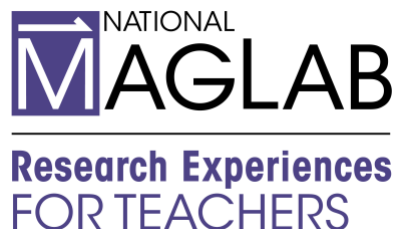


Culturally Responsive STEM Lesson Plan:



Classification and Diversity

Lesson Objectives:

- Students will explain how characteristics are used to classify organisms.
- Students will differentiate between Bacteria, Archaea, and Eukarya.
- Students will recognize the six kingdoms; however, focus will be limited to Protist, Fungus, Plant, and Animal.
- Students will distinguish the hierarchical relationship of classification: phylum, class, order, family, genus, or species.
- Students will recognize and explain the system of binomial nomenclature.

Next Generation Science Standard:

SC.6.L.15.1 – Analyze and describe how and why organisms are classified according to shared characteristics with emphasis on the Linnaean system combined with the concept of Domains.

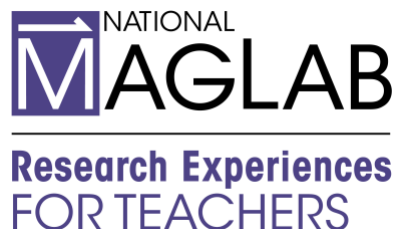
STEM Rationale for Lesson:

Students will analyze and describe how and why organisms are classified using dichotomous keys, gaming, plant investigations, and various other hands-on activities. This lesson is intended to be an introductory lesson for our 6th grade students, as well as a review for 8th grade science students for benchmark SC.6.L.15.1. Historically, our district tests show that only 20% of our students show proficiency for this benchmark standard. Thus, I wanted to create an engaging and culturally responsive lesson to help enhance our student's understanding on classification.

Culturally responsive connection:

Throughout this lesson students are encouraged to research and share aspects of their culture as it relates to classification. Specifically, they are researching plants that are native to their country of origin and studying their classification. Students will also engage in a dichotomous key activity using candy. They will be given candy that they are familiar with and then given candy from other countries of origin and they will have to decide how to “classify” that candy based on its characteristics. Students will be encouraged to bring in and share candy from their country of origin. Students will also reflect on their own classification (how do they identify in terms of race and ethnicity.) Based on what they have learned about classification, why is this system of classification important for people versus other organisms? How is it flawed in terms of human classification? All students will be given equal access to the content through a

Culturally Responsive STEM Lesson Plan:



variety of choice and activities such as collaboration, Kagan strategies, gaming, writing/reflection, and hands-on activities.

Materials Needed:

Provided by Teacher:

1. Candy items for the dichotomous key (i.e., Starburst, Starlight Mint, Jolley Rancher, Dum Dum, Jaw Breaker, Butterscotch, Gummy Bear, Tootsie Roll, Saltwater Taffy, Hershey Kiss, Fireball Candy.)
2. Foreign candy items such as Jin Jin Jelly Strips
3. Games: Jenga and Plinko Board
4. Organism Classification Playing Cards

Provided by Student:

1. Actual plant or picture of a plant from their place of origin.
 2. Optional: A type of candy from their place of origin.
-

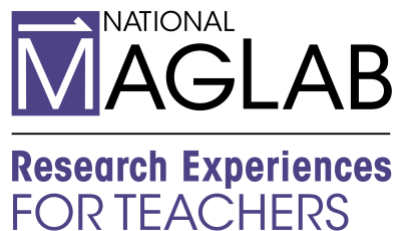
Activate Prior Knowledge:

Writing/brainstorming activity: Ask students to think about their favorite store (grocery, convenience, clothing, gaming, or even the library.) Have students write a paragraph or sketch a picture (student choice) outlining how the merchandise is organized in that store. (This will help students start to think about how real-world items are organized for order and simplicity and identification.) ASK: Why do you think it is important for items to be organized in the store and what is the rationale? What would happen if all the merchandise were tossed in a large pile? How does this organization help them find what they are looking for? How does this system of organization relate to the classification system scientists use for identifying living organisms? Have students work together to see if they can remember the major categories of classification: domain, kingdom, phylum, class, order, family, genus, species. What funny ways did they use to remember this order? (Example: Dumb King Philip Can Only Fart Green Slime)

Lesson Introduction:

1. Candy Classification Activity: Each student will be given 11 pieces of candy (Starburst, Starlight Mint, Jolley Rancher, Dum Dum, Jaw Breaker, Butterscotch, Gummy Bear, Tootsie Roll, Saltwater Taffy, Hershey Kiss, Fireball Candy.) Ask students if they are familiar with all the candies displayed? (Some candy may be

Culturally Responsive STEM Lesson Plan:

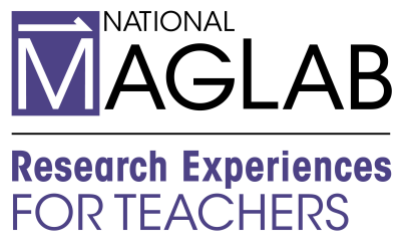


unrecognizable or new for some students). If students are unfamiliar with the candy, explain that they may only look at touch the candy, but not taste it at this time. (If teachers have budgetary constraints, pictures of candy can be used.)

2. Put your two cents in - Working in groups of four, each student needs to share their ideas for “grouping” or “classify” the candies based on their shared characteristics. The group will have to work together to come to a consensus as to how to “classify” the candies. Once they have come to a consensus, have students use chart paper to “group” their candies and explain why they chose this classification system. Have each group share how they decided to “classify” their candies.
3. Working in group of four, have students complete the Candy Dichotomous Key Activity. (An example is provided in Appendix A or can be accessed at: <https://reinsteinwoods.org/wp-content/uploads/2014/07/candy-classification.pdf>) to find the pathway and scientific name (binomial nomenclature) for each candy. You will need to review dichotomous key prior to this part of the activity. Have students watch <https://www.youtube.com/watch?v=M51AKJqx-7s> . Students should be able to trace the route to find the “scientific name” of their candy. Round Robin Activity: How do scientists use a similar system to identify plant and animal species? Can you give specific examples?
4. Now throw in a foreign candy (one most students have never seen before) and ask students to classify the candy according to the dichotomous key. Does it fit into a known category, or should we make a new category? (Example: https://www.amazon.com/Jin-Filled-Straws-Assorted-Flavors/dp/B002Z08M6C/ref=sr_1_30?dchild=1&keywords=japanese+candy&qid=1628008297&sr=8-30)
5. Think – Pair – Share Activity: What happens when scientists discover a new living organism that has never seen before? How do you think they go about classifying it?
6. Explain to students that the lesson objective is to describe how organisms are classified according to their shared characteristics, just like we organized the candy. What do scientists do if they discover a new organism? How do they determine how to categorize that organism?

Lesson Activity:

Culturally Responsive STEM Lesson Plan:



1. Ask students to bring in a plant that represents their culture. (Some discussion will have to be given as to what culture means and what types of plants can and cannot be included in this project.) This could be a picture, drawing, actual sample, pencil rubbing, or part of the plant (flower, leaf, stem, root.) Students must include at least three defining characteristics of this plant that scientists use to help classify the plant. Students will also need to include the origin of the plant/natural location and identify its domain, kingdom, phylum, class, order, family, genus, and species (taxonomic ranks.) Students will also need to identify the scientific name of the plant.
2. Relevance to students – Working in groups of four, students will share their plant research. They will discuss why this plant is relevant to their culture, where their plant is from (or found naturally) and share their taxonomic ranks and scientific name. Based on their taxonomic rank, students will try to determine how closely their plants are related. We will play a game in which all students stand up with their plant characteristics and taxonomic rank. The teacher will share the plant that they have chosen with the class and read through its taxonomic rank. Students will sit down when their plant does not fall into the same taxonomic rank. We will see how closely the plants are related and discuss what characteristics make them different.
3. Student Choice - Students will be given a choice to complete two additional activities if time allows. The purpose of these activities is to provide additional exposure to the classification standard. The students should become more familiar with the characteristics of domains and kingdoms used to classify living organisms, as well as the reasons behind how and why we use the Linnaean classification system. Two examples are provided below:
Option A: CPALMS student tutorial on Classification of Living Organisms (<https://www.cpalms.org/PreviewResourceStudentTutorial/Preview/107978?IsDashboard=true>)
Option B: Read the article “Classification of Living Things” at <https://www.ck12.org/book/ck-12-life-science-for-middle-school/section/2.3/>
Option C: Complete this interactive virtual lesson on classification using Nearpod. Student can do this individually or you can complete it as a whole-group activity.. <https://nearpod.com/t/science/8th/classification-of-organisms-L36253378>
Option D: Crash course Biology Video on Taxonomy: https://www.youtube.com/watch?v=F38BmgPcZ_I
4. Gaming/Competition - Each activity reviews the same information on classification of living organisms in a different format. Following the review, working in groups of four, students will play Classification Jenga. Each Jenga block has a point value. Students will select a Jenga block and then have to answer a question related to the topic. If they get it correct, they earn the points. If not, they lose that number of

Culturally Responsive STEM Lesson Plan:



points. The group who knocks over the tower loses all their points. A winning team is selected based on the most points.

5. Students will watch a PBS video clip on Ynes Mexia, one of the most successful botanists and female plant collectors of her time (<https://www.pbs.org/wnet/americanmasters/ynes-mexia-accomplished-latina-botanist-k6bggm/13948/>)
6. Think Pair Share - Students will be asked to use the TPS format to discuss important questions about the video clip. For example, what kinds of challenges did Ynes Mexia have to face in her lifetime. How did her work impact the field of Botany and STEM? How did her role as a female both help and hinder her study in Botany? Did her heritage and culture impact her studies? Why were so many doors closed to females in the field of science until recently?
7. Written Reflection/Journaling – Ask students to think about how people are “classified.” We know that we are all Homo sapiens; however, ask students to think about how we are asked to classify ourselves by gender, ethnicity, and race. (Students may need clarification on ethnicity and race.) Ask students how they feel about being asked to “check a box” when filling out information. Do they feel that these boxes adequately reflect who they are? Is it ok to “classify” people this way? What is the benefit and what are the consequences to classifying people according to gender, ethnicity, and race? Students will be asked to write or journal to reflect upon these questions.
8. Gaming/Competition - Students will then work individually (playing against other students at their table) to create a graphic organizer that outlines the characteristics of the three domains and six kingdoms. We will use a game called “Classification Plinko” (a basic spinner can also be used) to complete this graphic organizer. The Plinko game board has a series of numbers from 1-5 at the bottom (see picture.) This number will determine how many cards a student can draw. Each group will receive a stack of playing cards that has a picture of an organism and specific characteristics that help define the domain and kingdom to which it belongs (see below for examples.) They will use these cards to complete graphic organizer based on the characteristics of their organisms (Link to graphic organizer answer key: [Plinko Classification Answer Key.docx](#).)
9. Collaboration – Once students have completed their graphic organizer, they will work in groups of four to arrange the cards according to domain and then kingdom.



Culturally Responsive STEM Lesson Plan:



(Card Source borrowed from Spunky Science:

<https://www.teacherspayteachers.com/Product/Taxonomy-Card-Sort-and-Organism-Research-Cards-4717782>)

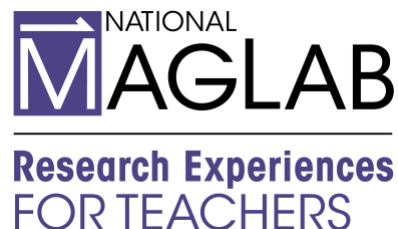
Lesson Assessment:

1. Gaming/Competition - Students will be evaluated on a series of questions on classification using a virtual escape room format, which can be found in Appendix B. Students will be asked to complete the virtual escape room individually to determine the depth of their knowledge; however, they may ask for help from their table partners if they get stuck or cannot “unlock” one of the levels in the escape room. Student can be given a paper copy of the escape room if needed.
2. Students will be evaluated on their graphic organizer.
3. Students will be evaluated on their plant projects using a rubric format.

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Culturally Responsive STEM Lesson Plan:



Appendix A: DICHOTOMOUS KEY ACTIVITY

A dichotomous key is a tool that allows the user to determine the identity of unknown items in the world. This type of key consists of a series of choices that leads the user to the correct name of an unknown item. “Dichotomous” means “divided into two parts.” Therefore, dichotomous keys always give two choices in each step.

Problem:

What are the identities and scientific names of the candies in your “bag of treats?”

Procedure:

1. Look at the candies in your plastic baggie. Do not eat them until you are told to do so by your teacher.
2. Using your group “Candy Key”, write the letters of the candies you have in your baggie in the data table on page 6.
3. Write down the common name for each candy in your data table.
4. Using the dichotomous key on page 6, follow each step to determine the Latin names and identities of your candies. Make sure you read each pair of choices beginning at 1A/1B and then the “Go To” section which will tell you what numbered step to go to next that applies to your candy. When you get to the step that gives the genus and species of your candy (scientific/Latin name) stop. Be sure to write down in order the numbered steps that you followed that led you to your answer. Record these steps in order in the “Pathway” section of your data chart. For example:

DATA CHART				
	CANDY LETTER	PATHWAY	LATIN NAME	COMMON NAME
1	L	1A, 2B,3A,	Lifus savus	Lifesaver

5. Have your teacher check your pathway. Redo if necessary.

CANDY KEY

FAMILY: CANDIUS

GO TO

1A. CANDY IS CHEWY/NOT HARD..... 2

1B. CANDY IS HARD..... 7

2A. CANDY IS WRAPPED..... 3

2B. CANDY IS NOT WRAPPED..... Ursa gummus

3A. CANDY IS ROUNDED..... 4

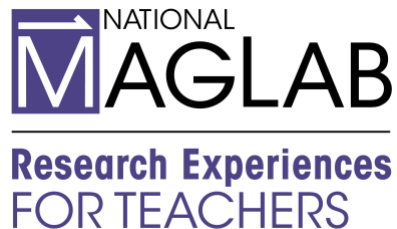
3B. CANDY IS NOT ROUNDED..... 5

4A. WRAPPER IS ALL WHITE..... Saltus taffinia

4B. WRAPPER IS NOT WHITE..... 5

5A. WRAPPER IS BROWN AND WHITE..... Tutus rollus

Culturally Responsive STEM Lesson Plan:



5B. WRAPPER IS NOT BROWN AND WHITE.....	6
6A. WRAPPER IS SILVER.....	Chocolatus cyssan
6B. WRAPPER VARIES IN COLOR.....	Steorra explodus
7A. CANDY IS SPHERICAL(ball shaped).....	8
7B. CANDY IS NOT SPHERICAL.....	9
8A. CANDY IS WRAPPED.....	11
8B. CANDY IS UNWRAPPED.....	Mandibulus crackus
9A. WRAPPER IS TRANSPARENT(see through).....	10
9B. WRAPPER TELLS THE FLAVOR.....	Joyous rancheria
10A. WRAPPER IS CLEAR.....	Mintus stripus
10B. WRAPPER IS YELLOW.....	Ranunculus scotchus
11A. CANDY IS ON A STICK.....	Moronus moronus
11B. CANDY IS NOT ON A STICK.....	Sperus combustus

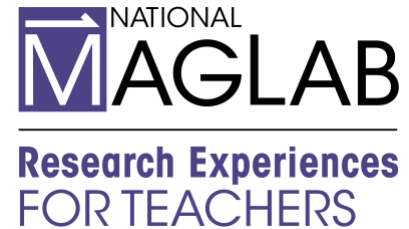
Culturally Responsive STEM Lesson Plan:



NAME: _____

DATA CHART				
	CANDY LETTER/ PICTURE	PATHWAY	LATIN NAME	COMMON NAME
1				
2				
3				
4				
5				

Culturally Responsive STEM Lesson Plan:



Candy Supplies:

(label with letters or do not label and have students draw a picture instead)

Starburst candy

Hershey's Kiss candy

Dum Dum sucker

Jolly Rancher Candy

Butterscotch Disc candy

Striped Mint candy

Atomic Fire Ball Candy

Tootsie Roll candy

Gummy Bear candy (unwrapped)

Jaw Breaker (unwrapped)

Salt Water Taffy candy

Answer Key:

Starburst candy = *Steorra explodus* (1A, 2A, 3B, 5B, 6B)

Hershey's Kiss candy = *Chocolatus cyssan* (1B, 2A, 3B, 5A, 6A)

Dum Dum sucker = *Moronus moronus* (1B, 7A, 8A, 11B)

Jolly Rancher Candy = *Joyous Rancheria* (1B, 7B, 8A, 9B)

Butterscotch Disc candy = *Ranunculus scotchus* (1B, 7B, 8A, 9A, 10B)

Striped Mint candy = *Mintus stripus* (1B, 7B, 8A, 9A, 10A)

Atomic Fire Ball Candy = *Sperus combustus* (1B, 7A, 8A, 11B)

Tootsie Roll candy = *Tutus rollus* (1A, 2A, 3B, 5A)

Gummy Bear candy = *Ursa gummus* (1A, 2B)

Jaw Breaker = *Mandibulus crackus* (1B, 7A, 8B)

Salt Water Taffy candy = *Saltus taffinia* (1A, 2A, 3A, 4A)

Culturally Responsive STEM Lesson Plan:



Appendix B – Escape Room Questions and Answer Key

Mission Objective

You and your fellow astronauts have been exploring our Solar System for months. During this time, you have discovered and classified thousands of new species. Unfortunately, a rather large, intimidating, and very intelligent species you discovered on one of the moons of Jupiter has also discovered YOU! They have taken you prisoner and you must use your knowledge of classification to escape. You must successfully progress through five levels in order to be freed and return to Earth. There are four questions on each level and you must use your answers and the decoder to escape. Good luck!

Level 1

Question 1: Which of the following is NOT one of the seven kingdoms of life?

- A. Mammalia
- B. Protista
- C. Eubacteria
- D. Fungi

Question 2: To which kingdom does a Spider Tortoise belong?

- A. Plantae
- B. Protista
- C. Animalia
- D. Fungi

Question 3: Which scientist created our current classification system?

- A. Galileo
- B. Linneaus
- C. Darwin
- D. Einstein

Question 4: Naming, describing, and classifying organisms into different categories based on their characteristics is a definition of:

- A. Darwinism
- B. Natural Selection
- C. Biological Organization
- D. Taxonomy

Level 1 Answer Key

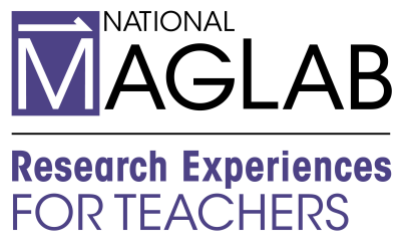
Question 1: A = 9

Question 2: C = 5

Question 3: B = 2

Question 4: D = 7

Culturally Responsive STEM Lesson Plan:



Level 2

Question 1: Newly discovered species are given _____ designations

- A. Genus and Species
- B. Binomial nomenclature
- C. Latin Name
- D. All of the above

Question 2: Which of the following pairs of animals are not in the same SPECIES?

- A. Golden Retriever and Husky
- B. Lions and Tigers
- C. Horse and Pony
- D. Grizzly Bear and Polar Bear

Question 3: *Escherichia coli* (or *E. coli*) belongs to which of the following kingdoms?

- A. Eubacteria
- B. Protista
- C. Fungi
- D. Archaeobacteria

Question 4: What KINGDOM has the most organisms on Earth?

- A. Plantae
- B. Protista
- C. Animalia
- D. Eubacteria

Level 2 Answer Key

Question 1: D 2

Question 2: B 3

Question 3: A 4

Question 4: C 1

Level 3

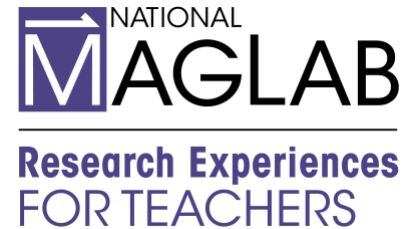
Question 1: The scientific name for a domestic dog is *Canis familiaris*. What two levels of classification are used in a scientific name?

- A. Family and Species
- B. Genus and Species
- C. Phylum and Order
- D. Class and Family

Question 2: To which kingdom does a mushroom belong?

- A. Plantae
- B. Protista
- C. Fungi

Culturally Responsive STEM Lesson Plan:



D. Eubacteria

Question 3: Animals with backbones are known as chordates. What level of classification is Chordata?

- A. Phylum
- B. Genus
- C. Order
- D. Class

Question 4: Which level of classification contains the largest number of organisms?

- A. Family
- B. Order
- C. Class
- D. Phylum

Level 3 Answer Key

Question 1: B 6

Question 2: C 8

Question 3: A 6

Question 4: D 7

Level 4

Question 1: The DOMAIN containing Kingdom Fungi, Protista, Animalia, and Plantae?

- A. Bacteria
- B. Archaea
- C. Eukarya
- D. None of the answers are correct

Question 2: What level of classification do these two types of black beetles, *Eleodes carbonarius* and *Eleodes armata*, belong to? .

- A. Genus
- B. Family
- C. Order
- D. All of the above

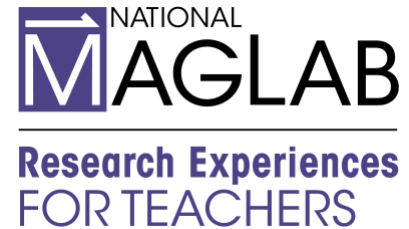
Question 3: *Paramecium* belong to which kingdom?

- A. Plantae
- B. Protista
- C. Fungi
- D. Eubacteria

Question 4: Humans are mammals. What level of classification is Mammalia?

- A. Class

Culturally Responsive STEM Lesson Plan:



- B. Genus
- C. Phylum
- D. Order

Level 4 Answer Key

Question 1: C 8

Question 2: D 4

Question 3: B 1

Question 4: A 6

Level 5

Question 1: What kingdom contains only autotrophs?

- A. Protista
- B. Plantae
- C. Fungi
- D. Eubacteria

Question 2: Which of the following is the highest level of classification?

- A. Class
- B. Genus
- C. Family
- D. Order

Question 3: Moss belongs in what kingdom?

- A. Fungi
- B. Protista
- C. Eubacteria
- D. Plantae

Question 4: List the 8 levels of classification, most broad to most specific.

- A. Domain, Genus, Family, Order, Class, Phylum, Kingdom, Species
- B. Domain, Species, Kingdom, Genus, Phylum, Family, Class, Order
- C. Domain, Kingdom, Phylum, Class, Order, Family, Genus, Species
- D. Order, Kingdom, Species, Domain, Phylum, Family, Class, Genus

Level 5 Answer Key

Question 1: B 8

Question 2: A 3

Question 3: D 5

Question 4: C 2

Final Code: TAXONOMY