section ➊ The History of Classification

● Before You Read

On the lines below, describe how you might organize a personal collection of books or CDs. In this section, you will learn the way biologists organize living things.

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● Read to Learn

Early Systems of Classification

It is easier for biologists to communicate and keep information about organisms when the organisms are organized into groups. One tool biologists use to organize organisms is classification. **Classification** is the grouping of objects or organisms based on a set of conditions. A regular system of classification helps scientists organize and communicate information about biology.

How did Aristotle classify organisms?

More than two thousand years ago, Aristotle, a Greek philosopher, developed the first commonly accepted system of biological classification. Aristotle classified organisms as either animals or plants. Animals were classified by their habitat and their morphology. Morphology relates to the physical characteristics and structures of organisms. Animals were also classified by the presence of red blood. Aristotle's classification of "bloodless" and "red blood" animals closely matches today's classification of invertebrates and vertebrates. Plants were classified by average size and structure—as trees, shrubs, or herbs. The table on the next page shows how Aristotle might have divided some of his groups. ☑

MAIN Idea

Biologists use a system of classification to organize information about the diversity of living things.

What You'll Learn

■ differences in methods of classifying
■ how to write scientific names
■ the taxa in biological classification

Mark the Text

Identify Concepts
Highlight each question heading in this section. Then use a different color to highlight the answers to the questions.

☑ Reading Check

1. Identify Who developed the first commonly accepted system of classification?

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2. Classify Using Aristotle's classification system, how would a daisy, a dog, and a whale be classified?

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Plants		
Herbs	**Shrubs**	**Trees**
violets rosemary onions	blackberry bush honeysuckle flannelbush	apple oak maple
Animals with Red Blood		
Land	**Water**	**Air**
wolf cat bear	dolphin eel sea bass	owl bat crow

What were the limitations of Aristotle's system of classification?

Aristotle's system of classification was useful for organizing, but it had many limitations. One limitation was that Aristotle's system was based on his understanding that species are distinct, separate, and unchanging. Because of this understanding, Aristotle's classification did not account for evolutionary history or relationships. Also, many organisms have been discovered that do not fit Aristotle's classification system, such as birds that do not fly and frogs that live on land and in water. Aristotle's system was used for many centuries before it was replaced by a new system. The new system built on the knowledge humans had gained about the natural world.

How did Linnaeus classify organisms?

In the eighteenth century, Swedish botanist Carolus Linnaeus developed a branch of biology called taxonomy. **Taxonomy** (tak SAH nuh mee) is a discipline of biology concerned with identifying, naming, and classifying species based on the morphological and behavioral similarities and differences of organisms. Linnaeus's system built on the foundation of Aristotle's system of classification. Linnaeus used similarities and differences in morphology and behavior to classify birds. The morphological differences can be related to differences in where the birds lived and their behavior.

What is systematics?

Taxonomy is part of a larger branch of biology called systematics. Systematics is the study of biological diversity. Scientists study diversity in the past, as well as present biological diversity.

Think it Over

3. Explain How did Linnaeus's system of classification build on Aristotle's system?

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How are scientific names written?

Linnaeus named organisms using binomial nomenclature. **Binomial nomenclature** (bi NOH mee ul • NOH mun klay chur) gives each species a scientific name that has two parts. The first part is the genus (JEE nus) name, and the second part is the specific epithet (EP uh thet), or specific name, that identifies the species. Latin is often used for binomial nomenclature because Latin is a language that is unchanging. Historically, Latin has also been the language of science.

Why do scientists use scientific names?

Biologists use scientific names because common names vary in their use. For example, the bird *Cardinalis cardinalis*, shown above, is commonly called a redbird, a cardinal, and a Northern cardinal. Binomial nomenclature is also used because common names can be misleading. A starfish is neither a star nor a fish, a great horned owl does not have horns, and a sea cucumber is not a plant.

When writing scientific names, scientists follow certain rules. The most important rules are as follows:
- The first letter of the genus name is always capitalized, but the rest of the genus name and all of the specific epithets are lowercase.
- If a scientific name is printed in a book or magazine, it is italicized.
- If a scientific name is written by hand, it is underlined.
- After the complete scientific name has been written once, the genus name will often be abbreviated to the first letter when used again. For example, the scientific name *Cardinalis cardinalis* can be written *C. cardinalis*. ☑

4. Identify Which is the scientific name for this bird? (Circle your answer.)
   a. cardinal
   b. Northern cardinal
   c. *Cardinalis cardinalis*

☑ **Reading Check**

5. Describe How should a scientific name be written by hand?

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How has the classification system changed?

Linnaeus's classification system made it possible to include evolutionary principles in classification in the 1800s. In the nineteenth century, important scientists, including Jean-Baptiste Lamarck, Charles Darwin, and Ernest Haeckel, introduced classification systems based on evolutionary relationships to organize biological diversity. Categories used in modern classification are based on Linnaeus's system but have been changed to show evolutionary relationships. ☑

Taxonomic Categories

Taxonomists classify organisms by dividing them into smaller groups based on more specific criteria. Taxonomic categories used by scientists are like nesting boxes—each category fits into another. The categories are arranged from broadest to most specific. A named group of organisms is called a **taxon** (plural, taxa).

What are a species and a genus?

Two of the taxa Linnaeus used were genus and species. Today, a **genus** (plural, genera) is defined as a group of species that are closely related and share a common ancestor. A species is a group of organisms that have similar characteristics such as skull shape and size. For example, the species American black bear (*Ursus americanus*) and the species Asiatic black bear (*Ursus thibetanus*), shown below, belong to genus *Ursus*. All species in the genus *Ursus* have massive skulls and similar tooth structure.

Picture This
7. Name characteristics that the American black bear and the Asiatic black bear have in common.

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American blackbear

Asiatic blackbear

What is a family?

A **family** is a group of genera that have similar characteristics. All bears, both living and extinct, belong to the family Ursidae. All members of the Ursidae family have similar characteristics. For example, they walk flat-footed and have forearms that can rotate to grasp prey closely.

What are the higher taxa?

An **order** is a group of families that have similar characteristics. A **class** is a group of one or more related orders. A **phylum** (FI lum) (plural, phyla) or a **division** is a group of related classes. The term *division* is used for bacteria and plants. A **kingdom** is a group of related phyla, or divisions. The least specific of all taxa is a domain. A **domain** is a group of one or more kingdoms. The pyramid of taxa shown below will help you remember how the taxa are organized.
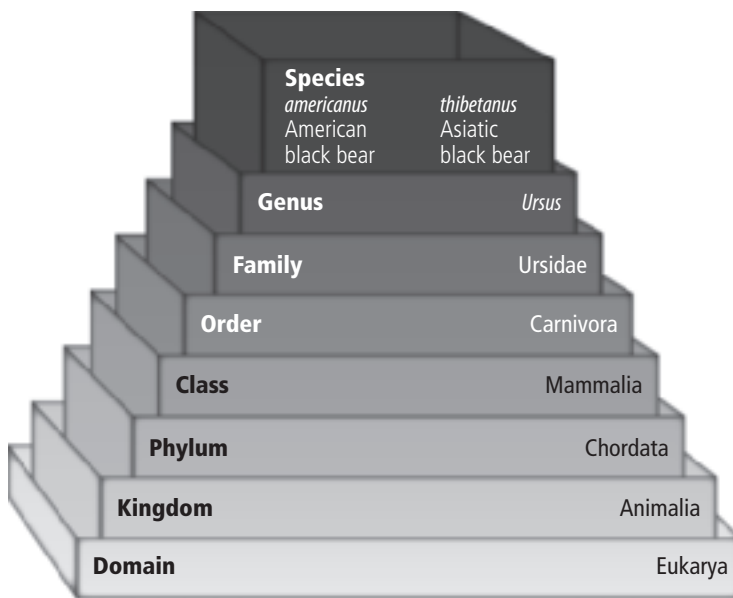
Systematics Applications

Systematicists are scientists who study classification. They provide detailed guides that enable other people to identify organisms. Many times, field guides have dichotomous (di KAWT uh mus) keys, which are keys based on a series of choices between characteristics. You can tell if a plant or animal is poisonous by using a field guide to identify it. Systematicists also work to identify new species and relationships among known species. If a known species produces a certain chemical, a close relative might produce a similar chemical.

Picture This

8. Determine At what level on the pyramid of taxa is the American black bear distinguished from the Asiatic black bear?

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Think it Over

9. Draw Conclusions Why might it be important to know the relationships among species?

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