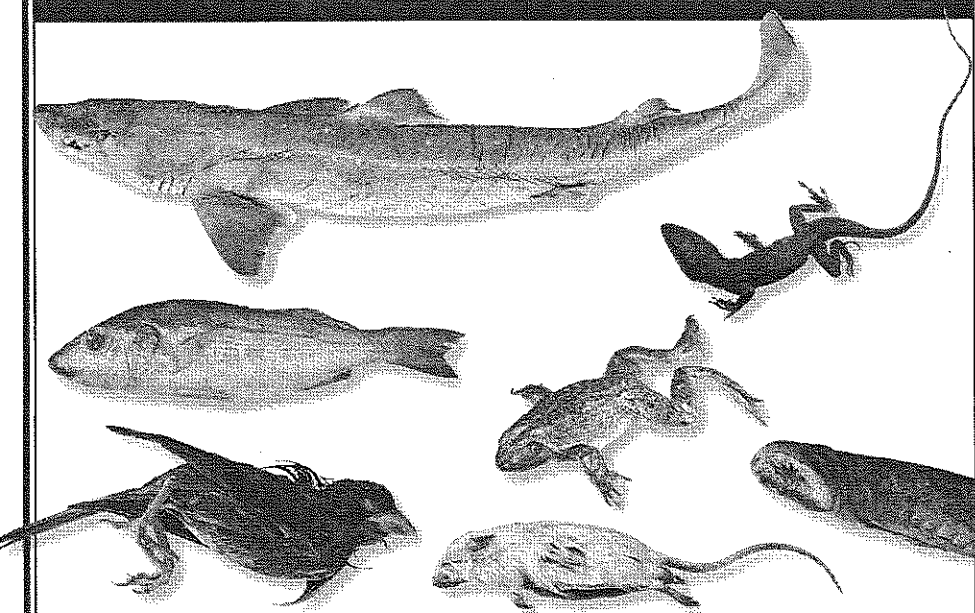


BioQuest[®]

OBSERVE • QUESTION • MEASURE • THINK • PREDICT

HANDS-ON VERTERBRATE STUDY KIT



STUDENT'S GUIDE

Information:

The world is filled with many interesting and varied forms of life which have occupied the biosphere for as many as two billion years. Fossil evidence, along with genetic, biochemical, and structural features, suggests that living organisms have not always appeared as they do today. As the face of our planet has changed over millions of years, the forms of life have changed as well. Some of the organisms that once existed have become extinct. However, other organisms have managed to be successful in reproducing and continuing their species as they adapted to the varied landscapes and different environments on our planet. It is suggested that over 30 million kinds of organisms exist and share space on this planet with humans. The fossils evidence previously mentioned suggests that it was over 500 million years ago that vertebrate animals began to predominate that landscape. The vertebrates still continue to be the most successful inhabitants on earth today. Because of their success, the vertebrate the dominant group of living organisms.

In about the 4th Century B.C., Aristotle, a natural philosopher from Greece, decided that it was important to have a system of classification to provide a basis for identifying different forms of life. Aristotle used habitat as a basis for establishing separate categories for the classification of living things in the animal kingdom. This system continued until the mid 1700s, when biologists began to recognize that there were thousands of new organisms being discovered each year. The system of classification developed by Aristotle did not provide a clear basis of identification for the large number of animal species with variations. An improved system of classification or taxonomy was developed by a botanist from Sweden by the name of Carolus Linnaeus which replaced the system proposed by Aristotle. Linnaeus' system is based upon structural similarity. Organisms with similar structure are identified as the same species and those of similar species are grouped into a larger category called a genus. This is the modern system of taxonomy that is in use today.

Each organism classified according to Linnaeus' system is given to two-word name (genus, species) which is referred to as binomial nomenclature. In addition to the genus and species, there are other levels used to further classify organisms. Starting with the largest and taken in order to the smallest categories, they are the kingdom, phylum, class, order, family, genus, species, and variety. This system includes five major KINGDOMS. In this investigation, you will study members of the ANIMAL KINGDOM and the PHYLUM CHORDATA. The chordate is an animal that, at some point in its life, has a notochord, a dorsal nerve chord, and temporary or permanent paired gills in pharyngeal pouches. There are three subphyla that belong to the phylum chordata. The first 2 subphyla are identified as lower chordates and include

the following: **UROCHORDATA** (Sea Squirts) and **CEPHALOCHORDATA** (Lancelets). The third and more common subphylum is the **VERTEBRATA** category which includes the more complex species identified as the higher vertebrate animals. The next taxonomic subdivision is the **CLASS** and includes seven structurally different categories of animals which will be studied in this activity: the **FISH** (jawless, cartilage, bony), **AMPHIBIANS**, **REPTILES**, **AVES**, and **MAMMALS**.

Vertebrate animals are identified by a definite column of bones or cartilage which is joined together and forms a vertebral column or backbone. The backbone is made of individual vertebra which fit together and have a common opening. This opening provides space to protect the nerve or spinal cord that begins at the brain and nearly runs the full length of the vertebral column. The skeleton of the vertebrates is located internally and referred to as an endoskeleton.

Depending on **CLASS** of vertebrates, the skeleton may be made of cartilage, bone, or a combination of both. The structure of vertebrate animals illustrates bilateral symmetry. There is considerable variation, or biodiversity, among the various species of animals as you observe the different physical appearances and compare their individual sizes and shapes. These structural differences provide the basis for which organisms are similarly grouped in the classification system developed by Linnaeus. As you examine the specimens, the vertebrate animals will have a definite head or anterior end as compared to its tail or posterior end. The back surface of the body is dorsal, while the chest or belly surface is ventral. Vertebrate animals are adapted to survive in their individual habitats where they exist as either water, land, or air dwellers.

Purposes:

1. Students will become familiar with the modern classification system of the animal kingdom.
2. Students will recognize that animals with special characteristics are members of the phylum chordata.
3. Students will be able to examine the characteristics of animals and observe the biodiversity that distinguishes one vertebrate animal from another.
4. Students will be able to identify and name seven different vertebrate animals.
5. Students will learn that binomial nomenclature provides individual identity for each specie of vertebrate animal.

6. Classification of animals is based upon structural similarity and provides information that is useful in developing a dichotomous key.

Materials:

Seven vertebrate animals prepared in NASCO-Guard® preservative, individually sealed in plastic bags with instructions (lamprey, dogfish shark, perch, frog, chameleon, sparrow, mouse); a teacher's guide with review questions and answers; 15 illustrated student guides; 1 set of activity sheets; *Pond Life Golden Guide* book; *Guide to the Study of Vertebrate Animals* book; and 15 hand magnifiers; all packaged in a durable plastic storage box with a snap-on lid.

Procedures and Observations:

The students will be advised if they are to work as partners or in groups to investigate the specimens provided in this study kit. Each kit will include a package of seven vertebrate animals which will be distributed to the student groups as designated by your teacher. Students may work in groups of five, with each group working with a different vertebrate specimen. The specimens are then rotated from group to group until all specimens have been observed. If the animal pack is not already opened, do so according to your teacher's instruction. After laying out the animal specimens, your task will be to make observations about each animal and see how they differ from one another. After completing your observations, read and follow the directions on the activity sheet for **EXERCISE 1**, placing your answers in the appropriate spaces. As you have questions, you may want to use the reference book provided (*Pond Life*) or the *Guide to the Study of Vertebrate Animals* to gather information about the various classes of vertebrate animals.

After completing **EXERCISE 1**, review **EXERCISE 2**, and note that for each animal there are various categories for which you will record information. For purposes of uniformity, five different columns are listed. Each column provides information on the structural characteristics of the vertebrates listed in the **DATA** section.

Data:

(ACTIVITY SHEETS/EXERCISES 1 & 2)

1. Begin with the three different classifications of **FISH**. List the names of the species for each of the **CLASSES** from the simplest to the most complex in the space provided. In the columns following the animals names, the type of answers you choose to list for any one of the five categories may be used more than once.

BODY COVERINGS: smooth skin, feathers, hair, fur, scales, etc.

APPENDAGES: none present (absent), fins, wings, arms, legs, nails, claws, tail

TEETH: none present (absent), upper jaw, lower jaw, both jaws, roof of mouth, etc.

BREATHING STRUCTURES: gills, skin, lungs

SKELETAL STRUCTURES: cartilage, bones nearly solid, hollow bones

FORELIMB SKELETAL STRUCTURES

Frog



Lizard



Bird



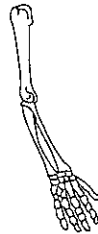
Bat



Whale



Human



2. Since the animals have an endoskeleton, sketches of the forelimbs for several vertebrates have been provided to examine internal details. Note that there are similarities in the bone structure (**HOMOLOGOUS STRUCTURES**). You can see that even though the limb may have a different structural use, such as swimming, jumping, flying, crawling, or walking, they each have the same basic plan for their bone structure. Your teacher may want to have you use colored pencils to identify the common bones that have the same name: **HUMERUS, ULNA, RADIUS, WRIST, FINGERS**.

3. Next identify and examine an **AMPHIBIAN** animal. Place the name for the animals in the space provided. After inspecting each animal, fill in the information requested for each of the five designated categories. After completing the answers for the first amphibian, list the name of another example of an amphibian animal (not provided in the kit) and place it in the space provided for answer #2.

4. Follow the same procedure for each of the remaining vertebrate animal CLASSES, until you completed the answers requested on the activity sheet.

(ACTIVITY SHEET/EXERCISE 3)

5. Taxonomists use what is called a dichotomous key for the classification of organisms. Your teacher will explain the manner in which a simple dichotomous key may be used for the classification of vertebrate animals. You are to select a structural characteristic that is listed from either choice A or B. By process of elimination, each structural trait may be considered to determine the correct information for identifying the animal in question. Study the details presented in EXERCISE 3. Look at the animal illustrations which identify the "dichotomous" choice. Next, select the correct choice which matches each sketch with the "dichotomous" statement, and place the name in the space provided to the right of each statement.

Questions For Further Study:

1. List FIVE classes of vertebrate animals.
2. What does it mean to describe an animal as a CHORDATE?
(What do they all have in common?)
3. Why is it important for a scientist or an individual to classify an animal?
4. In humans and other vertebrates, how does an "endoskeleton" provide a more efficient way of life and existence than an "exoskeleton" in an invertebrate animal?
5. How does the system of MODERN classification provide names for vertebrate animals which allow them to be identified as different from any others in the world?
6. How are vertebrate limbs similar? Does this suggest that there is similarity in the structure of vertebrates?
7. Why is a whale considered to be a mammal even though it lives in the sea?
8. What does it mean to suggest that an animal has a HOMOLOGOUS STRUCTURE?
9. Identify several structural characteristics that contribute to the success of vertebrate animals.