

GRADE 12 BIOLOGY
UNIT D – CLASSIFICATION OF BIODIVERSITY
STUDY GUIDE

18 -1 Finding Order in Diversity

There are millions of different species on Earth. To study this great diversity of organisms, biologists must give each organism a name. Biologists also must organize living things into groups in a logical way. Therefore, biologists need a classification system. Taxonomy is the discipline of naming and classifying organisms. To be useful, the names that are assigned should be universally accepted. A good classification system should also group together organisms that are more similar to each other than they are to organisms in other groups.

Common names for organisms vary by language and region. This creates confusion. By the 1700s, scientists had tried to solve this problem by agreeing to use a single name for each species. At first, the names they used were very long. Then, Carolus Linnaeus developed a two-word naming system, called binomial nomenclature. This system is still used today. In binomial nomenclature, each species is assigned a two-part scientific name. The first part of the name refers to the genus (plural: genera). A genus is a group of closely related species. For example, the genus *Ursus* contains six bear species.

The second part of the name, along with the genus name, refers to a single species (plural: species). Recall that species consist of individuals who can interbreed. The name *Ursus maritimus*, for example, refers to the species polar bear.

Linnaeus's system of classification has seven different levels. From smallest to largest, the levels are species, genus, family, order, class, phylum, and kingdom.

Or a mnemonic in reverse order; domain down to species:

DUMB KING PHILLIP CAME OVER FROM GERMAN SOIL

Each of the levels is called a taxon (plural: taxa). Just as a genus is a group of similar species, a family is a group of similar genera, an order a group of similar families, a class a group of similar orders, a phylum (plural: phyla) a group of similar classes, and finally, a kingdom a group of similar phyla.

Linnaeus named two kingdoms of living things, the Animalia (animal) and Plantae (plant) kingdoms.

18 - 2 Modern Evolutionary Classification

Linnaeus and other taxonomists have always tried to group organisms according to biologically important characteristics. However, they have not always agreed upon which characteristics are most important. Early classifications were based on visible similarities. Biologists now group organisms according to evolutionary relationships. The study of evolutionary relationships among organisms is called phylogeny. Classification based on evolutionary relationships is called evolutionary classification. Species within one genus are more closely related to each other than to species in another genus. This is because all members of a genus share a recent common ancestor. All genera in a family also share a common ancestor. However, this common ancestor is farther in the past than the common ancestor of species within a genus. The higher the level of the taxon, the farther back in time is the common ancestor of all the organisms in that taxon.

Many biologists now use a method called cladistic analysis to determine evolutionary relationships. Cladistic analysis is based on derived characters. Derived characters are new traits that arise as a group evolves over time. Derived traits are therefore found in closely related organisms but not in their distant ancestors. Derived characters can be used to construct a cladogram. A cladogram is a diagram that shows the evolutionary relationships among a group of organisms. A cladogram is basically an evolutionary tree, much like a family tree.

All organisms have DNA and RNA. Because DNA and RNA are so similar across all forms of life, these molecules can be compared in different species. The more similar the molecules are in different species, the more recently the species shared a common ancestor. Therefore, the more closely related they are.

Comparisons of DNA can also be used to estimate the length of time that two species have been evolving independently. A model called a molecular clock can be used for this purpose. The model assumes that neutral mutations, which do not affect phenotype, accumulate in gene pools. Two species evolving independently from each other will accumulate different neutral mutations through time. The more there are of these different neutral mutations, the longer the two species have been evolving independently.

18 - 3 Kingdoms and Domains

As biologists learned more about the natural world, they realized that Linnaeus's two kingdoms, Animalia and Plantae, did not represent all life forms. First, microorganisms, such as bacteria, were discovered. Microorganisms did not seem to fit into either kingdom, so they were placed in their own kingdom, called Protista. Then, mushrooms, yeast, and molds were separated from plants and placed in their own kingdom, called Fungi. Later, bacteria were separated from other Protista and placed in another new kingdom, called Monera. Finally, the Monera were divided into two kingdoms: Eubacteria and Archaeobacteria. By the 1990s, a six-kingdom system of classification was proposed. It includes the kingdoms Eubacteria, Archaeobacteria, Protista, Fungi, Plantae, and Animalia.

A new taxon, called the domain, is now used by many biologists. The domain is one level higher than the kingdom. Three domains are recognized: Bacteria, Archaea, and Eukarya.

The domain Bacteria includes unicellular organisms without a nucleus. They have cell walls containing a substance called peptidoglycan. The domain Bacteria corresponds to the kingdom Eubacteria.

The domain Archaea also includes unicellular organisms without a nucleus. These organisms have cell walls that do not contain peptidoglycan. The domain Archaea corresponds to the kingdom Archaeobacteria.

The domain Eukarya includes the four remaining kingdoms: Protista, Fungi, Plantae, and Animalia. All members of the domain Eukarya have cells with a nucleus.

Most members of the kingdom Protista are unicellular organisms. Some Protista are autotrophs; others, heterotrophs.

Most members of the kingdom Fungi are multicellular, and all are heterotrophs.

All members of the kingdom Plantae are multicellular autotrophs. Most plants cannot move about, and their cells have cell walls. All members of the kingdom Animalia are multicellular heterotrophs. Most animals can move about (they are 'motile'), and their cells lack cell walls.

Section 18-1 Finding Order in Diversity

Key Concepts:

- How are living things organized for study?
- What is binomial nomenclature?
- What is Linnaeus's system of classification?

Why Classify?

Explain why biologists use a classification system to study the diversity of life.

The science of classifying organisms and assigning them universally accepted names is known as: _____

Is the following sentence true or false? In a good system of classification, organisms placed into a particular group are less similar to each other than they are to organisms in other groups.

Assigning Scientific Names

Why is it confusing to refer to organisms by common names?

Circle the letter of each sentence that is true about early efforts at naming organisms.

- a. Names were usually in English.
- b. Names often described detailed physical characteristics of a species.
- c. Names could be very long.
- d. It was difficult to standardize the names

The two-word naming system developed by Linnaeus is called:

Circle the letter of each sentence that is true about binomial nomenclature.

- a. The system is no longer in use today.
- b. Each species is assigned a two-part scientific name.
- c. The scientific name is always written in italics.
- d. The second part of the scientific name is capitalized

State the genus of the grizzly bear, *Ursus arctos*





























Linnaean System of Classification

A group or level of organization in taxonomy is called a taxonomic category, or _____

The largest taxonomic category in Linnaeus's system of classification is the _____, and the smallest is the _____

What two **kingdoms** did Linnaeus name?

Fill in the name at the right of each missing taxonomic category in the chart below.

Grizzly bear	Black bear	Giant Panda	Red fox	Squirrel	Coral Snake	Sea Star	
							KINGDOM Animalia
							Chordata
							Mammalia
							Carnivora
							Ursidae
							Ursus
							SPECIES <i>Ursus arctos</i>

Reading Skill Practice

Taking notes can help you identify and remember the most important information when you read. Take notes on Section 18—1 by writing the main headings and under each heading listing the most important points. Include in your notes the boldface terms and sentences. Do your work on a separate sheet of paper

Section 18 - 2 Modern Evolutionary Classification

Key Concepts

- How are evolutionary relationships important in classification?
- How can DNA and RNA help scientists determine evolutionary relationships

Introduction

Explain the traits Linnaeus considered when classifying organisms.

Which Similarities Are Most Important?

What problems are faced by taxonomists who rely on body-structure comparisons?

Evolutionary Classification

Is the following sentence true or false? Darwin's theory of evolution changed the way biologists thought about classification.

Describe how contemporary biologists now group organisms into categories.

Is the following sentence true or false? Genera placed within a family should be less closely related to one another than to members of any other family. _____

The strategy of grouping organisms together based on their evolutionary history is called: _____

Classification Using Cladograms

Circle the letter of *each* sentence that is true about cladistic analysis.

- a. It considers only traits that are evolutionary innovations.
- b. It considers all traits that can be measured.
- c. It considers only similarities in body structure.
- d. It is a method of evolutionary classification.

Characteristics that appear in recent parts of a lineage, but not in its older members, are called: _____
(*example: snakes are considered quadrupeds, four-limbed organisms*)

A diagram that shows the evolutionary relationships among a group of organisms is called a(an): _____

Is the following sentence true or false? Derived characteristics are used to construct a cladogram: _____

Similarities in DNA and RNA

Is the following sentence true or false? Some organisms do not have DNA. _____

Explain how similarities in genes show that humans and yeasts share a common ancestry.

Molecular Clocks

A model that uses DNA comparisons to estimate the length of time that two species have been evolving independently is known as a(an):

A molecular clock relies on the repeating process of: _____

Why are only neutral mutations useful for molecular clocks?

Is the following sentence true or false? The degree of dissimilarity in DNA sequences is an indication of how long ago two species shared a common ancestor. _____

Why are there many molecular clocks in a genome instead of just one

Section 18 - 3 Kingdoms and Domains

Key Concepts

- What are the six kingdoms of life as they are now identified?
- What is the three-domain system of classification?

The Tree of Life

Is the following sentence true or false? The scientific view of life was more complex in Linnaeus's time. _____

What fundamental traits did Linnaeus use to separate plants from animals?

What type of organisms were later placed in the kingdom Protista?

Mushrooms, yeast, and molds have been placed in their own kingdom, which is called: _____

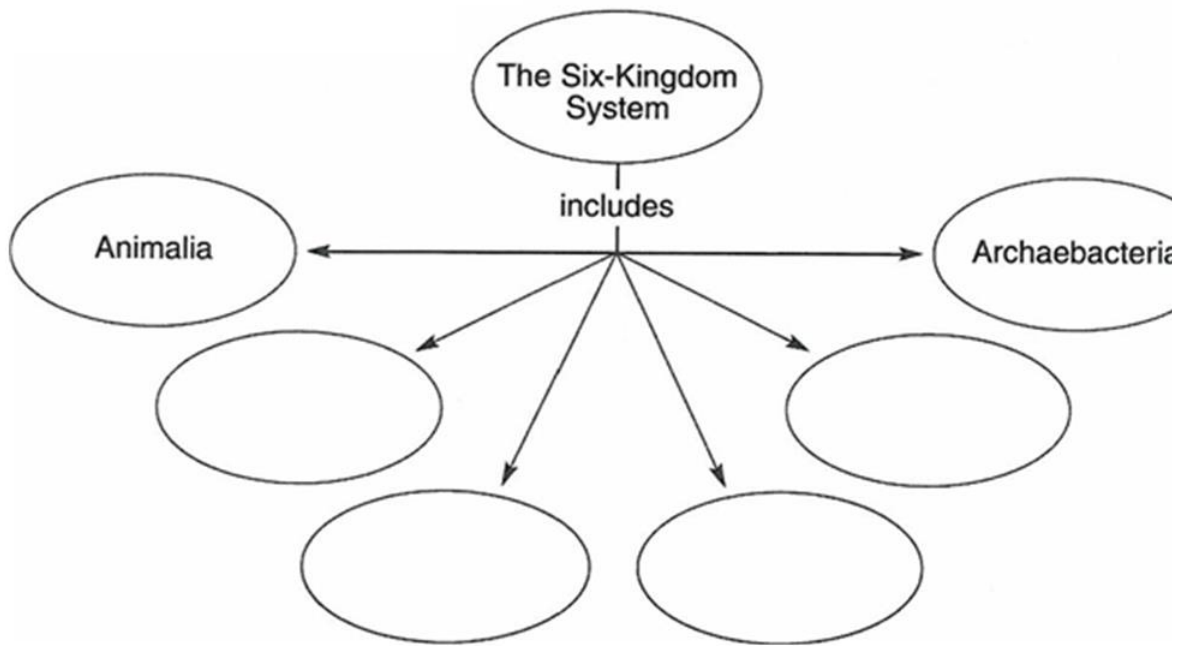
Why did scientists place bacteria in their own kingdom, the Monera?

List the two groups into which the Monera have been separated.

a.

b.

Complete the Concept Map



The Three-Domain System

A more inclusive category than any other, including the kingdom, is the: _____

What type of analyses have scientists used to group modern organisms into domains?

List the three domains

- a.
- b.
- c.

Complete the chart below.

CLASSIFICATION OF LIVING THINGS

Domain	Kingdom	Examples
	Eubacteria	Streptococcus, Escherichia colim (E-coli)
Archaea		
	Protist	
		Mushrooms, yeasts
	Plantae	
		Sponges, worms, insects, fishes, mammals

Domain Bacteria

Circle the letter of each sentence that is true about members of the domain Bacteria.

- a. They are multicellular.
- b. They are prokaryotes.
- c. They have rigid cell walls.
- d. The cell walls contain peptidoglycans.

Is the following sentence true or false? All members of the domain Bacteria are parasites. _____

Domain Archaea

Circle the letter of each sentence that is true about members of the domain Archaea.

- a. They are unicellular.
- b. They are eukaryotes.
- c. They lack cell walls.
- d. They lack cell membranes

Is the following sentence true or false? Many members of the domain Archaea can survive only in the absence of oxygen. _____

Domain Eukarya

Circle the letter of each sentence that is true about all the members of the domain Eukarya.

- a. They have a nucleus.
- b. They are multicellular.
- c. They are heterotrophs.
- d. They have cell walls and chloroplasts

Vocabulary Review

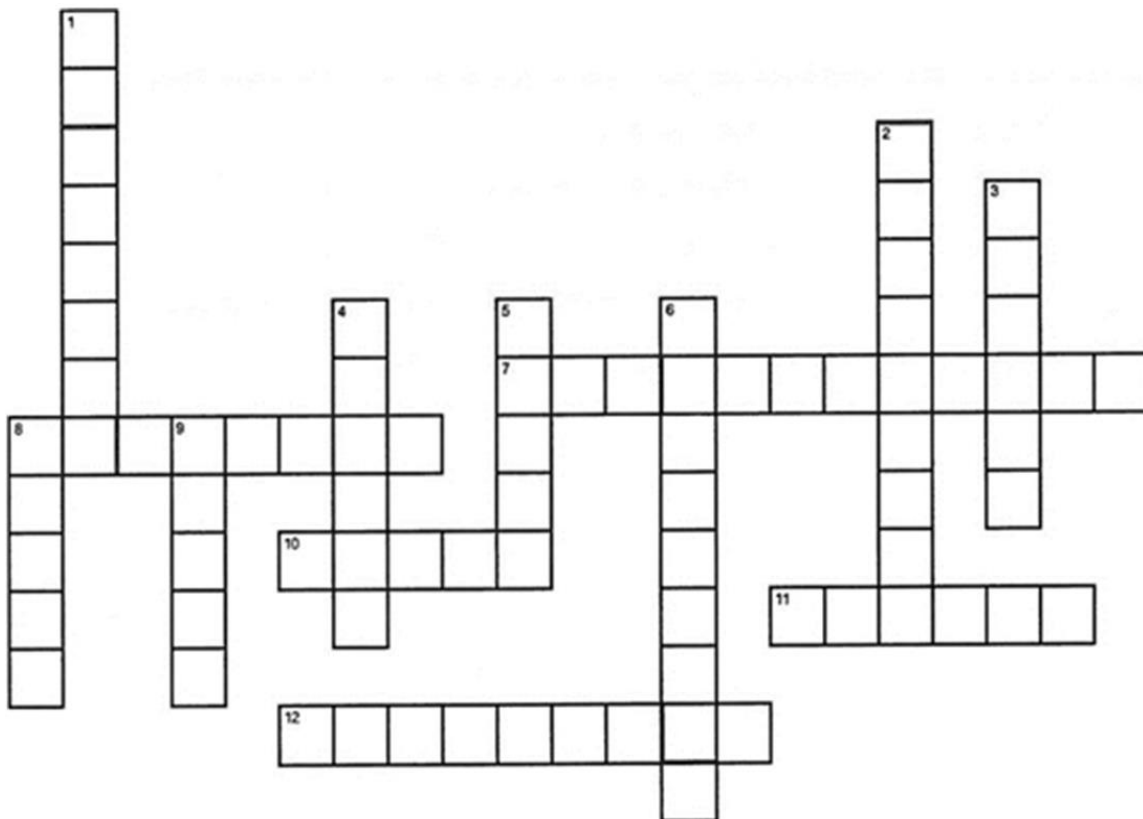
Crossword Puzzle. Complete the puzzle by entering the term that matches each numbered description.

Across

7. type of classification that is based on evolutionary history
8. discipline of classifying and naming organisms
10. taxon composed of similar orders
11. taxon composed of similar classes
12. type of clock that estimates how long species have been evolving independently

Down

1. kingdom in the Eukarya domain that includes unicellular autotrophs
2. study of evolutionary relationships among organisms
3. new taxon that is higher than the kingdom
4. taxon composed of similar genera
5. taxon composed of closely related species
6. diagram based on derived characters
8. general term for any level, or category, in a taxonomic system
9. taxon composed of similar families



In what ways are members of the domain Bacteria and the domain Archaea similar?

Which domain includes only organisms with a nucleus in their cells?

What are two ways that most members of the kingdom Plantae and the kingdom Animalia differ?