TITLE: TAXONOMIC CONNECTIONS
PRIMARY SUBJECT - Science
GRADE LEVEL – 6th to 12th
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CONCEPT / TOPICS TO TEACH:

Taxonomy is a scientific process that sets out to group and classify living things based on similar qualities and characteristics. Many of these qualities are external and easily observable such as the size, shape, and the number of fins on a fish. Other qualities are not as easily observed and would include things such as genetics and even fossil studies.

STANDARDS ADDRESSED:

COMMON CORE	NGS STANDARDS
Grades 6-8: CCSS.ELA-LITERACY.RST.6-8.7 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).	**Grades 6-8:** MS-LS4-2. Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.
Grades 9-10: CCSS.ELA-LITERACY.WHST.9-10.9 Draw evidence from informational texts to support analysis, reflection, and research.	**Grades 9-12:** HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
Grades 11-12: CCSS.ELA-LITERACY.SL.11-12.4 Present information, findings, and supporting evidence conveying a clear and distinct perspective, such that listeners can follow the line of reasoning, alternative or opposing perspectives are addressed, and the organization, development, substance, and style are appropriate to purpose, audience, and a range of formal and informal tasks.	HS-LS2-8. Evaluate evidence for the role of group behavior on individual and species' chances to survive and reproduce.

General Goal(s):

Introduce students to variables considered in the process of identifying and defining relationships among organisms. Acquaint students with the categorization of living things into groups based on physical similarity (taxonomy) and why those groupings must be revisited periodically. This exercise builds analytical thinking and consensus building skills.

Specific Objectives:

Students will collaborate to create a system of organization (taxonomy) for soda pop.
This activity will provide students time to engage in critical thinking, research skills, debate, literacy and vocabulary development, and to utilize important strategies for creating structure and consensus.

Required Materials:

- Multiple sets of soda pop card decks (provided below) enough sets so students can work in small groups. These pages can be printed (ideally in color) and cut to make "card decks".
- Work space large enough for students to spread out and arrange their decks.
- This website: https://www.itis.gov/

Anticipatory Set (Lead-In):

- Q: Ask students if they have ever organized a closet or set of drawers, and if so what criteria did they use in their organization?
- A: Answers should be things like size, shape, color, or other physical similarities.
- Q: Ask students how they could have organized their space differently in a way that still makes sense.
- A: Answers will vary.
- Q: Ask students how they ultimately decided the system they used was better than other organizational strategies.
- A: Students will offer a variety of answers, so explore how different or similar their strategies were.
- RESOLVE: As species new to science are discovered, scientists have to figure out how they fit within the established structure of organization. At times, a new discovery might impact other parts of the system and cause a massive overhaul. The system is not static, it evolves with every new discovery.

GLOSSARY OF LESSON TERMS

- Binomial nomenclature - A naming system comprised of two names. In biology the name of the genus and species are the two names combined to provide the scientific name.
- Biodiversity - The number of species and genes they contain.
- Holotype - A single specimen identified by an author as the "type" (first of its kind to be identified) of a species or lesser taxon at the time of establishing the group.
- Morphology - The form of living organisms and the relationships between their structures.
- Taxonomy – The science dealing with the description, identification, naming, and classification of organisms or in some cases non-living materials or conditions.

Plan for Independent Practice:

- Encourage students to come up with a similar taxonomy for something in their homes and chart it out as an additional assignment.
- Ask students to do additional reading about discoveries of species new to science and discuss the unique features of these animals that scientists would have considered when giving them their taxonomic assignments.
- Challenge students to research an animal called tiktaalik and write a summary about why it was such an important taxonomic discovery and also explain what it means to be a transitional species.
- Ask students to write a short story from the perspective of a scientist who has just made a new taxonomic find. What part of the world were they working in and why? Was the find expected or a surprise? How did it feel to make the discovery and what steps did they have to take to verify that it was a first? Encourage students to use their imagination and offer as many details as possible.

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Suggested Reading

Living Fossil: The Story of the Coelacanth
Author, Keith S. Thomson ISBN: 978-0393308686

"Discovery of the Yeti Crab"
https://www.mbari.org/discovery-of-yeti-crab/

"Paleo Profile: The Paradoxical Mega Shark":
https://blogs.scientificamerican.com/laelaps/paleo-profile-the-paradoxical-mega-shark/

Potential Connections to Other Subjects:

Art - design, graphics, layout, drawing, and other media.
Language –vocabulary development, research writing, and literacy.
Biology - taxonomy, anatomy, ecology

ACTIVITY PROCEDURE

BACKGROUND

The system of taxonomy begins with the broadest possible connections at the level called kingdom. There are currently six kingdoms; Animalia, Plantae, Fungi, Protista, Archaea, and Bacteria. Kingdoms are followed by increasingly specific connections as follows; phylum, class, order, family, genus, and species.

It is the categories genus and species that yield the scientific name. For example, there are nine kinds of hammerhead shark. Almost all of them belong to the genus *Sphyrna*. In order to know which kind of hammerhead shark we are talking about, we designate them by species. For example, the largest of the bunch (the Great hammerhead) is called *mokarran*. Therefore the scientific name of the Great hammerhead is *Sphyrna mokarran*. Scientific names are always in italics with the genus capitalized and species in lower case. This naming system is called binomial nomenclature.

In some instances, you might see a set of parentheses after a scientific name that includes a name and year. Here is an example of what that looks like; *Hippocampus whitei* (Bleeker, 1855). What this tells us is that in 1855, someone by the name of Bleeker made the discovery that *Hippocampus whitei* is its own unique species of seahorse. In other words, it indicates the formal discovery and recognition of a new species. Naming of a new species must follow specific rules. Five general requirements are as follows;

1. The name of the taxon must be based on the 26 letters in the Latin alphabet.
2. The name must be unique.
3. The description must be based on at least one name-bearing representative specimen.
4. It should include reference to the attributes that make the taxon unique.
5. These first four requirements must be published in a work that is obtainable in numerous identical copies, as a permanent scientific record.

A holotype is a single, physical representative organism or drawing that was used when that particular organism was described. Think of it as the primary sample. Often holotypes are housed at museums or similar research institutions and are kept accessible for research and study. In some instances only parts of an organism serve as a holotype such as in the case of incomplete fossils, or perhaps stored DNA if the organism is very large.

Step 1 - With your group, examine the various carbonated drinks on the index cards, and discuss the qualities that make them similar to and different from one another. Answer this following question:

1) Describe all of the various *properties* you could potentially use to break the sodas into broad categories.

**Now, physically arrange the cards on the table in the way that makes the most sense to your team.*

Step 2 **–** With your team, answer the following questions about how you arranged your soda taxonomy.

2) Describe how your group organized the cards. Be sure to discuss the logic that you used to arrange the groups. What were the qualities and properties that put certain sodas together and/or set them apart?

3) Were there certain sodas that presented a challenge for your group, and if so please describe the soda and discuss why it presented an issue.

4) Were there any sodas in your system that could have easily been placed in another grouping? If so, describe which soda it was, the group it was in, and the optional grouping.

5) Were there any sodas that were not on the cards that you felt necessary to make any of your groupings more complete? If so, which ones and why?

Step 3 – As a class, the teacher will have one representative from each group explain the system their team devised to taxonomically organize the sodas. Once each group has had a chance to explain, the groups will be paired up to debate which system they would choose as "correct" and answer the following questions.

6) What were the key differences (and simiarities) between how your team and your pair team organized the sodas?

7) Of the two organizational soda structures what system did the team choose as most correct and why?

8) In what ways was creating a system of organization for the soda pop similar to what scientists must consider when they are classifying living creatures?

Step 4 – These questions may be answered in class as time permits or at home, but they are part of the lab and must be answered.
Please visit this website: http://www.itis.gov/

Using the search engine of Integrated Taxonomic Information System, please search for the answers to the following questions.

1) Use the scientific name *Antennarius maculatus* to discover the common name for the animal.

2) Please give the name and year pertaining to who discovered the Great White Shark.

3) Using the common name “guitarfishes” please state who established the family and when.

4) What kind of animal is *Enteroctopus dofleini?*


mello yello
CITRUS FLAVORED SODA
12 FL OZ (355 mL)


Mountain Dew
12 FL OZ (355 mL)


Sunkist


Sprite


Coca-Cola
classic

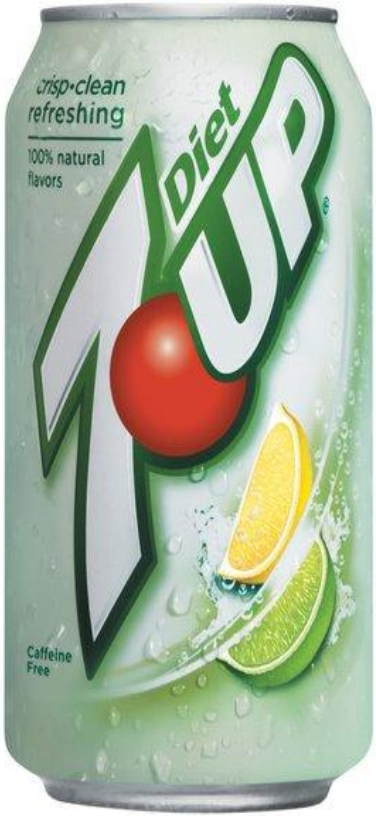

Coca-Cola
cherry
zero


SINCE 1919
A&W
ROOT BEER
Naturally and
Artificially Flavored
12 FL OZ (355 mL)


Red Bull
ENERGY DRINK


NOW ASPARTAME FREE
diet
pepsi
caffeine free

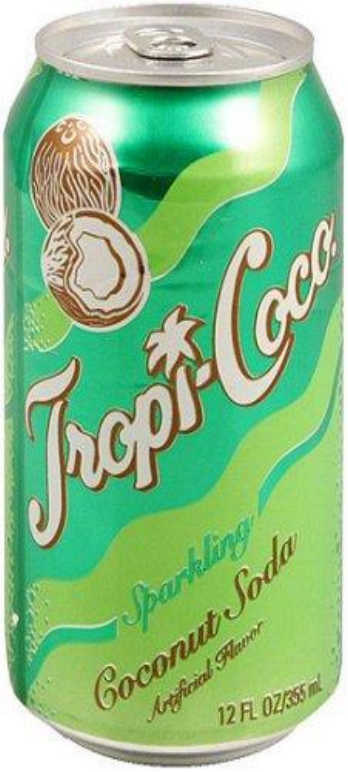

Coca-Cola
Vanilla
Coca-Cola with
VANILLA FLAVOR
& OTHER NATURAL FLAVORS
12 FL OZ (355 mL)

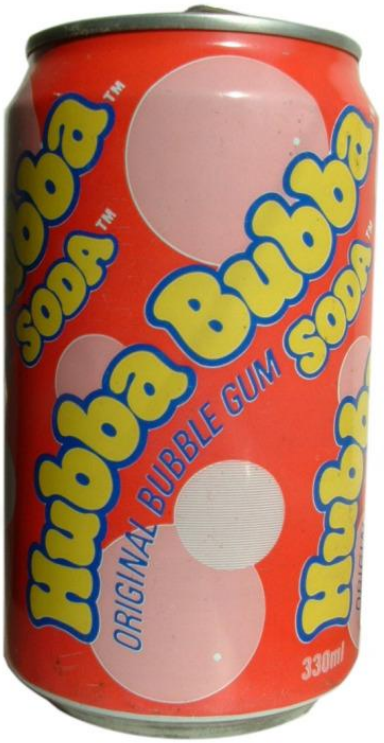

crisp•clean
refreshing
100% natural
flavors
Diet
7UP
Caffeine
Free


CAFFEINE
FREE
100%
NATURAL
FLAVORS
fanta
GRAPE
GRAPE
FLAVORED SODA
WITH OTHER
NATURAL FLAVORS
12 FL OZ
(355 mL)
180
CALORIES
PER CAN


Schweppes
CAFFEINE FREE
GINGER ALE
12 FL OZ (355 ml)

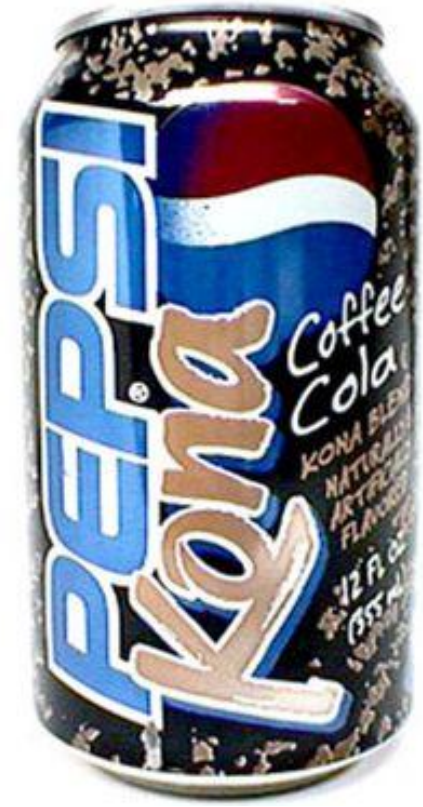

Dr Pepper
Est.1885
Diet


Tropi-Coco
Sparkling
Coconut Soda
Artificial Flavor
12 FL OZ/355 mL


Hubba Bubba
ORIGINAL BUBBLE GUM
SODA
330ml


CAFFEINE FREE
100% NATURAL FLAVORS
fanta
zero
ORANGE


Diet
Coke


PEPSI
Kona
Coffee
Cola


LEMON-LIME SODA
CRANBERRY FLAVORED WITH
OTHER NATURAL FLAVORS
Sprite
cranberry