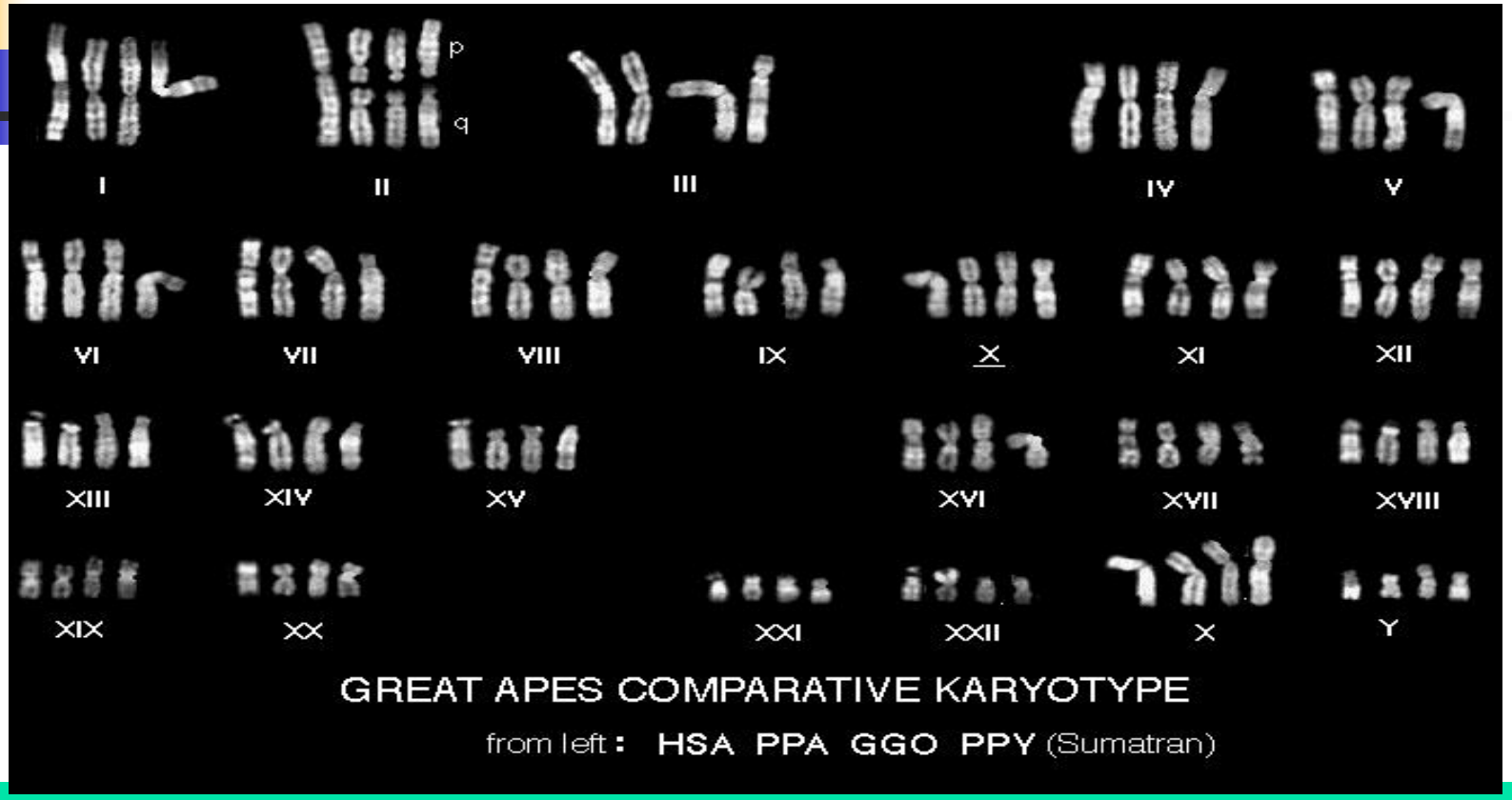
Chromosomes and Macromolecules

- Taxonomists use comparisons of macromolecules such as DNA, RNA, and proteins as a kind of “molecular clock”.
- Scientists compare amino acid sequences for homologous protein molecules of different species.
- The number of amino acid differences a clue to how long ago two species diverged from a shared evolutionary ancestor.

Chromosomes and Macromolecules

- Biologists also compare the karyotypes or patterns of chromosomes of two related species.
- Regions of chromosomes that have the same pattern of banding are clues to the relatedness of organisms.
- The chromosomes of humans and chimpanzees show a surprising degree of similarity (see fig 18-5,page345)

Comparison of Karyotypes



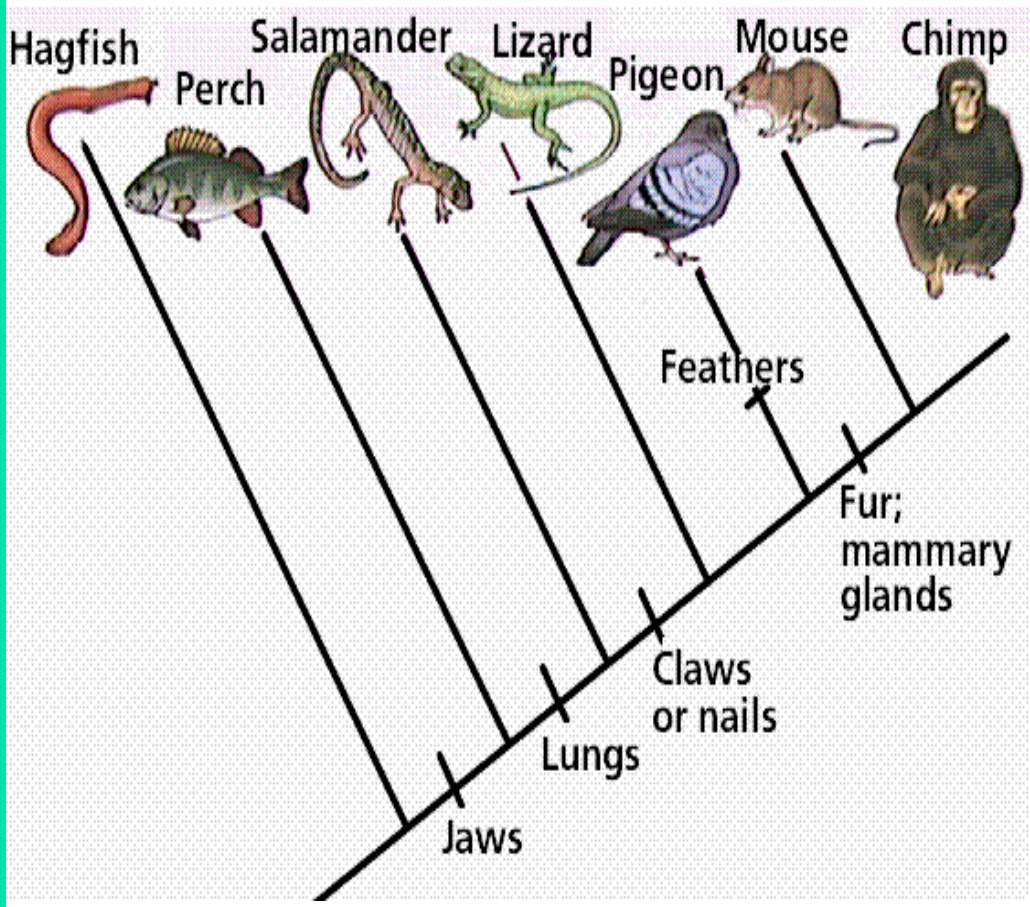
- Human (HSA), chimpanzee (PPA), gorilla (GGO), and orangutan (PPY) chromosomes are illustrated in a comparative karyotype of the great apes.
- Photo courtesy of Dr. Mariano Rocchi, Institute of Genetics, Italy.

Cladistics

- Cladistics is a system of taxonomy that reconstructs phylogenies by inferring relationships based on similarities.
- It is used to determine the sequence in which different groups of organisms evolved.
- To do this, it focuses on a set of unique characteristics found in a particular group of organisms.
- These unique characteristics are called derived traits or derived characters.

Cladogram

- Using patterns of shared derived traits, biologists used cladisitcs to construct a branching diagram called a cladogram.
- A cladogram shows show a sequence in which different groups of organisms evolved
- The key to Cladistics is identifying morphological, physiological, molecular, or behavioral traits that differ among the organism being studied and that can be attributed a common ancestor.



18.3 Two Modern Systems of Classification

Objectives

- **What are the six-kingdoms in the six-kingdom system of classification. Briefly describe each.**
- **List the characteristics that distinguish archaebacteria from eubacteria.**
- **Explain why the protists are grouped together in the six kingdom system in spite of having differences that are greater than those between plants and animals.**
- **Describe the evidence that prompted the creation of the three-domain system of classification.**
- **Explain the principal difference between the six kingdom system and the three-domain system of classification.**
- **What characteristics place fungi, plants, and animals in the Eukarya domain?**

Six-Kingdom System

TABLE 18-2 *Six Kingdoms of Life*

Kingdom	Cell type	Number of cells	Nutrition
Archaebacteria	prokaryotic	unicellular	autotrophy and heterotrophy
Eubacteria	prokaryotic	unicellular	autotrophy and heterotrophy
Protista	eukaryotic	unicellular and multicellular	autotrophy and heterotrophy
Fungi	eukaryotic	unicellular and multicellular	heterotrophy
Plantae	eukaryotic	multicellular	autotrophy and (rarely) heterotrophy
Animalia	eukaryotic	multicellular	heterotrophy

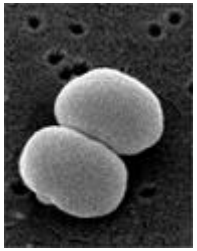
KINGDOM:ARCHAEBACTERIA

- **Modern Archaebacteria MAY BE Directly descended from and very similar to the First Organisms on Earth.**
- **They Are UNICELLULAR PROKARYOTES with distinctive Cell Membranes as well as Biochemical and Genetic Properties that differ from ALL other kinds of life.**
- **Some are autotrophic, producing food by chemosynthesis. Includes Chemosynthetic Bacteria**
- **Most are heterotrophic.**
- **Many Archaebacteria live in harsh environments such as Sulfurous Hot Springs, very salty lakes, and in anaerobic environments, such as the intestines of mammals.**

KINGDOM EUBACTERIA

- They are UNICELLULAR PROKARYOTES. Most of the Bacteria (Germs) that affect your life are members of the Kingdom Eubacteria.
- Eubacteria are both autotrophic and heterotrophic.
- Includes the disease-causing bacteria such as tooth decay or food poisoning.
- The Combined Kingdoms, Archaebacteria and Eubacteria include the greatest number of living things on Earth.
- ALL OF THE PROKARYOTES ARE IN THESE TWO KINGDOMS.
- Both reproduce by binary fission, but they do have some ways to recombine genes, allowing evolution to occur.

E. coli

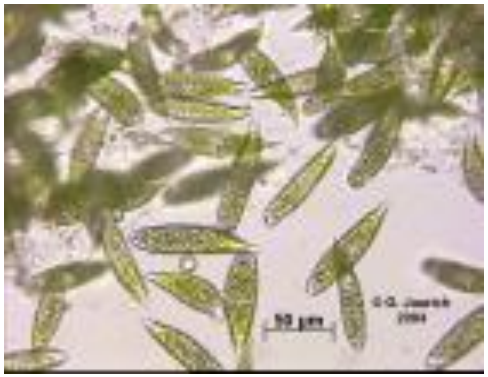


Staphylococcus

KINGDOM PROTISTA

- These organisms are placed here more because of What They Are Not than What They Are.
- Kingdom Protista contains all eukaryotes that are NOT Plants, Animal, or Fungi, more than 50,000 species in all. Kingdom Protista includes unicellular and a few simple multicellular EUKARYOTES.
- Eukaryotic cells have nuclei and organelles that are surrounded by membranes.
- The cells of multicellular protists are not specialized to perform specific functions in the organisms.
- Includes *Euglena* and Amoeba.

Amoeba



Euglena

KINGDOM FUNGI

- Fungi are eukaryotes, and most are multicellular.
- The cells of fungi have cell walls that contain a material called chitin.
- These organisms are heterotrophic and obtain their nutrients by releasing digestive enzymes into a food source.
- They absorb their food after it has been digested by the enzymes.
- Fungi act either as decomposers or as parasites in nature.
- Kingdom Fungi includes molds, mildews, mushrooms, and yeast.

mushroom

KINGDOM PLANTAE

- Plants are eukaryotic, multicellular and carry out photosynthesis. They are autotrophs.
- The cells of plants have cell walls, that contain the polysaccharide cellulose.
- Plant cells are specialized for different functions, such as photosynthesis, the transport of materials, and support.
- Kingdom Plantae includes mosses, ferns, cone-bearing plants (gymnosperms), and flowering plants (angiosperms).

Flowering plant (Poinsettia)

fern

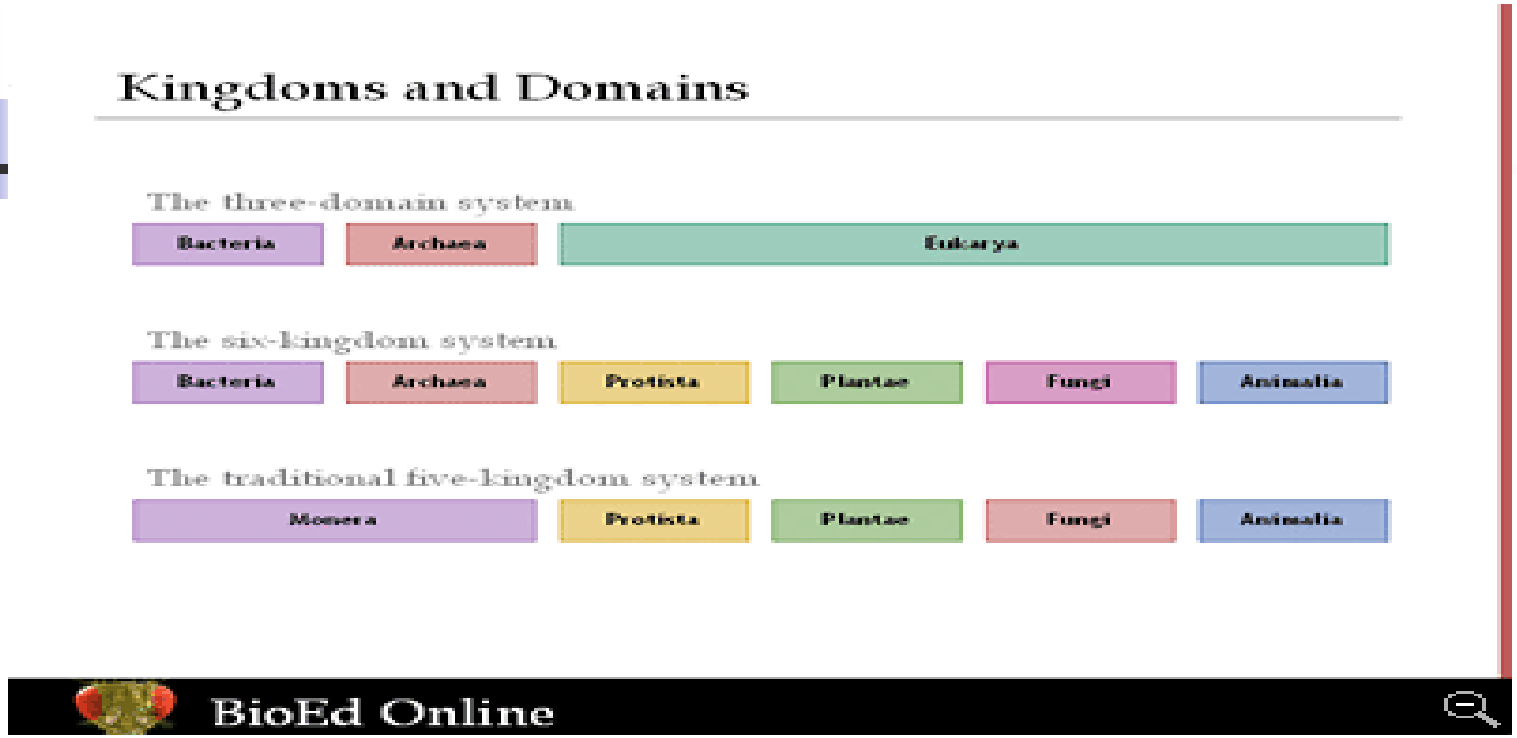
KINGDOM ANIMALIA

- Animals are multicellular, eukaryotic, and heterotrophic.
- Animal cells have NO CELL WALLS.
- Most members of the Animal Kingdom can move from place to place.
- Some are permanently attached to surfaces such as sponges and barnacles.
- Fish, Birds, Reptiles, Amphibians, and mammals-including humans belong to the Kingdom Animalia.
- This Kingdom also includes sponges, jellyfish, worms, sea stars, and insects.

elephant

jellyfish

Three Domain System

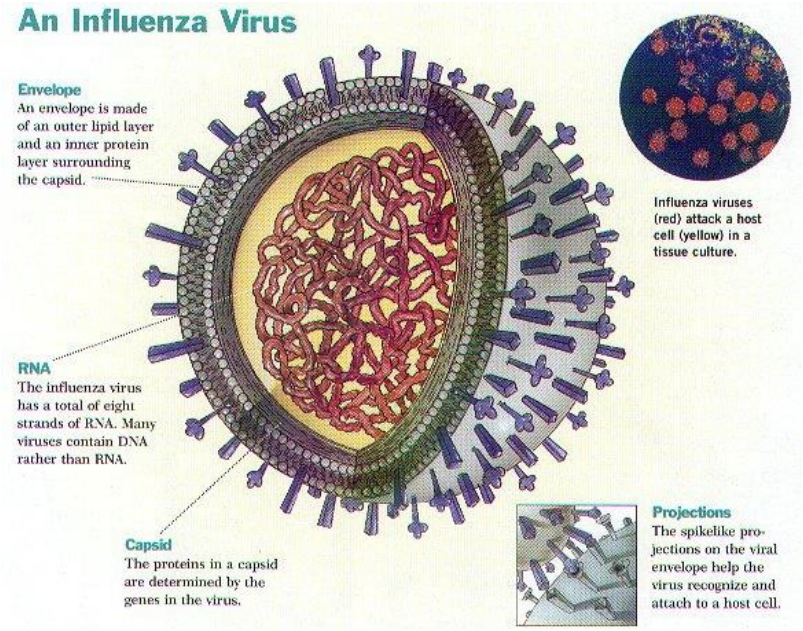


- Living things fall into three broad groups called domains.
  - Domain Archaea (archaebacteria)
  - Domain Bacteria (eubacteria)
- Domain Eukarya (eukaryotes)-true nuclei with linear chromosomes and membrane—bound organelles.
  - This Includes Protista, Plantae, Fungi, and Animalia.

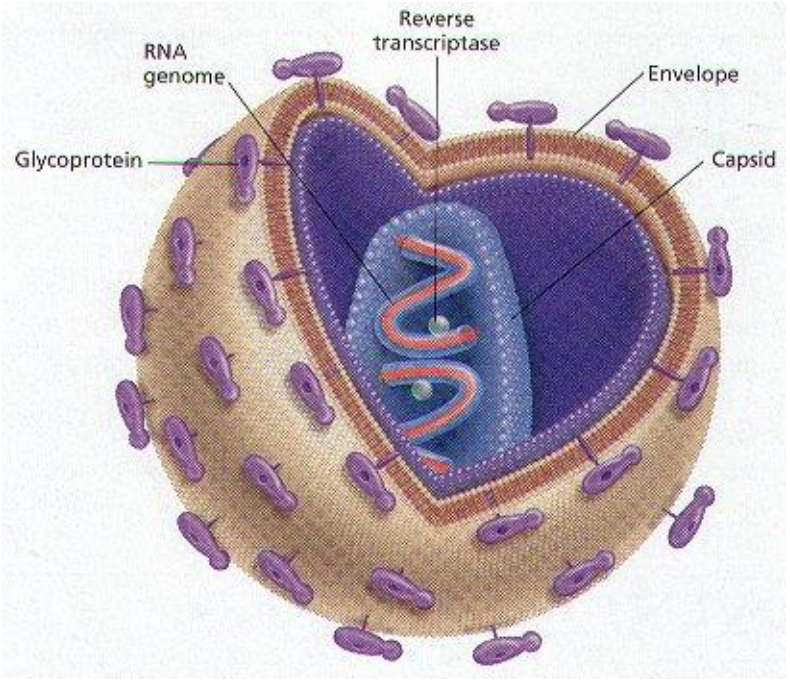
II.C.3.c. Justify why many scientists group viruses in a category separate from living things.

- Viruses have no nucleus, cytoplasm, organelles, or cell membrane, so can not carry out cellular functions.
- Only able to replicate by infecting cells and using the organelles and enzymes within
- very small, size ranges form 20nm to 250 nm (size of small bacteria)
- Consists of two parts: a nucleic acid and a protein coat called a capsid
- Nucleic acid may be DNA or RNA but not both
- Some viruses have a membrane-like structure outside the capsid called an envelope

Examples of Viruses



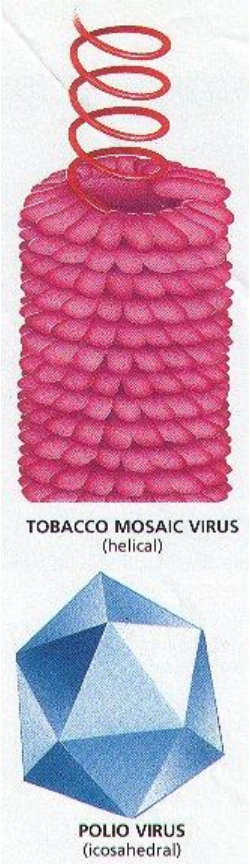
Flu virus



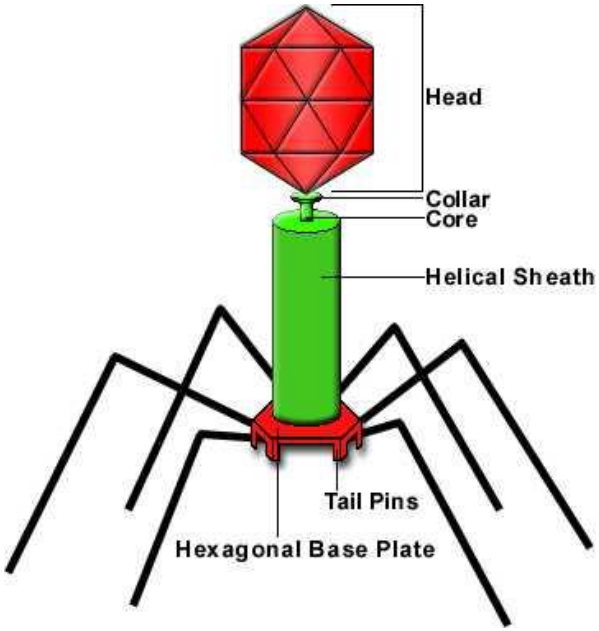
HIV virus

Examples of Viruses

Tobacco mosaic virus

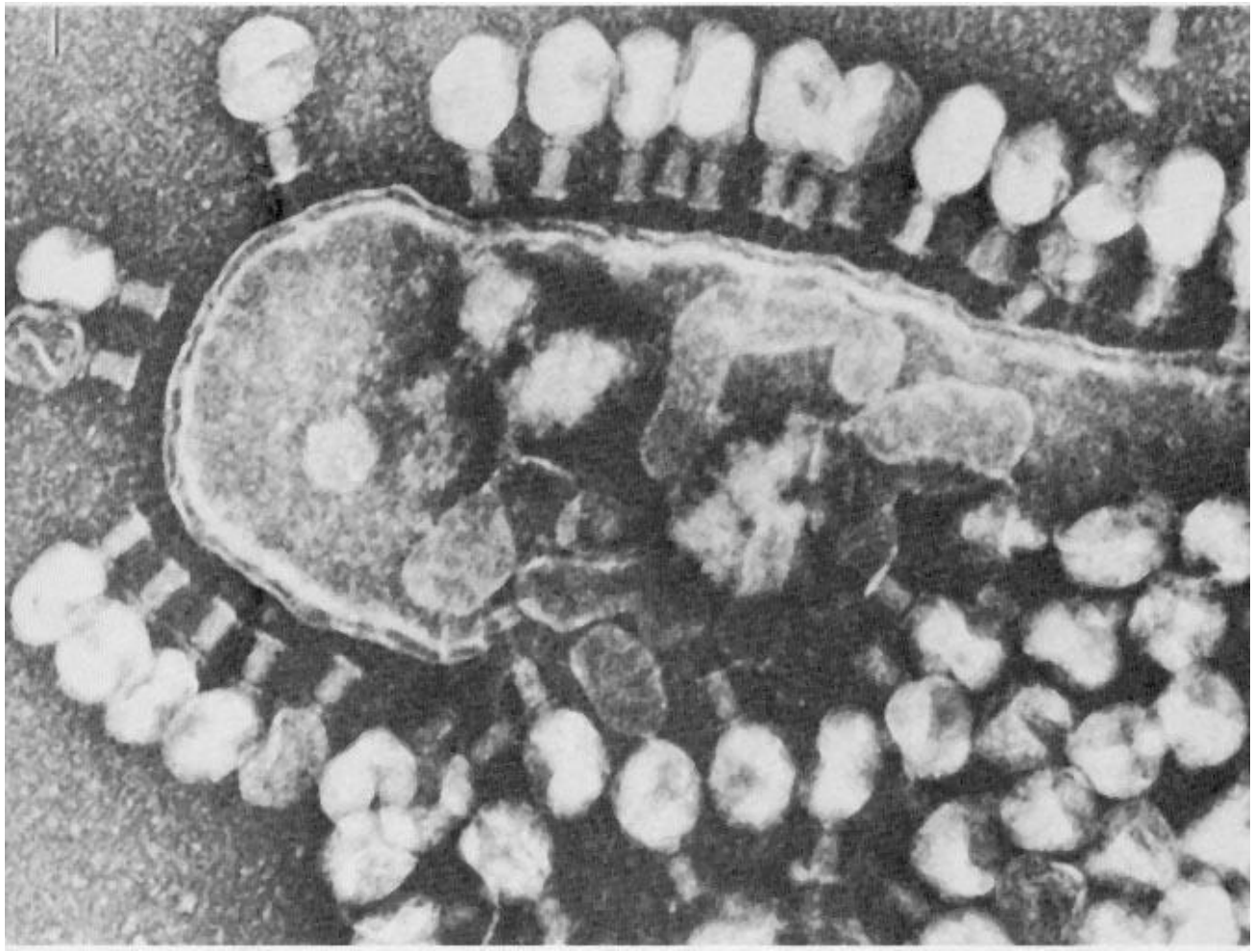


Polio virus



bacteriophage

Bacteriophage attacking E. coli



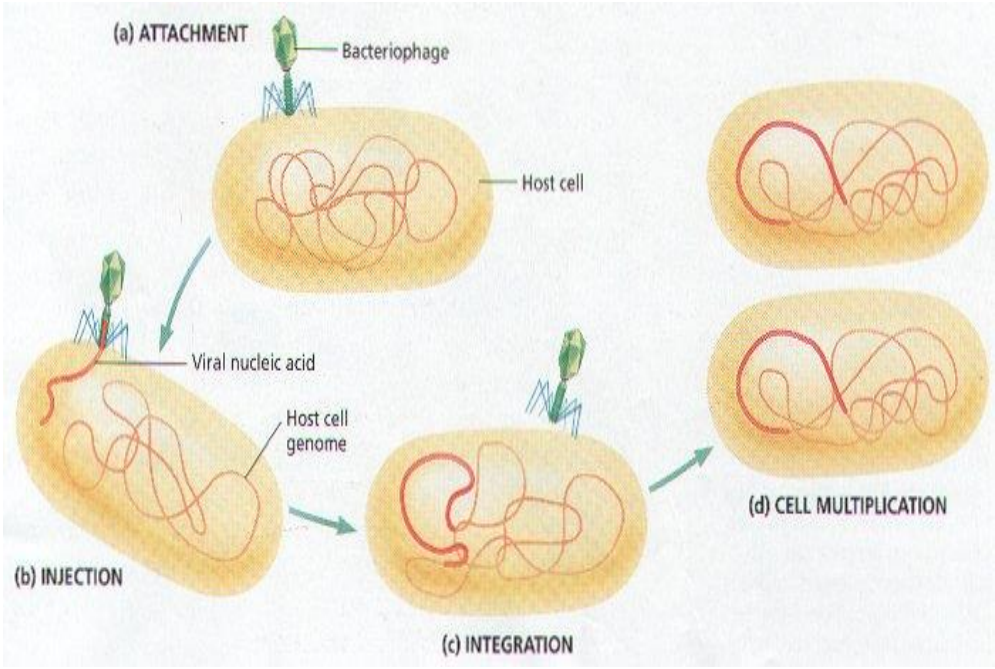
How a Virus Invades a Cell

a) attachment of virus to host cell

b) injection of viral DNA

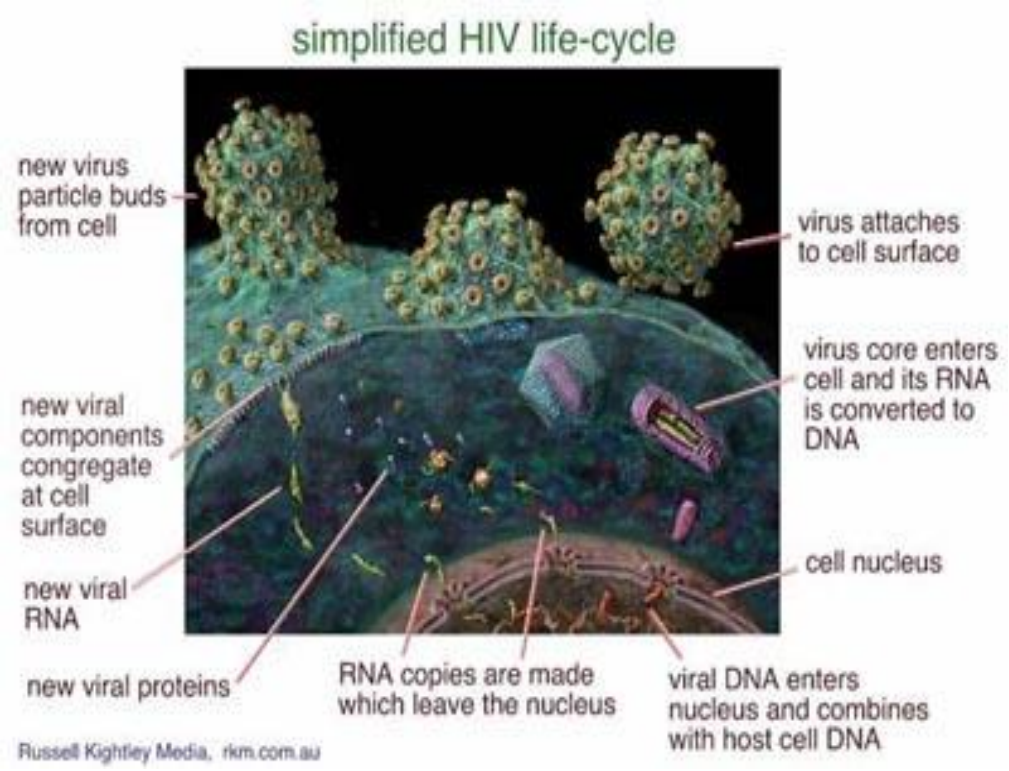
c) Integration of the viral DNA into host genome, and

d) Multiplication of the host cell with the viral DNA.



Lysogenic cycle of a temperate bacteriophage

HIV: a Retro Virus



a) HIV attaches to the cell surface

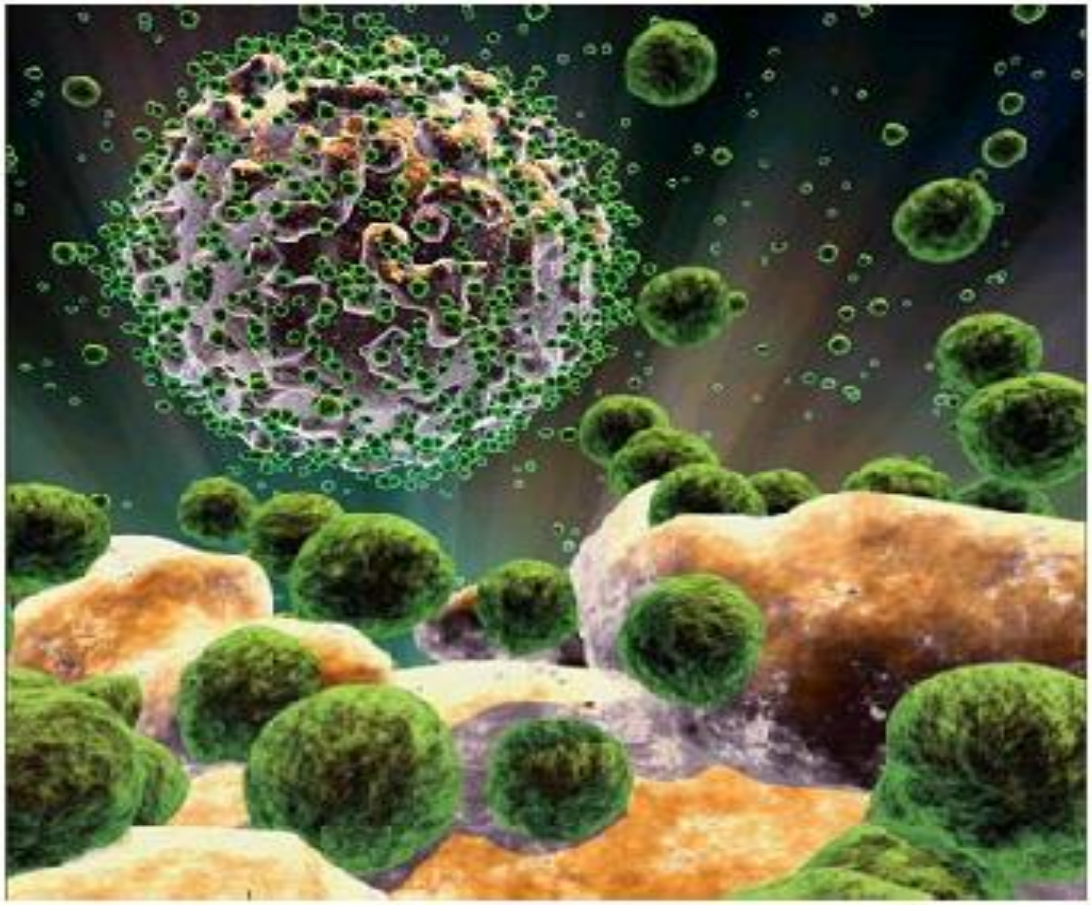
b) Virus core enters cell and its RNA is converted to DNA (reverse transcription)

c) Viral DNA enters nucleus and combines with host cell DNA

d) RNA copies of virus are made (viral assembly)

e) The assembled viral particles leave the cell through lysis or budding.

HIV Invading a White Blood Cell



Viral Diseases

Disease	Transmitted by	Symptoms
Chickenpox	Air currents	Rash, fever
Measles	Air currents	Blotchy rash, high fever, congestion in nose and throat
Rubella (German measles)	Air currents	Rash, swollen glands
Mumps	Air currents	Swollen salivary glands
Influenza (flu)	Air currents	Headache, muscle aches, sore throat, cough; historically, one of the great "killer" diseases
Smallpox	Air currents	High fever, pustules on skin; often fatal; now eliminated
Infectious hepatitis	Contaminated food or water	Fever, chills, nausea, swollen liver, jaundice, pain in the joints
Polio	Contaminated food or water	Headache, stiff neck, possible paralysis
Yellow fever	Mosquitoes	Nausea, fever, aches, liver cell destruction; can be fatal
AIDS	Sexual contact, contaminated blood products, contaminated hypodermic needles and syringes	Immune system failure; fatal

Herpes

Picture Book of Viruses

Click here to go to a site about viruses