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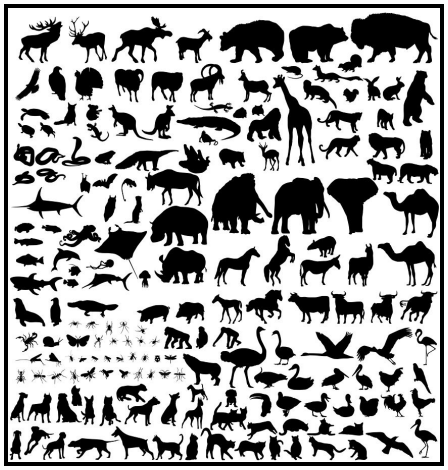
Name: _____ Date: _____

Biological Systematics



1 Scientists estimate that there are more than 10 million different species on planet Earth. Almost two million species have already been studied and named. More are being discovered every day. Scientists have identified a variety of animals, plants, and fungi. They have also identified a rapidly growing number of microorganisms. In order to keep track of all these organisms, scientists need a system in place to categorize all of the species on Earth. The organisms must be classified and grouped into discrete units. Each organism must have its own unique name. This is not an easy job. It can be done, however, with taxonomy. Taxonomy is a system of classification for all living organisms that is used worldwide.

2 The field of science grew in the 1700s. More organisms were being discovered each year. Early scientists began to see the need to categorize organisms. They wanted to place organisms into groups based on how closely they are related. For example, it was predicted that a dog would more likely be related to a lion than a fish. This is because both dogs and lions are mammals. Dogs share more characteristics with lions than they do with fish. The system of biological classification formally began in the 1730s with a Swedish scientist named Carl Linnaeus. He was a botanist and zoologist. Linnaeus spent much of his life traveling and writing about the organisms that he found.

3 Linnaeus realized that a clear system to classify biological organisms did not exist. So Linnaeus modified a two-part naming system proposed by John Ray, called the binomial nomenclature system. Linnaeus created different levels of classification groups. The smallest is a genus group containing closely related species. He used the genus and species name in the two-part naming system. The first part of each organism's name would be the genus. The second part of the name would be the species. He gave names in Latin because that was a language understood by all scientists in western Europe at the time. He thought it was so important to scientifically name organisms in Latin that he changed his name. Latinized, his Swedish name, Carl von Linné, became Carl Linnaeus.

4 Using Latin ended confusion among scientists from different countries. They would no longer need to write about an experiment with *der Hund* or *le chien*. A scientist could now write to others in Germany and France about *Canis familiaris*. They would all understand that he was referring to a dog. As humans, we are classified as *Homo* (genus: "human") *sapiens* (species: "thinking"). The genus name is always capitalized, and the species name is always lowercase. Both are italicized. The names are written in italics to show that they are from a different language.

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5 The binomial nomenclature system led to an ordering system in which organisms were grouped according to relatedness. This system became known as hierarchical classification. This means that the categories are arranged in a hierarchy of different levels. Each level contains groups of the next lower category. Organisms are first grouped into the broadest (or most inclusive) category of a kingdom. Each lower category is more and more specific. The last category is the species, the most specific category for each organism. This system became the basis for taxonomic classification. This systematic process sorts living organisms into groups of different levels according to their structure, function, and genetic relationships. Each taxonomic unit, or group, became known as a taxon. Now there is an even more inclusive group, called a domain. Related kingdoms are grouped into domains.

6 The Linnaean system gave scientists a way to group organisms into a hierarchy of categories. It did not give them a way to trace the organism's evolutionary history. It also did not help scientists determine how closely different organisms were related. In order to do this, scientists built upon the hierarchical classification system by creating a grouping system called phylogeny. The primary goal of the study of systematics is to trace the evolutionary history of organisms. Systematics uses diagrams to better represent how organisms are related.

7 Phylogeny is a system that traces the relatedness of organisms according to evolutionary history. Specific types of diagrams are used to help show these relationships, called phylogenetic trees, evolutionary trees, or cladograms. They are the same by any name. They trace the history of the progression of organisms. Each cladogram begins with the most ancient organism, called the origin. From this point, the tree will branch with each new organism. Organisms are grouped into units called clades. Each branching point has two branches representing when the two species split apart from the origin. The farther away the branch point is from the organism, the more distantly related those organisms are. Organisms at the top of the cladogram are the most recent organisms. The closer an organism is to the origin, the older it is.

8 In the past, organisms were grouped based on shared characteristics. Today, scientists understand that common features do not always mean common ancestry. Convergent evolution can also lead to common features. Convergent evolution is a series of changes in two species whose populations are adapting to similar environmental pressures. For example, dogs and hyenas share many common features. DNA analysis, however, has shown that hyenas are actually more closely related to cats than dogs. Molecular clocks have also been useful in uncovering how closely related organisms may be. This method studies the rates of evolution of specific genomes. Scientists try to calculate the average rate at which DNA will mutate over time. They compare nucleotide sequences on the DNA. Some of these sequences change quickly. Others hardly change at all and are therefore said to be highly conserved. Scientists use molecular clocks to calculate how closely organisms are related.

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1. According to paragraph 7, we know that the phylogeny system–

   A. groups organisms together into units called clades.

   B. has phylogenetic or evolutionary trees and cladograms that demonstrate the same pattern.

   C. traces the relatedness of organisms according to their evolutionary history.

   D. All of the above

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2. What is the main aim of the study of systematics?

   A. To calculate how many organisms there are on Earth

   B. To understand the evolutionary relationship of biological organisms

   C. To create a naming system for biological organisms

   D. None of the above

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3. What do you call the system that categorizes organisms by using a naming system that includes the genus and species?

   A. Dichotomous tree

   B. Phylogeny

   C. Cladistics

   D. Binomial nomenclature

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4. What modern method of study can trace the evolutionary relatedness of organisms by comparing the nucleotide sequences on DNA?

A. Phylogeny

B. Molecular clocks

C. Cladograms

D. Classification

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5. Which of the following statements about taxonomy systems is false?

A. Phylogeny and the Linnaean system give us the same results.

B. The hierarchical classification and the Linnaean system give us the same results.

C. The phylogeny system traces organisms according to their evolutionary history.

D. The hierarchical classification system is the basis for taxonomic classification.

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6. In a cladogram–

A. the most ancient organisms, called the origin, are found at the very base of the tree diagram.

B. the closer the branch point is to an organism, the more distantly related those organisms are.

C. neither A nor B are true.

D. both A and B are true.