BEAKERBOX
CLEMSON® SCIENCE OUTREACH

ADAPTATION INTRODUCTION

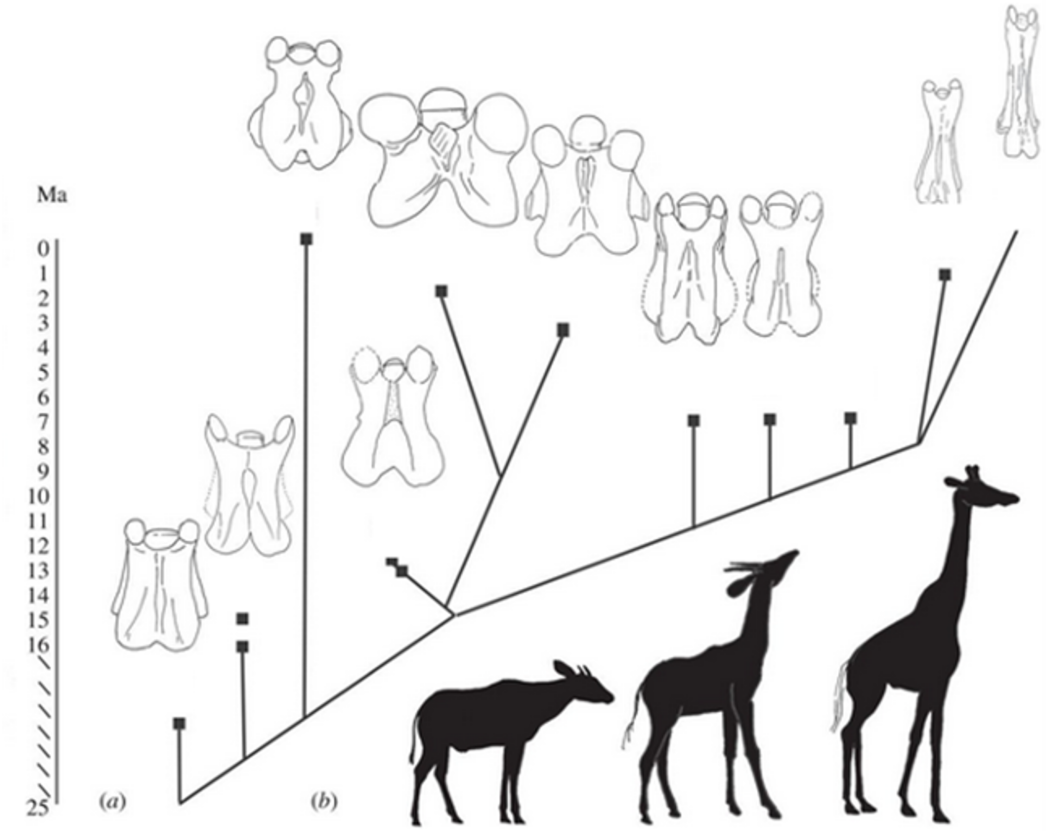
1. Randomly choose one adaptation card from the set of cards.

2. Think about the question on the card. In 3-4 sentences, write down how or why your animal or plant has this feature. Include in your explanation below why you think this structure might help this animal or plant function in its environment.

3. Share your thoughts with one or two classmates.
    a. Do you agree or disagree with your classmates' thinking?
    b. What questions do you have about your or your partner's animal's adaptations or adaptations in general?
    c. What information would help you better evaluate their thinking?

Figure 1: Fossil Record of Giraffe

Ma = millions of years ago



(c)

Figure from Danowitz, Vasilyev, Kortlandt, and Solounias. 2015. Fossil evidence and stages of elongation of the *Giraffa camelopardalis* neck. *Royal Society Open Science* 2(10): 150393. doi:10.1098/rsos.150393

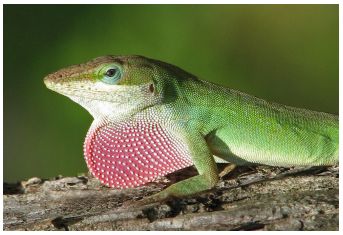
4. The above data shows a fossil record of a giraffe. The image shows how their vertebrae (back and neck bones) have changed (adapted) over time. The oldest giraffe ancestor species called *Okapia johnstoni* is shown at the left of part c, and the most recent giraffe species called *Giraffa camelopardalis* is shown on the right of part c.
    a. When you analyze the data in these images, what parts of the giraffes' neck stayed the same and what parts changed? Write your observations in the box provided.
    b. How does the size of vertebrae in the neck relate to the overall proportion of the body? Write your observations in the box provided.

5. Explore one or more of the resources provided by your teacher to answer this question.
    a. How does the structure of the modern giraffe neck shape provide advantages or disadvantages to how the animal lives and functions?
    b. How do you think the changes over time in the giraffes' necks have affected a giraffe's ability to survive?

    Provide explanations 5a and 5b below. Be sure to include evidence to back up the explanations!

BIRDS AND THEIR BEAKS PART 1

Student Activity Instructions:
Phenomenon:



Green anole lizards are common in South Carolina. Recently, scientists have observed that the green anole lizards in Florida have larger toepads and more scales than previous generations of lizards.

Image: “Strawberry” redux- wild green anole, Vicki DeLoach, https://www.flickr.com/photos/vickisnature/6481619097

Another scientist was interested in guppies. He moved a population of guppies into a predator-free stream to see what happened. The guppies grew larger, matured later, and reproduced slower. However, the guppies in the stream with predators matured earlier and reproduced faster.

Image: Trinidadian guppy (Poecilia reticulata) male and female.png
https://commons.wikimedia.org/wiki/File:Trinidadian_guppy_%28Poecilia_reticulata%29_male_and_female.png#/media/File:Trinidadian_guppy_(Poecilia_reticulata)_male_and_female.png

Bedbugs are pesky animals. When DDT (a powerful pesticide) was introduced after WWI, bedbugs seemed to go away for a while. Now, they are back and more resistant to (unaffected by) pesticides.

Image: bedbugs, Charles LeBlanc, https://www.flickr.com/photos/httpoldmaisonblogspotcom/4244054615

From these examples, it is evident that sometimes populations change. The driving question for this lesson, which you will work to answer throughout the activity is, how do populations change and why?

In 1977 and 1978, Rosemary and Peter Grant noticed a change in the population of medium ground finches (*Geospiza fortis*) on the Galapagos Islands. They had been collecting data and studying these famous birds for a number of years when they noticed a dramatic shift in the size of bird beaks within the population of medium ground finches.

Additional questions to think about and add to the driving question board:
What caused this sudden change in the population of medium ground finches? How can we explain this change in the medium ground finch population and use what we learn to understand how other populations of animals change?

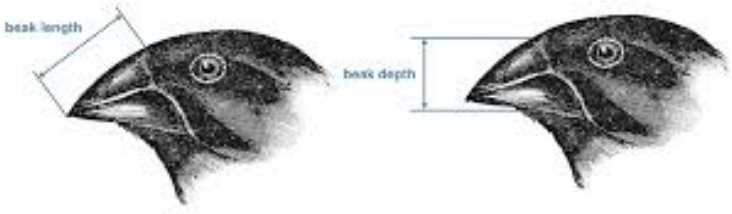


Figure 1: Beak Measurements Diagram
Image: retrieved from: http://bebi103.caltech.edu.s3-website-us-east-1.amazonaws.com/2019a/content/homework/hw3/hw3.2.html

In this activity, you will simulate a population of finches to explore the mechanisms that drive population change.

1. Make some initial predictions about why you think the birds' beaks may have changed.

Procedure Instructions:

1. Look at the materials provided by your teacher. You should have the following at your station to carry out your investigation:
    a. Three types of "food" (15 beads, 5 pom poms, 15 grains of rice)
    b. Two types of "beak" (large and small binder clips)
    c. One "stomach" (paper bag, plastic cup, or sandwich bag)
2. You will use your "beak" to collect food, one item at a time, for 20 seconds. On your teacher's cue, begin collecting food using your beak, putting what you pick up in your "stomach."
3. You can only use the "beak," black part of the binder clip to pick up the "food"
4. Once time is up, put down your "beak." Count and record how many beads and pom poms you collected during your investigation.
5. Repeat this process (steps 3 and 4) using the second type of beak.

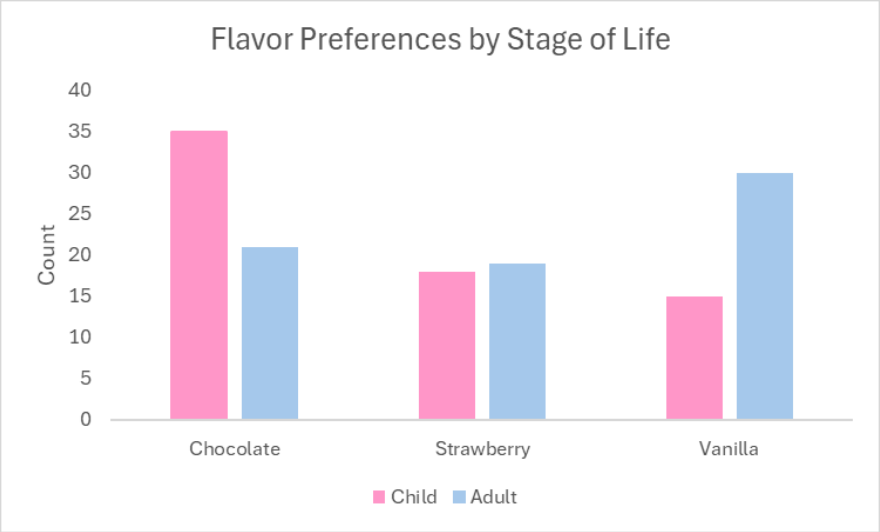
Data Table: Record your data here

Small Binder Clip			Large Binder Clip		
Pom Poms	Beads	Rice	Pom Poms	Beads	Rice

2. Determining your independent and dependent variables.

An **Independent variable** is the variable being changed or manipulated in an experiment. A **Dependent variable** is the variable that could change in response to changes in the independent variable.
Example: The number of people who like a flavor of ice cream (dependent variable) depends on the type of person asked (independent variable)

You may also have more than one independent variable. Here is a sample bar graph with multiple independent variables.



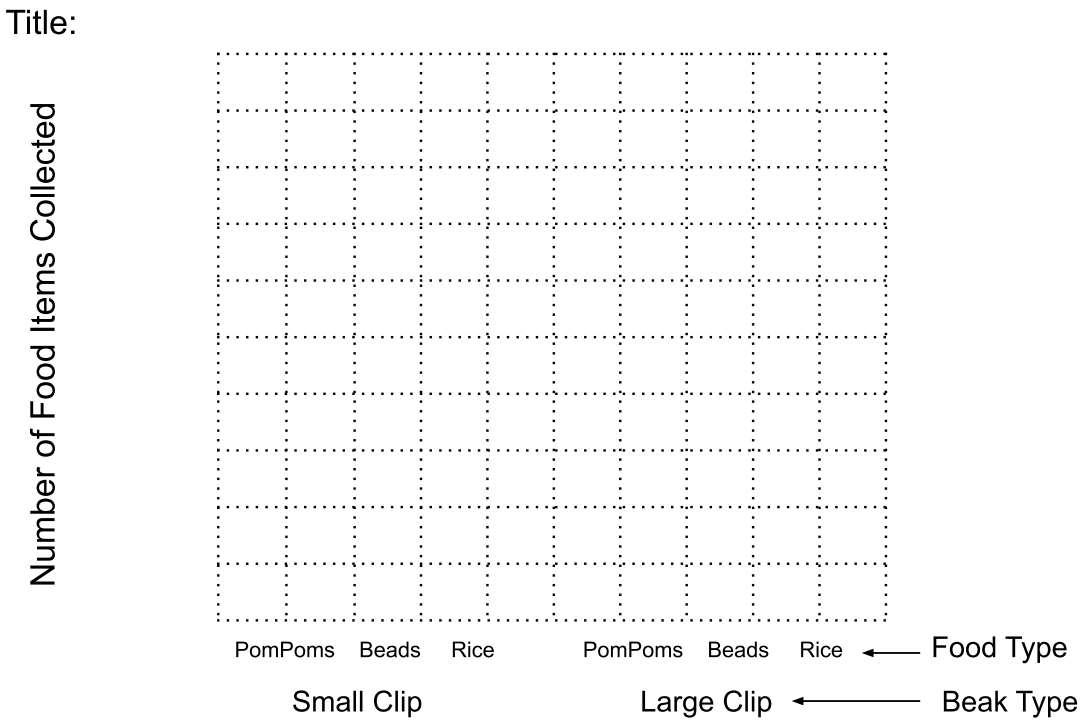
When graphing, your independent variable goes on the x-axis and the dependent variable goes on the y-axis.

In this investigation, your 3 variables are the type of beak, type of food, and the amount of food gathered. Using this information, determine which 2 variables are independent and which 1 variable is dependent.

Independent Variable(s):	
Dependent Variable:	

3. Create a bar graph representing the number of each type of food you collected for each type of "beak."
    a. Your axes are already labeled, and you can begin by adding numerical values for your count of food types on the y-axis.
    b. Now you're ready to begin graphing! Create bars that go up to the amount of food you collected.

To graph data with two independent variables, pretend you are making two separate graphs. Start with your small clip data. Label the x-axis with the type of food and color in the bars. Repeat this process but now with data for the large clip. <u>Write a title for your graph at the top.</u>



4. Which type of food was the small clip best able to collect according to your data? Which type of food was the large clip best able to collect according to your data?

5. How did the size of your “beak” impact the function? Did it make it easier or harder to pick up certain types of food? Discuss your results with your classmates.

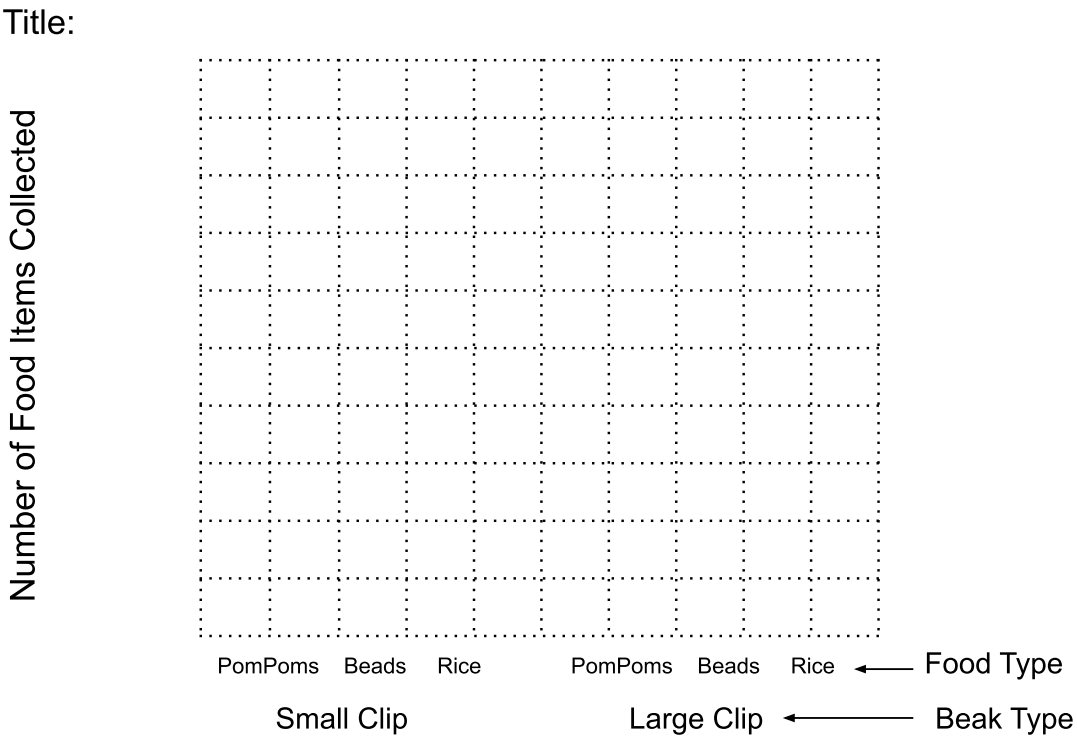
6. Now that you have some practice graphing, you will analyze the data collected by the whole class. Collect the data from each group and record the data in the table below. Calculate the average number of pom poms, beads, and rice collected by each individual for each beak type.

Class Data Table

Group	Small Binder Clips			Large Binder Clips		
	PomPoms	Beads	Rice	PomPoms	Beads	Rice
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
Average						

The independent and dependent variables will be the same as your individual graphs. Following the same procedure, create a graph for your class data graphing the averages.

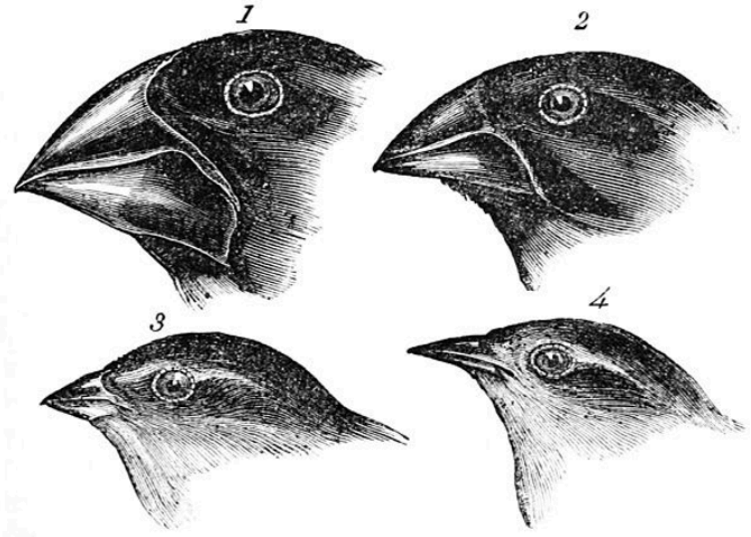
Graph of Class Data



7. Most scientific investigations have many repetitions to confirm the accuracy of the results. Every person conducted one repetition, and when your data is put together you have done multiple repetitions.
    a. Do you notice a pattern in the data collected across the multiple repetitions? (Hint: *What happens to the dependent variable as the independent variable changes?*)

b. Are the patterns the same from your personal data set and the class data set which contains repetitions, or did they change?

8. The following birds are a set of birds that live on the Galapagos Islands in South America and are called Darwin's finches after the scientist who studied them, Charles Darwin. On the islands, these birds can eat either large, hard nuts or small, soft seeds. **Which of the birds below do you think are most likely to feed on the nuts and which do you think are most likely to feed on the seeds?** Explain why using the patterns you observed in your data.



9. In 2003, there was a drought in the Galapagos Islands. This low rainfall caused plants not to produce larger seeds, and the effect was that only small seeds were available to eat. **When this environment changed, what do you think the effects of this would be for each of the birds in Question 8 and why?** When answering 'Why' (e.g. your explanation), use your data from the experiment and be sure to address how the structure of the beak relates to the animal's ability to eat both the larger and smaller seeds.

BIRDS AND THEIR BEAKS – PART 2

Student Activity Instructions:

In this activity, you will simulate a population of finches to explore the mechanisms that drive population change. In Part 1, you kept track of the amount of food that was eaten and graphed how much food each type of "beak" was able to collect. In Part 2, you will be keeping track of how well the "birds" survive from one generation to the next.

1. Make some initial predictions about why you think some birds of the same species may survive and reproduce better than other birds with different observable traits (phenotypes).

Procedure Instructions:

1. Work in groups of 2 with your own set of materials.
2. Look at the materials provided by your teacher. You should have the following at your station to carry out your investigation:
   a. Three types of "food" (beads, pom poms, rice)
   b. Two types of "beak" (large and small binder clips)
   c. One "stomach" (paper bag, plastic cup, or sandwich bag)
3. Put the food into a pile in the center of your table, where both partners can reach it equally.
4. Each person will have one beak
5. You will use your "beak" to collect food, one item at a time, for 20 seconds. On your teacher's cue, begin collecting food using your beak, putting what you pick up in your "stomach."
6. You can only use the "beak," black part of the binder clip to pick up the "food"
7. Once time is up, put down your "beak." Count how many of each type of food you collected and record in the data table. Circle whether or not you survived.
   a. If you were able to collect 5 or more pieces of food, you survive and reproduce. Circle Yes
   b. If you did not collect 5 or more pieces of food, you do not survive and reproduce. Circle No
8. For each round, reset the food types in the center of the table according to what is available each round
   a. Round 1: all food types available
   b. Round 2: only Beads and Rice available
   c. Round 3: only Rice available

d. Round 4: only Beads available

9. Repeat this process (steps 3 through 7) for each round AND each type of beak to complete the data collection.

Data Table: Record your data here

Individual data: Type of Food Eaten and Survival

Round	Type of Beak	Pom Poms	Beads	Rice	Total	Survived?
1	Small					Yes No
	Large					Yes No
2 The environment changed and no pom poms are available	Small	0				Yes No
	Large	0				Yes No
3 The environment changed and no pom poms or beads are available	Small	0	0			Yes No
	Large	0	0			Yes No
4 The environment changed and no pom poms or rice are available	Small	0		0		Yes No
	Large	0		0		Yes No

Class Data Table

Survival Data: Record the number of birds of each beak type that survived each round. Calculate the percent of birds of each size that survived *each round*.

Calculating percentages:
Take the number of survivors with mini beaks and divide by the total number of survivors. Multiply this number by 100.

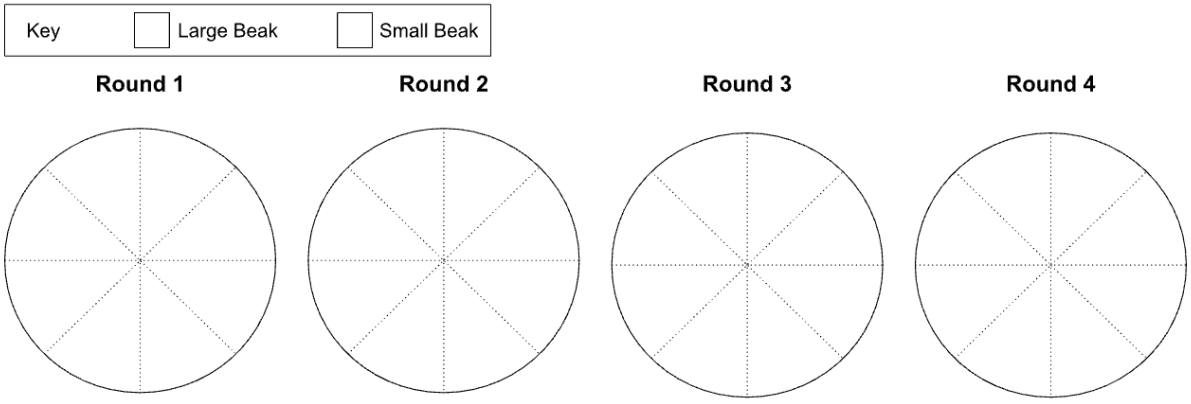
$$\frac{\text{\# Small beak survivors}}{\text{Total \# of survivors}} \bullet 100$$

$$\frac{\text{\# Large beak survivors}}{\text{Total \# of survivors}} \bullet 100$$

To check your work: see that the percentage of mini beak survivors + the percentage of big beak survivors = 100 for each round.

	Round 1			Round 2			Round 3			Round 4		
Type of Beak	Small	Large	Total	Small	Large	Total	Small	Large	Total	Small	Large	Total
Total												
Percent Survival			100%			100%			100%			100%

Graph the Survival Data
In the circle graphs below, create a graph that represents the percentage of the surviving birds represented in the Class Data Table for each round. (*Hint: Use the lines provided in the circles to help you estimate the percentages*)

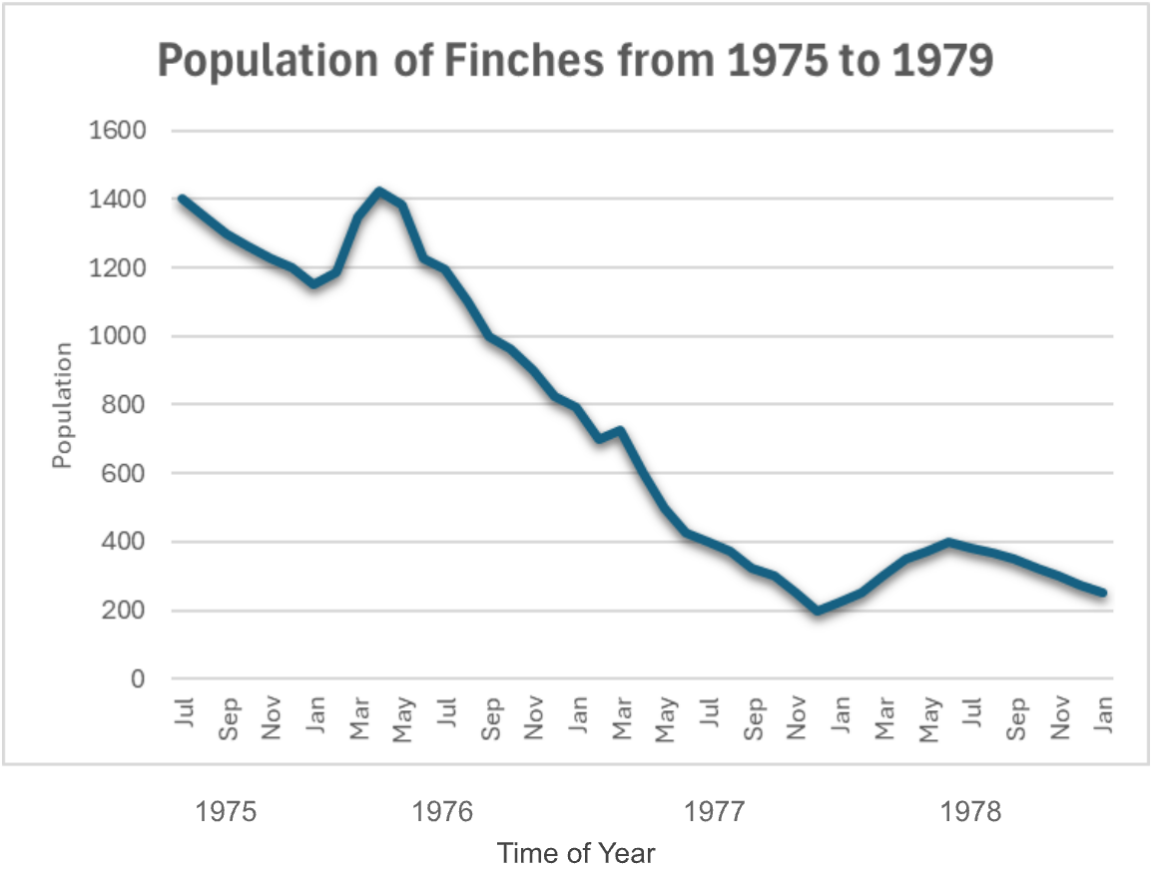


2. Describe what you notice about how the type of beak may or may not affect the survival of birds during each round.

3. How did the interaction between the "environment" (*Hint: available food*) and the bird's beak size affect their survival? Write a claim supported by evidence and reasoning from the activity regarding the proportion of birds with different sized beaks that survived.

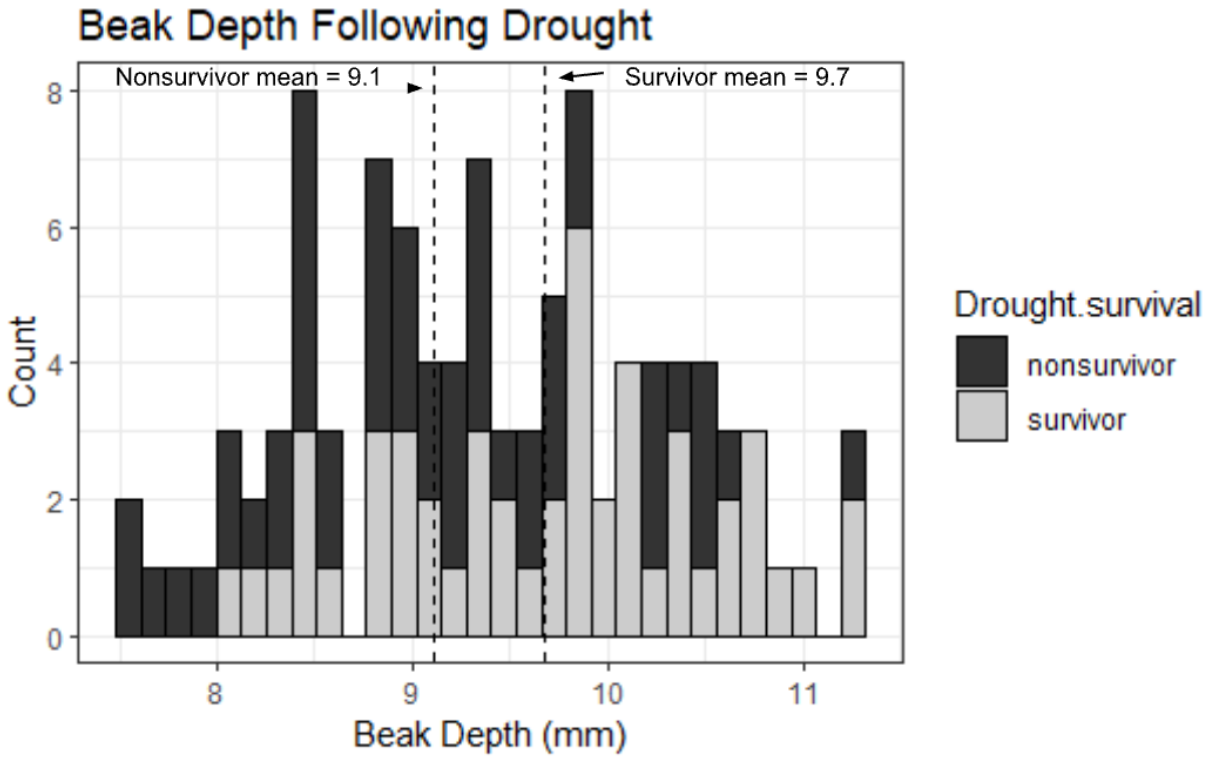
4. The graph below illustrates the finch population through the years 1975 to 1979. During this time, there was a severe drought leading to changes in the environment including the types of food available to the finches.
    a. What do you notice about the finch population from 1975-1979?
    b. What might have caused the change in the population of finches?

Graph 1

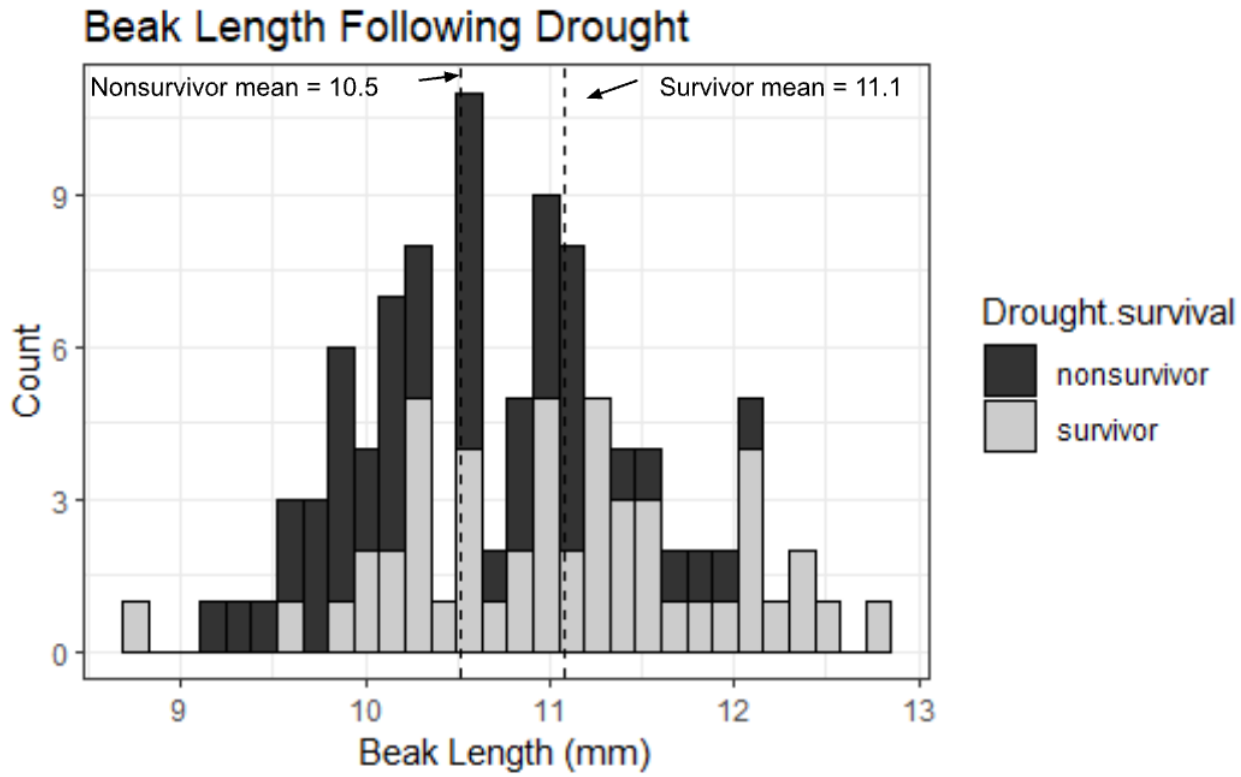


5. The following two graphs depict data collected about surviving and non-surviving finches after the severe drought in 1977. Interpret the two histograms (graphs) below and determine the pattern in beak traits (beak depth and beak length) that you notice between surviving and non-surviving finches.

Graph 2



Graph 3



6. Based on the patterns in graphs 2 and 3, describe what you think the future generation of birds will look like.

7. Construct an explanation in which you discuss how natural selection led to changes in the overall population of finches from 1975-1979. Include in your explanation how the characteristics of the surviving population of finches compared to those that did not survive citing evidence from the three graphs.

SELECTION

Phenomenon: Think of a time when you saw a squirrel. What color was it? Do you remember where you saw it? Have you ever seen a squirrel whose appearance surprised you? How well adapted are the squirrels that you saw to the environment they live in? How well do you think they might survive in their current environment? What do you think might cause the squirrels to look different? Why don't you think we see more of the black morph or blonde morph of the squirrels?

Gray and Black Squirrels | Blonde Squirrel | White Squirrel

Image: White Squirrel Research Institute (CC BY-SA 2.0 DEED) https://www.squirrelmapper.org/the-squirrels

Student activity instructions:

The frequency of organisms with a certain trait (phenotype) can be influenced by a variety of events, both naturally occurring and those influenced by human activity. Through a process called selection, traits can either increase or decrease within a population. For this activity the driving question is: How will different selective forces affect a population?

MATERIALS NEEDED

- 24 Event Cards
- 20 pink "beetles"
- 20 yellow "beetles"
- 20 green "beetles"
- 20 blue "beetles"
- Scorecards (see page 2)
- Optional: gameboard (see next page)
- Optional: calculator

NUMBER OF PARTICIPANTS

1 to 4

GOAL

For this activity, you'll each be in charge of monitoring an isolated population of beetles that are affected by different events. See Figure 1 for a sample game set-up

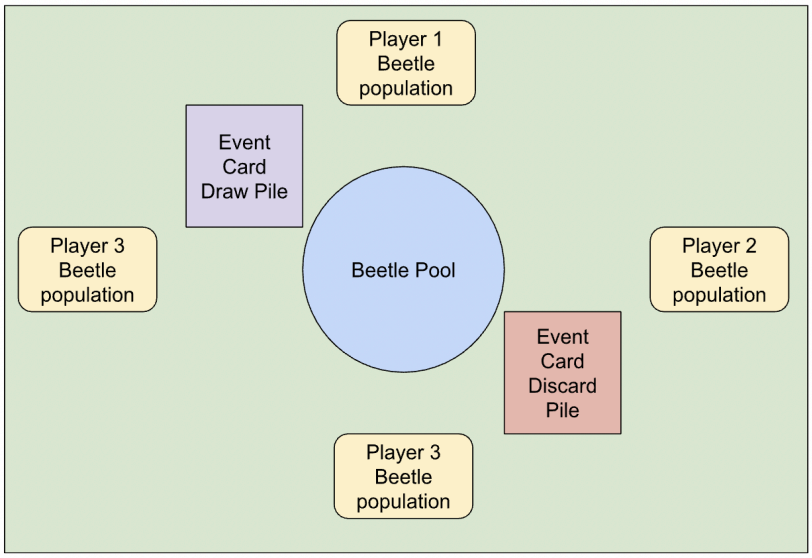
SETUP

- Shuffle the EVENT CARDS and place them face down in the middle of your group where everyone can reach them.
- Place all of the "beetles" in the center of the table where everyone can reach them (Beetle Pool).
- Each player draws 5 pink, 5 yellow, 5 green, and 5 blue counters ("beetles") from the pile and places them in front of you. This is your starting population.
- Record the number of beetles of each color following the example of the starting population line on your SCORECARD.

GAMEPLAY

- Rock-paper-scissors to decide who goes first.
- The first player draws an event card and follows the instructions on the card. Record the event card and effect on your SCORECARD. At the end of your play, record your beetle numbers in the Round 1 Row on your SCORECARD.
    - When an event card tells you to ***draw beetles at random***, you can close your eyes or look away to draw the indicated number of beetles from the beetle pool.
- After the first player plays, gameplay proceeds to the left.
- The next player draws an event card and follows the instructions on the card, recording their beetles in Round 1. Continue through all four players.
- When play returns to the first player, Round 2 begins.
- Play through 5 Rounds.
- If you run out of beetles, play with the beetles you have. For example, if you only have 1 green beetle and the instructions on the card tell you to lose 2 green beetles, just play your 1 green beetle.

Figure 1: Beetle Selection Game Set-up



POST GAME ANALYSIS

Using your data in your scorecard, calculate the percentage that you have of each color in your starting population by dividing the number of beetles of that color by the total number of beetles in the population. Record the percentages in the data table.

SCORE CARD: BEETLE POPULATION

Round	Pink		Yellow		Green		Blue		Total	
	#	%	#	%	#	%	#	%	#	%
Starting Population	5	25%	5	25%	5	25%	5	25%	20	100%
1										100%
2										100%
3										100%
4										100%
5 Ending Population										100%

TRACKING YOUR EVENTS

Round Number	Card Title	Card Description	Effect on population
Example	Resource	All beetles can eat	+ 3 random
1			
2			
3			
4			
5			

ADAPTATION: Selection

1. Data tables do not lend themselves to seeing patterns compared to other visual representations. To more fully analyze your results, use your data in the SCORECARD to create a visual representation of your data. Consider your independent variable and dependent variables and the key outcome you want to be able to visualize.

2. Explain why you chose this particular visualization (in question 1) to represent your data.

3. Compare your data about your starting population to the ending population. Using your visual from question 1, what patterns do you notice? What stayed the same and what changed in terms of the numbers or percentages of each color of beetle?

4. Do a gallery walk of other visual representations. Compare and contrast at least two visual representations of the data and consider the patterns you were able to identify (Look for patterns across data; what data are included or excluded).
    a. Which visualization do you think best represents data and why? Consider the following:
        i. What information is included or excluded in each type of graph?
        ii. What are the benefits of including or excluding certain data?

5. Talk with your group members and discuss the following:
    a. The patterns you notice in the traits (color) of beetles that survived and those that did not survive across all your data (use your visual representations and percentages).

    b. Spread the event cards out and determine if certain beetle colors are more affected by events.

    c. Using the evidence from (a) and (b) write an explanation about which of your beetle populations are more likely to survive or not.

6. Pollution, hunting, and disease disproportionately affect the pink beetles.
    a. Are these events driven by humans? Why or why not?

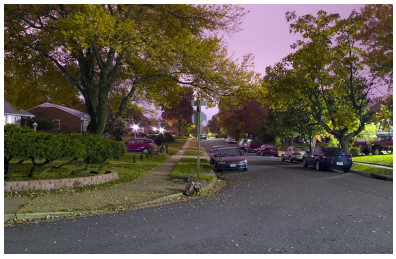
b. What is our ethical obligation, if any, to try and prevent the loss of the pink beetle phenotype?

c. Propose one method for monitoring or minimizing a human impact.

PLANTS AND HUMANS

PART I: What adaptations do plants have that help them survive in their environments?

Phenomenon: Consider the environments plants grow in such as a yard, around the school, the medians of highways, cracks in the sidewalk, forests, and so on. Examine the pictures of different environments and think about various challenges plants might face in each environment that could impact their survival.

 **Swamp**	 **Tidal Creek**	 **Grass Field**
 **Golf course**	 **Beach Dunes**	 **Scrub**
 **Virginia Creeper (Native to South Carolina)**	 **Spanish Moss growing in a tree**	 **Urban forest**

1. Thinking back to the pictures or other environments that plants grow in, what are some adaptations that plants have to help them survive in their environments?

2. How do you think humans can/do use plant adaptations to support human society?

PLAYING THE PLANT ADAPTATION GAME

Plants face a lot of different challenges from their environments. In this game, you will explore some changes or events in the environment that impact plants and that some plants have adapted to survive.

- Read through all of the plant cards to get a sense of the adaptations for each of the plants. You may notice the icons in the bottom left corner of some plant cards, the meanings of which are described in the table below.

Item	Icon	Description
Fork		Is eaten by humans
Tractor		Selectively adapted by humans
Medicine bottle/pill capsule		Used in traditional medicine (the use of natural products to treat illness, prevent disease, and maintain health)
State of South Carolina		Native to the state of South Carolina

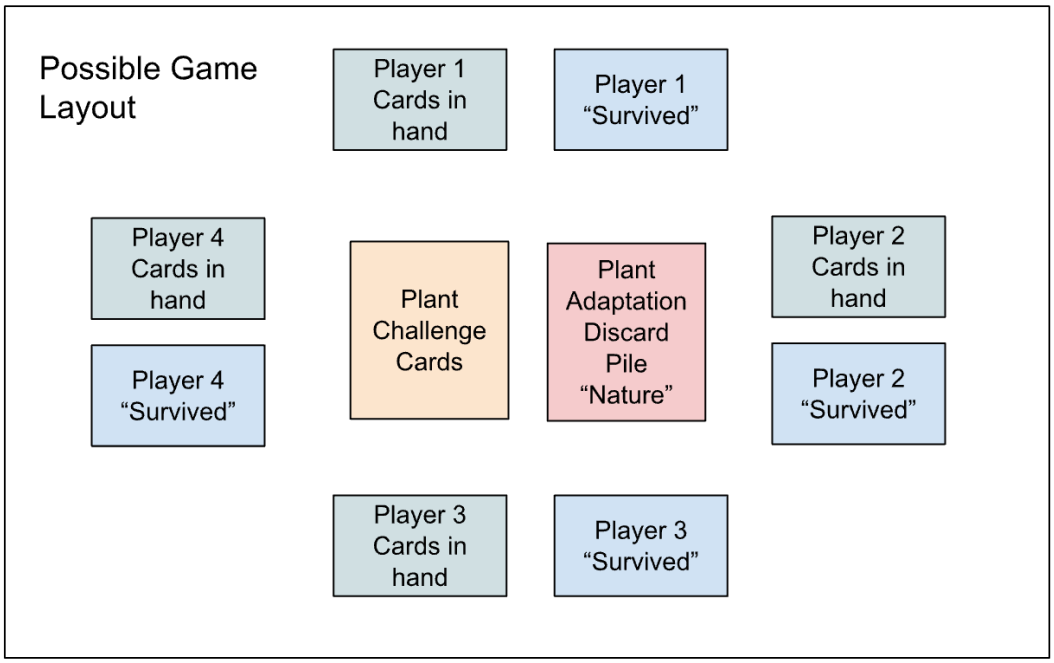
3. Now that you have looked through the cards, for what purposes do humans use and/ or adapt plants? (Challenge: come up with some additional responses compared to question 2.)

GOAL

In this activity, your aim is to keep as many plant cards as possible from the beginning of the game to the end.

SETUP

- With instructions from your teacher, decide on the version of the game you will play:
  a. Team vs. Nature (Group of students playing cooperatively)
  b. Team vs. Team (Group of students playing in teams against each other)
  c. Everyone for Themselves (Individual students playing against each other)
- Shuffle the PLANT ADAPTATION CARDS and then divide them so each team/player has the same number of cards. If there is an uneven number of cards remaining, leave the extras out of the game. ***Each player may read the cards in their hand.***
- Shuffle the PLANT CHALLENGE CARDS and then place them in the center. You'll want to put the side with a thick black border and the name of the challenge facing up.



GAMEPLAY

- For each round, the top challenge card represents the event for that round. (Alternatively, the teacher or one player could play the challenge cards at random)
- Each team plays one plant "against" the challenge.

- Once all teams/players have played a card, turn the challenge card over to see which plants survived and which plants were killed by the challenge.
- If your plant survived, you should put that next to you in your "survived" pile. ***You may NOT play this card again***, but this will help you keep track of how many of your plants survived.
- If your plant was killed, place it in the "nature" pile indicating these plants were returned to nature. These cards will not be played again.
- Repeat this until all plant adaptation cards have been played.
- After all the plant adaptation cards have been played, count the number of plant cards in the "survived" pile and record each team's/player's score in the data table.
- The team/player with the most "survived" cards wins!
- Play multiple rounds as you wish.

There are 8 different challenges that your plants may face, so you should take a minute to look through your cards and think about whether each plant in your hand would survive or die given that challenge.

Your plants may be challenged by:

1. Herbivores
2. Low Light
3. Extreme Cold
4. Fire
5. A Bulldozer
6. Drought
7. High Water
8. Pests

Team/ Player	**Round 1**	**Round 2 (Optional)**
1		
2		
3		
4		

POST GAME ANALYSIS

4. Take a look at the Pests Plant Challenge Card. Pull the Plant Adaptation Cards for all plants that can survive pests. Read the descriptions of the plants' characteristics and adaptations. What characteristics do you notice that allow different plants to survive pests?

5. Specifically look at the Plant Adaptation Cards for corn, rice, and sugarcane.
    a. What do these plants have in common about their ability to survive pests?

    b. What icons do these Plant Adaptation Cards have in common?

    c. Why are some plants modified by humans for society and others are not?

PART II: How have humans influenced the desired traits of organisms?

6. Brainstorm ways humans have influenced the desired traits of organisms.

What I know: What I wonder:

7. **Card Sort:** Examine the Ancestral Plant Comparison cards labeled A-F with an orange border displaying early forms of modern day foods from plants. What fruit or vegetable do you think are shown on each of these cards?

8. Examine the Modern Plant Comparison cards labeled G-L with a purple border displaying modern day food from plants. Determine which image from the A-F Plant Comparison cards matches with Plant Comparison cards labeled G-L. You should form 6 pairs of cards.
    a. Check your Plant Comparison Card pairs with your teacher before moving on to the next step. Teacher Signature: _____

    b. What anatomical similarities and differences do you notice?

c. Write a scientific explanation, which includes a claim, evidence, and reasoning, of how you connected the ancestral plant with the modern plant.

9. **How** do you think the ancestral plant became the modern day plant? Generate two mechanistic ideas with your classmates.
Mechanisms are processes that cause something to happen.

10. As a class, generate questions about how humans have modified plants to support the survival of humans. Reference question 5 when generating questions. You may also look back at the Plant Adaptation Cards you examined for question 5.

Part III: How has technology changed the way humans have influenced the desired traits of organisms?

Information about Scientific Communication

Science communication can be defined as a way of delivering information from the scientific community to a more general audience like non-scientists. Science communication can include delivering a speech/presentation, having a conversation, writing an article, blogging, posting on social media, or creating a piece of artwork. Great science communication can be very tricky to accomplish and is a skill that needs to be practiced.

Infographics are one way scientists can communicate information to the general public. Consider the following characteristics of science communication as you look at the infographics in the following activity. This will potentially help you answer the strengths and weaknesses column in question 11.

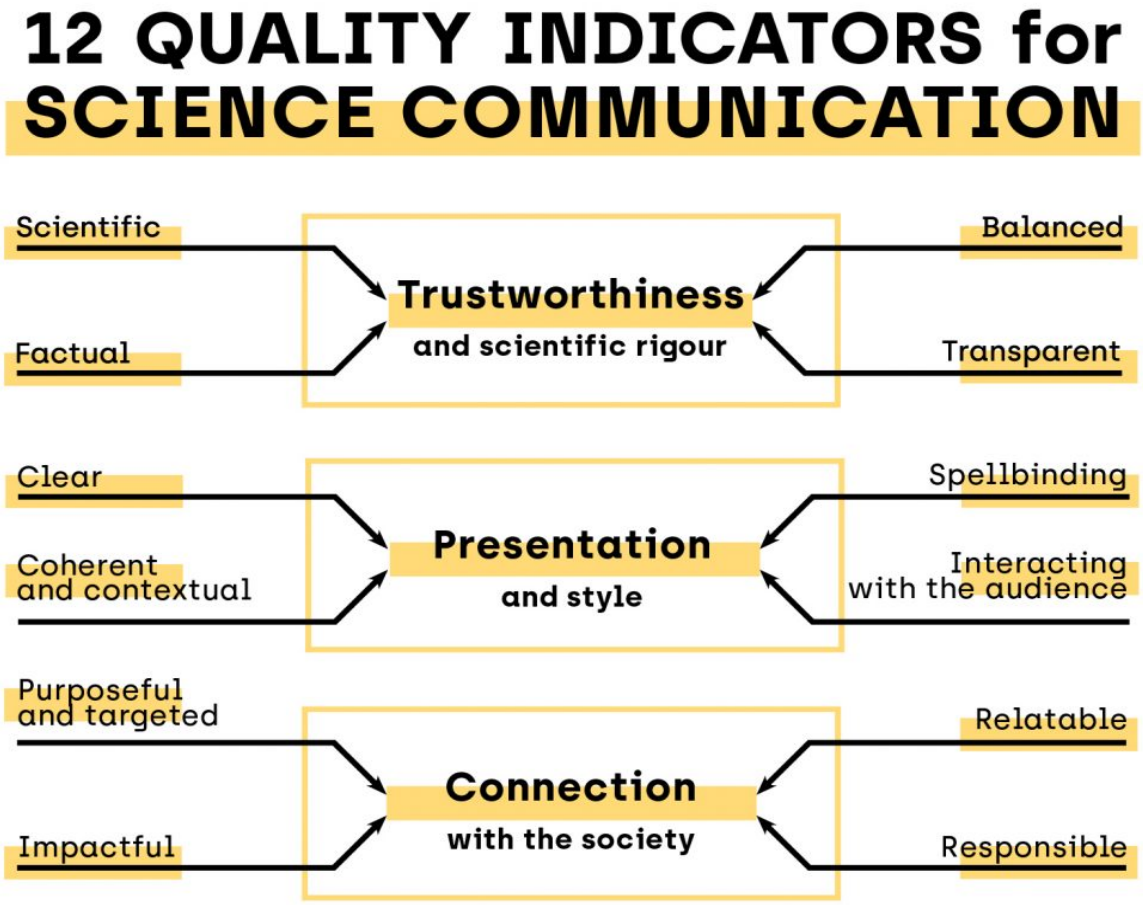


Figure 1: Image from: https://questproject.eu/12-quality-indicators-for-science-communication/

11. Explore the provided resources to learn more about how humans have influenced the desired traits of organisms.
    a. Examine each of the five infographics to explore how humans work to modify organisms.
    b. Write down at least one thing you learn and one question you have in the chart below.
    c. Utilize the *12 Quality Indicators for Science Communication* to evaluate each infographic, identifying at least one strength and one weakness.

Info-graphic #	What you Learned	What questions do you have about ways humans have influenced the inheritance of traits?	Identify one strength and one weakness of each infographic
1			Strength: Weakness:
2			Strength: Weakness:
3			Strength: Weakness:
4			Strength: Weakness:
5			Strength: Weakness:

d. Share what you learned from the infographics. Share what questions the infographics raised for you. Discuss strengths and weaknesses of the infographics.

12. Lesson Wrap up: Reflect on what you learned about while exploring the infographics. Fill out the chart below regarding your thinking about how humans have influenced traits and used technology to create genetically modified organisms (GMOs).

3 Things I Learned today:
2 Things I found interesting:
1 Thing I still have questions about:

Infographic Vocabulary Glossary

Artificial	Not naturally occurring, occurring through human selection
Balanced	Taking everything into account; fairly judged or presented
Chromosome	A threadlike structure found in the nucleus of most living cells that carries the genetic information
Clear	Explained well, in an understandable manner
Coherent	Logical and consistent explanation or argument
Contextual	Relating to a particular setting or circumstance
Corrosive	Having the quality of corroding or eating away, erosive, harmful, or destructive
DNA	Deoxyribonucleic Acid: a molecule found in living cells that contains the genetic information for an organism's development and function. Consists of a double strand of nucleotides.
Enzyme	A protein molecule that helps speed up chemical reactions in the body
Factual	Concerned with what is actually the case rather than interpretations of or reactions to it. Actually occurring.
Fusion	The process resulting in the joining of two or more things together
Gene	A segment of DNA that contains information for making proteins; the basic unit of heredity that is passed from parent to child; A sequence of DNA found on a chromosome.
Impactful	Having great power or force or potency or effect
Mutagens	A physical or chemical agent that changes an organism's DNA causing a mutation
Nucleases	An enzyme (see above) that breaks nucleic acids (like DNA and RNA) by cutting the bonds that link them together
Oceania	A geographical region in the Pacific Ocean that includes Australasia, Melanesia, Micronesia, and Polynesia
Offspring	The young or children of a parent; the descendants of a person, animal, or plant
Permafrost	Any ground that remains completely frozen at 32°F (0°C) or colder for at least two years straight. Common in regions with high mountains and in higher latitudes.

Pluots	A hybrid fruit created through the cross between a plum and an apricot
Purposeful	Intentional; having or showing a purpose
Recombinant DNA	Combining different pieces of DNA
Relatable	Enabling a person to feel that they can relate to someone or something
Responsible	Capable of being trusted
Rhizome	A horizontal underground stem that grows in plants
RNA	Ribonucleic Acid; a molecule found in living cells and some viruses that is essential for most biological functions. Consists of a single strand of nucleotides.
Scientific	Related to or exhibiting the methods or principles of science. Practicing or using thorough or systematic methods.
Spellbinding	Holding one's attention completely as though by magic; fascinating
Tangelos	A citrus fruit hybrid, a cross between an orange or tangerine and a pomelo or grapefruit.
Targeted	Directed at a particular audience
Tissue culture	A technique that involves growing cells or tissues from an organism in a controlled environment
Traits	Genetically determined characteristic; A distinguishing quality or characteristic
Transparent	Easy to perceive or detect