Overview

Focus Questions
How are animals classified using taxonomy? Why is it important to classify animals (or any living organism)?

Activity Synopsis
Students will learn about the Kingdom Animalia and group organisms based on their shared characteristics.

Time Frame
60 minutes

Objectives
The learner will be able to:
- List the 8 levels/taxa of taxonomy
- Understand the basic classification within the Kingdom Animalia
- Group animals based on their shared characteristics
- Understand the importance of classification

Student and Teacher Key Terms
- Taxonomy
- Taxon/Taxa
- Domain
- Kingdom
- Phylum
- Division
- Class
- Order
- Family
- Genus
- Species

Standards

South Carolina College- and Career-Ready Science Standards 2021

The new 2021 science standards do not address Taxonomy.

2014 Academic Standards and Performance Indicators for Science

6th Grade: 6.S.1A.1, **6.S.1A.2, 6.L.4A.2, 6.L.4B.1**
7th Grade: 7.S.1A.1, **7.S.1A.2**
8th Grade: 8.S.1A.1, **8.S.1A.2**

* Bold standards are the main standards addressed in this activity

Sixth Grade Performance Indicators
6.S.1A.1 Ask questions to (1) generate hypotheses for scientific investigations, (2) refine models, explanations, or designs, or (3) extend the results of investigations or challenge claims.
6.S.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.

6.L.4A.2 Develop and use models to classify organisms based on the current hierarchical taxonomic structure (including the kingdoms of protists, plants, fungi, and animals).

6.L.4B.1 Analyze and interpret data related to the diversity of animals to support claims that all animals (vertebrates and invertebrates) share common characteristics.

Seventh Grade Performance Indicators

7.S.1A.1 Ask questions to (1) generate hypotheses for scientific investigations, (2) refine models, explanations, or designs, or (3) extend the results of investigations or challenge claims.

7.S.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.

Eighth Grade Performance Indicators

8.S.1A.1 Ask questions to (1) generate hypotheses for scientific investigations, (2) refine models, explanations, or designs, or (3) extend the results of investigations or challenge claims.

8.S.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.

Cross Curricular Standards

South Carolina College and Career Standards for ELA
Communication (C) – 6-1.1, 6-1.2, 7-1.1, 7-1.2, 8-1.1, 8-1.2

Common Core ELA Standards
Reading Informational Text – 6.4, 6.7, 7.4, 8.4
Writing – 6.7, 7.7, 8.7
Speaking/Listening – 6.1, 6.4, 7.1, 7.4, 8.1, 8.4
Language – 6.1, 7.1, 8.1

Background

Key Points
Key Points will give you the main information you should know to teach the activity.

- **Taxonomy** is the classification of organisms based on shared characteristics.
- There are 8 main levels (**taxa**) of taxonomy (**Domain**, **Kingdom**, **Phylum**, **Class**, **Order**, **Family**, **Genus**, **Species**).
- The Animal Kingdom - Animals are a very diverse group of organisms. They are heterotrophs (eat other organisms for energy), live in all land (cold, hot, humid, dry,…) and water (freshwater, saltwater and brackish) environments as well as the air, lack a cell wall, have the ability to move (majority), reproduce sexually (majority).
- There are 35 animal phyla. There is 1 vertebrate phylum (Chordata) and 34 invertebrate phyla.
- Grouping organisms using taxonomy helps understand what organisms are closely related. By knowing the relationships between organisms we can better understand our world and the diversity of life on earth.

Detailed Information
Detailed Information gives more in-depth background to increase your own knowledge, in case you want to expand upon the activity or you are asked detailed questions by students.

Taxonomy is the classification or grouping of organisms based on shared characteristics. It is said to be the "oldest profession" because it dates back to times when humans were classifying whether plants were edible, poisonous or useful for medicinal purposes.

In fourth century B.C., Aristotle created the first grouping of organisms by looking at shared characteristics and for over 2000 years this system was not significantly changed. John Ray in the late 1400s came up with the idea of the **species** as the most specific level of classification.

By grouping organisms, relationships can be studied, patterns in nature can be identified and information can be organized for all to use. With conservation being of increased value, understanding the diversity of an area is very important in making informed decisions and taxonomy is very important in discovering diversity.

People who study taxonomy are called taxonomists. It is thought that there are over 30 million species of organisms in the world, but only 1.7 of them have been classified and named. Taxonomists still use the naked eye to identify characteristics of an organisms, but they also use microscopes, electron microscopes and DNA testing.

In taxonomy, there are 8 main levels or categories, called **taxa** (singular **taxon**). The categories in order of most general to most specific are **Domain, Kingdom, Phylum** (plural phyla), **Class, Order, Family, Genus** and **Species**. At this time there are 3 Domains and 6 Kingdoms of organisms on earth. The 3 domains are the Eubacteria, Archaebacteria and the Eukarya (including the protists, fungi, plants and animals). The Eukarya are lumped together because they are mostly multicellular. The 6 Kingdoms are Animalia (Animals), Plantae (Plants), Fungi, Protista (mostly one-celled organisms), Archaebacteria and Eubacteria.

Taxonomy is an ever changing science as time moves on due to new technology and new discoveries. For example, for years the Archaea and Bacteria were in 1 Kingdom called Prokaryotes. Today it has been split into two different groups of microbes. To confuse us even more, but worth mentioning is that when classifying plants and fungi, the term Division is used in place of Phylum. The taxonomy for Plants and Fungi would be Kingdom, Division, Class, Order, Family, Genus and Species.

Another level, the eighth level, of classification is sometimes used and places all living things in 3 domains. The 3 domains are the Eubacteria, Archaebacteria and the Eukarya (including the protists, fungi, plants and animals). The Eukarya are lumped together because they are mostly multicellular.

There are also subcategories within the main 8 taxa. An example would by subphylum or superorder. If the prefix is sub it is just below that level. If the prefix is super it is right above that taxon. These subcategories allow for small variations within a taxon. To remember the 8 levels of taxonomy, many use a mnemonic. A couple examples would be: Does King Phillip Come Over For Great Spaghetti or Do Kings Play Chess On Fancy Glass Stools. Come up with your own in order to remember it better!

Scientists name organisms based on the genus and species names. This is called binomial nomenclature. The correct way to write a scientific name is Genus species (underline). When the scientific name is typed it is typed *Genus species* (italicized). Please note than the Genus name has the first letter capitalized and the species name is all lower case. Examples would be *Alligator mississippiensis* (Ameican alligator) or *Haliaeetus leucocephalus* (Bald eagle). Scientific names are often used because sometimes the same animal has many common names. There is only ever one scientific name. An example of this is the scientific name *Sciaenops ocellatus*, which is a fish called a red drum, redfish and spottail bass for just a few of its common names.

By using taxonomy, every living thing will have its own species name and therefore can be distinguished from any other living thing. The definition of a species is a widely argued topic. For our purposes, we will use the biological species definition which is that a species is an organism that cannot breed with another organism to produce a fertile offspring. For example; a grizzly bear and a giraffe cannot reproduce to create a baby.

Domains Archaebacteria and Eubacteria

The Domains Archaebacteria and Eubacteria consist of unicellular organisms. These organisms differ greatly from all other living things. The organisms of these two domains have small cell size that vary greatly between organisms. They also divide using binary fission (not mitosis like the eukaryotes). The flagella of these organisms are very simple and move by spinning (eukaryote flagella move using a whiplike motion).

Domain Eukarya

Kingdom Protista
The Kingdom Protista is the most varied of the eukaryotes. Some are single celled and some are multicellular. Some are tiny and microscopic while others are huge, larger than a school bus. Eukaryotes are placed in this kingdom when they are not plants, animals or fungi. That is the main characteristic of this group, to be a eukaryote, but not a plant, animal or fungus. Some move using cilia (ciliates). Some are photosynthetic (algae and diatoms). Some have no permanent appendage (amoebas). The kingdom Protista includes 15 phyla.

Kingdom Fungi
Many people think fungi are plants, but they share very few traits with plants. The only two traits they share are that they are multicellular and grow out of the ground. Fungi get their food by consuming other organisms (heterotrophs). Fungi do not photosynthesize like plants do. Many fungi are decomposers, feeding on dead plants (trees). That is why they can be found a lot of times on logs in a forest. Not all are decomposers, some feed on living plants and animals. There are about 77,000 named fungi species in the world representing 3 phyla.

Kingdom Plantae
Plants are autotrophs or self-feeding organisms. Plants produce their own "food" using sunlight energy, water and carbon dioxide to create glucose (food) and oxygen. They are grouped as nonvascular plants (3 phyla; mosses, liverworts and hornworts) and vascular plants (9 phyla; ferns, flowering plants and conifer trees to name 3). Some vascular plants are seedless (4 phyla) including ferns. Some vascular plants produce seeds (5 phyla) including gymnosperms (4 of the 5 phyla) and angiosperms (1 phyla). Gymnosperms lack fruits and flowers. Angiosperms are the flowering plants and have fruits and flowers. There are over 300,000 species of know plants represented by 12 living phyla. They produce much of the oxygen on earth through photosynthesis. We eat them. We used them to build houses and to make paper and other products. Animals use them for shelter, food and shade to name a few. Plants are the base of almost every food chain in the world.

Kingdom Animalia
Animals are heterotrophs or eat other organisms for energy. Most of 10 million animals species in the world, about 99% are invertebrates (lack a backbone). That means about 42,500 species are vertebrates (have a backbone). Animals consists of a very diverse group. Some can only live in freshwater, some saltwater, some brackish water and some on land. Some can only live in the colder climates such as the artic and others need the warmth of the tropics. All animal cells lack a cell wall, most have the ability to move and most reproduce sexually. There are 35 animal phyla. All but 1 of these are invertebrates such as the sponges, arthropods and cnidarians. Vertebrates (mammal, fish, birds, reptiles and amphibians) are all part of the phylum chordata, subphylum vertebrata (see below).

Domain Eukarya
        Kingdom Animalia
                Phylum Porifera – sponges
                Phylum Cnidaria – jellies, anemones, hydra
                Phylum Mollusca – snails, bivalves, cephalopods
                Phylum Echinodermata – urchins, sea stars, sea cucumbers
                Phylum Annelida – segmented worms
                Phylum Arthropoda – insects, crustaceans, arachnids
                Phylum Chordata
                        Subphylum Vertebrata
                                Fishes (3 classes) – over 20,000 species
                                        Class Agnatha
                                        Class Chondrichthyes
                                        Class Osteichthyes
                                Class Amphibia – over 4200 species
                                Class Reptilia – over 7000 species

Class Aves (birds) – over 8800 species
Class Mammalia – over 4100 species

Procedures

Materials

- Introduction to Animal Taxonomy PowerPoint
- Animal Taxonomy Pictures (one set per group)
- Animal Taxonomy Answer Key (for teacher only)

Procedure

Prep: Cut 1 set of organism cards per group of 3-4 students. Would be great if the picture sets could be laminated so they could be used again from year to year.

1. Let the students know that they are going to look at pictures of different organisms and group them according to how they look.
2. Give each group of students a set of organism pictures.
3. Allow them a few minutes to group the organisms.
4. Have each group explain how they decided to group their organisms. What characteristics did they use to group them?
5. Talk in more depth about taxonomy by using the Introduction to Animal Taxonomy Powerpoint.
6. Now let them know that they need to group the organisms according to the following guidelines and the first group to do so <u>correctly</u> wins (Come up with an incentive for them to play. Maybe, extra computer time or they get to leave 2 min early for lunch). Place the following on the board for them to reference.
    A) Invertebrates
        i. Phylum Porifera
        ii. Phylum Cnidaria
        iii. Phylum Mollusca
        iv. Phylum Echinodermata
        v. Phylum Annelida
        vi. Phylum Arthropoda
    B) Vertebrates
        i. Phylum Chordata
            1. Fish (3 Classes)
            2. Class Amphibia
            3. Class Reptilia
            4. Class Aves (Birds)
            5. Class Mammalia
7. Ask them their thoughts. Was it easy? Were there any tricky animals?
8. Remind them that organisms give us food, oxygen, medicines and so much more. That is why it is important to learn as much as we can about them and how to protect them. One way to do this is to classify them into groups.

Follow-up questions

- If you discovered a new animal species, what would you name it? Why?
- What percentage of living things on earth are in the Kingdom Animalia?

At-home Learning and Virtual Modifications

At-home Learning: Send this google slide sorting presentation and assignment home with your students (https://docs.google.com/presentation/d/1HhKzxSjSWnkGnH2ZcL16ntuhvZXDktr4kyiLFwx9mko/edit?usp=sharing). This assignment includes some background information on taxonomy, animals and 3 sorting assignments. The first has them classify pictures of animals as invertebrates or vertebrates. In the second portion, students will classify animals into one of 6 phyla (P. Porifera, P. Cnidaria, P. Mollusca, P. Echinodermata, P. Arthropoda and P. Chordata). The third portion dives into the Phylum Chordata, where students will move the animal photos into the class in which they belong.

Instruction to assign the presentation in google classroom:
1. Save the Animal Taxonomy Sort Slideshow to your Google Drive
2. Open your Google Classroom and create a new assignment
3. Select Add > Google Drive
4. Be sure to choose "Make a copy for each student"
5. You'll be able to see their answers and interactions

Instructions if sending through email:
1. Save the Animal Taxonomy Sort Slideshow to your Google Drive
2. Download the slideshow as a powerpoint
3. Send to your students
4. Have students complete the powerpoint and send it back to you

Virtual: Introduce students to the concept of taxonomy and the different phylum of invertebrates and vertebrates using the Introduction to Animal Taxonomy powerpoint found in the materials section of this activity. One way to teach the activity portion is to show the class an image of an animal and choose a student to classify it using the following criteria: vertebrate or invertebrate, phylum, and class. A second method if you would like to have the students in groups, would be to send a subset of animal pictures to each group or have each group draw animals that are assigned. Groups can then classify their animals using the following criteria: vertebrate or invertebrate, phylum, and class. Each group can share out and explain why they classified as they did.

Assessment

Have each student complete the Taxonomy Assessment Worksheet.

Scoring rubric out of 100 points

For each correctly labelled picture 1-5 (A, B, C) **5 points (total 75 points)**
For answering #6 correctly and in detail **25 points**

Taxonomy Assessment Worksheet Answer Key

Cross-Curricular Extensions

STEM Extension
After researching the different levels of taxonomy for a particular animal of their choice, students should build a pyramid (or something like it) to create each level. The big base would be Kingdom, and then each level gets smaller as it goes up, with the species being on top. About how many other animals are in each level with their animal? Have them graph the results.

6th grade Social Studies Extension
Have students research and then write an essay about how hunter-gatherer societies used taxonomy (6-1.1).

6th grade Social Studies Extension

Have students work together as a group of 3-4 to discuss about how a better understanding of taxonomy could have helped decrease the effects of the exchange of plants, animals and diseases throughout the world. Have each group share their opinions with the class (6-6.6).

Resources

Teacher Reference Books

Raven, Peter H. and George B. Johnson. *Biology: Sixth Edition*. McGraw-Hill Companies. New York. 2002

Darwin, Charles. *The Origin of Species by Means of Natural Selection*.
http://www.talkorigins.org/faqs/origin.html

Teacher Reference Websites

Natural History Museum
http://www.nhm.ac.uk/nature-online/science-of-natural-history/taxonomy-systematics/what-is-taxonomy/
Great website for basic taxonomy information and history.

How Stuff Works
http://science.howstuffworks.com/life/biology-fields/taxonomy-info2.htm
Website for basic taxonomy information as well as a list of each Kingdom and the Phyla that are within each.

International Union for Conservation of Nature
http://www.iucnredlist.org/
List of species that are of conservation concern.

National Center for Biotechnology Information
http://www.ncbi.nlm.nih.gov/taxonomy
Database for the taxonomy of most organisms