

Inherited and Acquired Traits

A trait is a property or characteristic of an organism. Many traits are inherited from parents, but other traits are learned (acquired) from interactions with the environment. Dogs learn tricks, like begging, shaking hands, or playing dead. Doing tricks is a learned trait, not an inherited trait. Riding a bicycle is also a learned trait. You were not born knowing how to ride a bicycle. Acquired traits are learned after birth.

Heredity is the passing of traits from parents to offspring. Inherited traits include hair type, skin color, body type, and facial features. Acquired traits include the ability to read, the ability to solve math problems, and the ability to hit a baseball with a bat. Speech is an inherited trait, but the language you speak is an acquired trait.

A gene is the unit of inheritance that is passed from parent to offspring. A new organism receives its inheritance of traits through its genes. One half of the genes come from the father and one half comes from the mother. In humans, pairs of genes located on 23 chromosomes in the DNA control inherited traits. Some inherited traits are **dominant traits**- a trait that prevents another trait from appearing. Some are **recessive traits**- a trait that does not appear when a dominant trait is present.

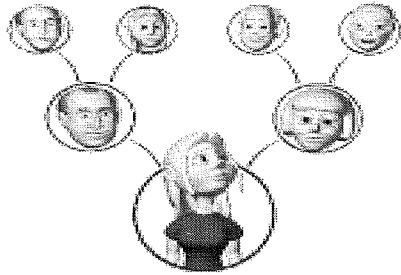
The key to inherited patterns is the process of meiosis. Meiosis is division in the nucleus of a cell that results in the

production of gametes – egg and sperm cells. Each gamete carries genetic information from one parent. When gametes combine during fertilization, a full complement of 23 pairs of chromosomes results. These have the genetic materials from both parents in them to determine a number of physical traits such as handedness, eye color, free or attached earlobes, presence of a widow's peak, hair on fingers between the first and second knuckles, and a cleft chin are all inherited in this way.

Salmon leave the ocean and return to rivers where they swim upstream to lay their eggs. Salmon did not learn to do this. It is an instinct, which is an inherited behavior. An instinct is something that a species does naturally.

Some traits occur because of the environment. Trees grow sideways because the wind blows constantly in the environment. The wind causes the trees to grow sideways. Growing sideways is not an inherited trait in these trees. It is not instinct. Trees grow sideways because of the environment. An acquired (learned) behavior helps the organism to be successful in the environment.

Inherited traits such as the color of flowers and the number of limbs of an animal can be passed on to the next generation. Other features, such as the ability to ride a bicycle, are learned through interactions with the environment and cannot be passed on to the next generation.



Inherited Traits

Key Words
 trait
 behavior
 inherited trait
 population
 acquired trait
 learned behavior

A trait is a _____ or characteristic of a living thing, such as physical features or behaviors that make it _____. Some traits, called _____ traits, are passed from parents to offspring before they are born. _____ features and behaviors can be inherited. A _____, group of organisms of the same kind that live in the same area at the same time, shares many physical features and _____ they inherited from their parents. Feathers, fur, singing, barking, eye color, hair color, laughing, and crying are all examples of inherited _____. Inherited characteristics of plants include roots growing down toward _____; while stems and leaves grow up toward _____. Most plants and animals get their traits from _____ parents, so the _____ will be similar to both parents but will not have exactly the same traits as either parent. _____ traits are characteristics that develop during the lifetime of an organism. Scars are an example of _____ traits that are acquired. Birds learn the behavior of flying and humans _____ to speak, ride a bike, and read books. Learned behaviors and other acquired traits are not passed on from _____ to their offspring.

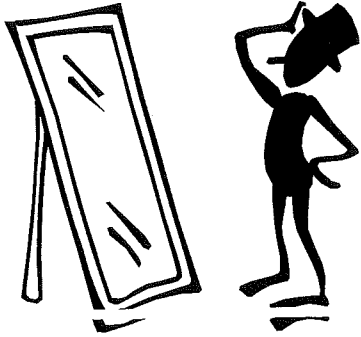
Fill in the chart below with examples of inherited and acquired traits.

Inherited Traits	Acquired Traits

1. _____ 2. _____ 3. _____ 4. _____

Exploration 2: Mirror, Mirror on the Wall

A Way to Understand Traits are Inherited from Parents to Offspring



Lesson Summary

In this exploration, students will look consider their own traits and compare them to others in the class. They will be working through a number of activities that will lead them to compare and chart their traits. Finally, students will create a model that emphasizes their uniqueness.

Time Estimate

4-5 class periods

Learner Outcomes

Students will ...

- Identify physical traits in humans
- Identify variations within each trait
- Link traits of offspring with similar traits in parents

Key Vocabulary

*science words students should know and use

- dominant trait – a gene that is expressed and therefore visible in an organism
- gene – material that is inherited from parents to offspring; recipe for a protein which may be a body structure (e.g., hair or color pigments in eyes) or enzyme (eg., digestive chemicals); made of DNA and found within chromosomes
- heredity – the process of passing genetic material (genes) from parents to offspring
- inherited – genetic material received from parent organism offspring – the young of a person, animal, or plant.
- offspring – the young of a parent
- parent organism – life form that donates its genetic material to produce offspring
- recessive trait – a gene that may not always be expressed or visible, especially when it occurs with a dominant trait (gene)
- traits – genetically determined characteristics, could also be a behavior.
- variation – the differences that occur within the offspring of a particular species

Materials and Supplies

- Science notebooks
- Fingerprint transparency
- The Family Pedigree lab sheet
- 16 magnifying lenses
- 1 pkg. of note cards, 2 per student
- pencils (darker is better)
- 1 roll of $\frac{3}{4}$ " Scotch tape
- small multi-colored tablet of Post-It notes, 6 colors (each student will receive 1 of each color)
- 6 Large pieces of paper, size of poster board
- color markers/crayons/pencils

- 6 rulers
- 32 pipe cleaners
- 11 different colors of pony beads

Queen Victoria of England has an interesting anecdote

Essential Questions

- What are some traits found in humans?
- What are some variations of these traits?
- Where do young get their traits?

ACTIVITY 2: FINGERPRINTS

1. Explain that these traits that are "expressed" are the dominant traits of our appearance, some of these dominant traits are obvious and some are not quite so obvious. One that is not quite as apparent is our fingerprints. Fingerprints are determined primarily by genetics, but they are also subject to environmental adaptation when we are developing inside our mother's womb, which is why identical twins don't even have the same fingerprints.
2. Have students compare fingerprints with one another.
 - a. If you have time, students can make their own "ink pad" in the following manner:
 - i. Rub a small dark area with a pencil point on a 3 x 5 note card.
 - ii. Press and rub your right index finger in the pencil-lead dust.
 - iii. Place the sticky side of a piece of transparent tape on the dusted finger.
 - iv. Take the tape with the fingerprint and tape it to a clean sheet of white paper.
 - v. Label the fingerprint to identify which finger you have printed. ("L" for left hand "R" for right and "I" for index finger and "M" for middle)
3. Continue the process until you have printed both your index and middle fingers on both hands.
4. After prints are made and labeled, have partners look at them with magnifying lenses and compare their prints for similarities and differences.
 - a. Are the two prints from the same hand more alike than prints from different people? How?
 - b. What kinds of patterns do they see? Help them give names to the patterns (circles, triangles, curvy lines)
 - c. Fingerprints have been classified by forensic scientists into six categories. Show students the transparency so they can learn the "official" names for patterns (loops, whorls, and arches)
 - i. What are the positions of those patterns on the finger (how close are they to the joint lines?)
 - ii. In which direction do the loops curve – toward the thumb or toward the pinkie finger? (Remember the taped prints are like looking at your finger palm up so these are mirror images. It may be easier to ask whether they curve toward the right or the left of the card.
 - iii. Compare the size of those patterns (such as how many ridges make up a loop).
 - iv. Scars, such as the white line on one of the sample prints in this lesson are the easiest patterns to see, but they cannot be used for classification. They are not unique in the way that ridge patterns are and they change over time.
5. Have the students tape their card inside their science notebook and identify it and write a description.
6. Divide the class by patterns.
7. Ask how you might look most efficiently for a particular pattern. For example, "In which of these groups would I look for a loop that leans to the left? Would it make sense to look through the whorls?"
8. Which is the most common pattern? You may wish to graph results, or to figure fractional or percentage representation of each type.
9. In their journal have the students copy the results done in class, whether graphical or mathematical.

ACTIVITY 3: STUDENT COMPARISONS

1. Provide students with multi-colored post-it notes. Have one color for each of the six traits that you will be comparing. Ask them to write their names on each differently colored post-it.

2. Divide the students into groups of four. Give each group a large sheet of paper and a marker.
 - a. Each group will represent a genetic trait (gender, rolling the tongue, hitchhiker's thumb, dimples, attached earlobes, hairline) by drawing the skeleton for a bar graph.
 - i. On each sheet of paper, construct a horizontal and a vertical axis.
 - ii. Label the horizontal axis with the appropriate group, of traits (gender, tongue, thumb, dimples, ear, and hairline). Widow's peak
 - b. Tape them to the wall.
3. Ask students to discuss all the possible variations that students in the class have for the six traits being studied.
 - a. Gender – male or female
 - b. Tongue – can or cannot curl / roll tongue
 - c. Hitchhiker's thumb – curl back when you hold it up or not
 - d. Dimples – one dimple, two dimples, no dimples
 - e. Earlobe – attached or detached
 - f. Hairline – comes down to a point or goes straight across
4. Students then place their post-it notes with their name above the category that fits them.
5. All post-its should be placed in a vertical column above each category, so as to create a bar graph.
6. Look at the bar graph.
 - a. How many students have the same exact variations as you have for all these traits?
 - g. Consider just hair and eyes. How many have the same hair color, hair line configuration, eye color?
 - h. Why don't students who have these same variations look alike? Explain.

ACTIVITY 4: INHERITANCE

1. Before doing this activity have students complete the handout, "Your Family Pedigree".
2. Ask students to reflect on family characteristics. Have them look at their family pedigrees.
 - a. Do they see other family members with the same variations that they possess?
 - b. Do they see that occasionally both parents may lack the same variation of a trait they have? Perhaps this variation can be seen in the grandparent generation. This is a "recessive" trait...one that is hidden in the presence of a "dominant" trait.
3. Ask students to explain how traits get from the parent to the offspring.
4. Guide them to discuss how an egg from the maternal parent carries genes (recipes) from the mother for a specific trait while the sperm carries the paternal genes (recipes). Each student therefore, has a gene from their mother and a gene from their father for every trait in their body.
5. This is true not only for humans but for most organisms on Earth.
6. As a culmination of this investigation have students make "Genetic Trait bracelets". There are many renditions of this activity, but it is simply using pipe cleaners as bracelets and different colored beads to represent inherited traits which create a multi-colored bracelet that is unique to each student. Here are some suggestions as well as sample colors for each trait:

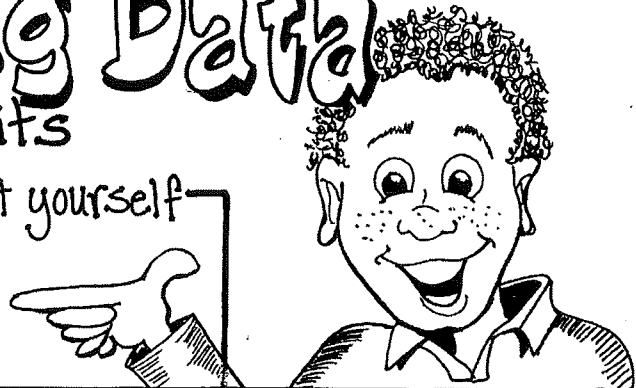
a. FIRST BEAD	Gender	Male = blue	Female = yellow
b. SECOND BEAD	Rolling Tongue	Roll = green	Cannot = orange
c. THIRD BEAD	Hitchhiker Thumb	Curved=neon green	Straight = red
d. FOURTH BEAD	Earlobes	Attached = purple	Detached = pink
e. FIFTH BEAD	Widow's Peak	Point = light blue	Straight = clear blue
f. SIXTH BEAD	Human	brown bead	(some traits are universal)

Collecting Data

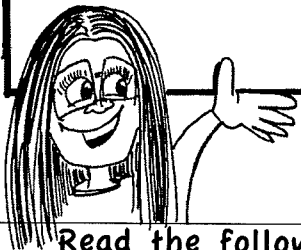
About Traits

Name: _____

Brainstorm a list of traits about yourself



Brainstorm a list of traits that your classmates have.



Fact or Fiction?



Read the following statements and mark your response.

	Fact	Fiction
1. Humans are the highest of the animals; therefore, they have the most chromosomes.		
2. An injury suffered in an accident will be passed on to one's children.		
3. If both your parents have brown eyes, then you will have brown eyes.		
4. You have inherited traits that do not seem to be visible.		
5. Hereditary traits are carried from parent to child through the blood.		
6. Each person inherits exactly half of the genetic makeup from each parent.		
7. If you are a girl, you inherit more from your mother.		
8. A parent may give a trait to his/her child without ever having the trait visible.		
9. If you resemble one parent more than the other, then you probably inherited more from that parent		
10. You have all the hereditary traits that you are ever going to have.		



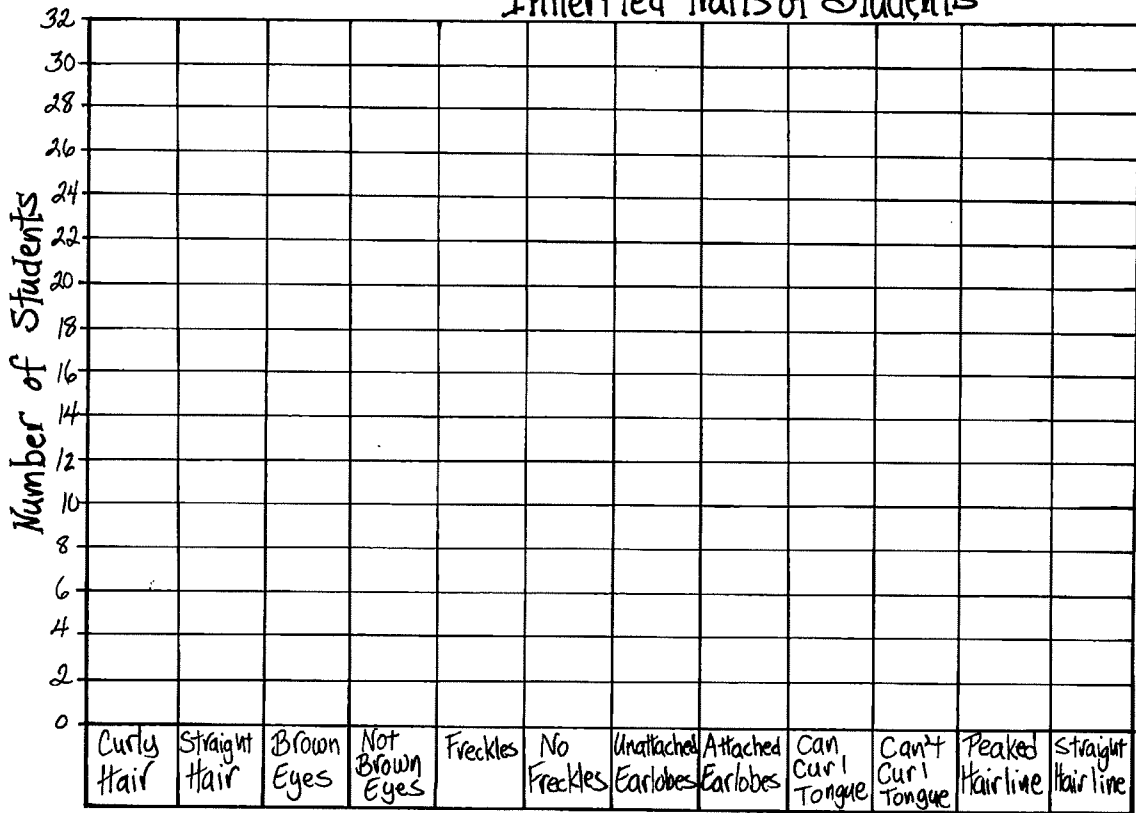
Name: _____

Collecting Data

1. Mark the inherited traits that you have with a ✓ mark.
2. Gather data. Record how many students in your class population have each inherited trait.

Traits	Curly Hair	Straight Hair	Brown Eyes	Not Brown Eyes	Freckles	No Freckles	Unattached Earlobes	Attached Earlobes	Can Curl Tongue	Can't Curl Tongue	Peaked Hairline	Straight Hairline
# of Students												

3. Make a graph to display the data:
Inherited Traits of Students



4. Which traits do you think are dominant, based on your data?

Write It!



1. Which traits are dominant and which are recessive?

2. Explain how you used the data to determine which traits are dominant or recessive.

3. Look back at you brainstormed list. Which traits on your list are learned or acquired?

4. If you surveyed another classroom of students, do you think the results would be the same? Why or why not?

5. Which results were surprising and why?



Name: _____

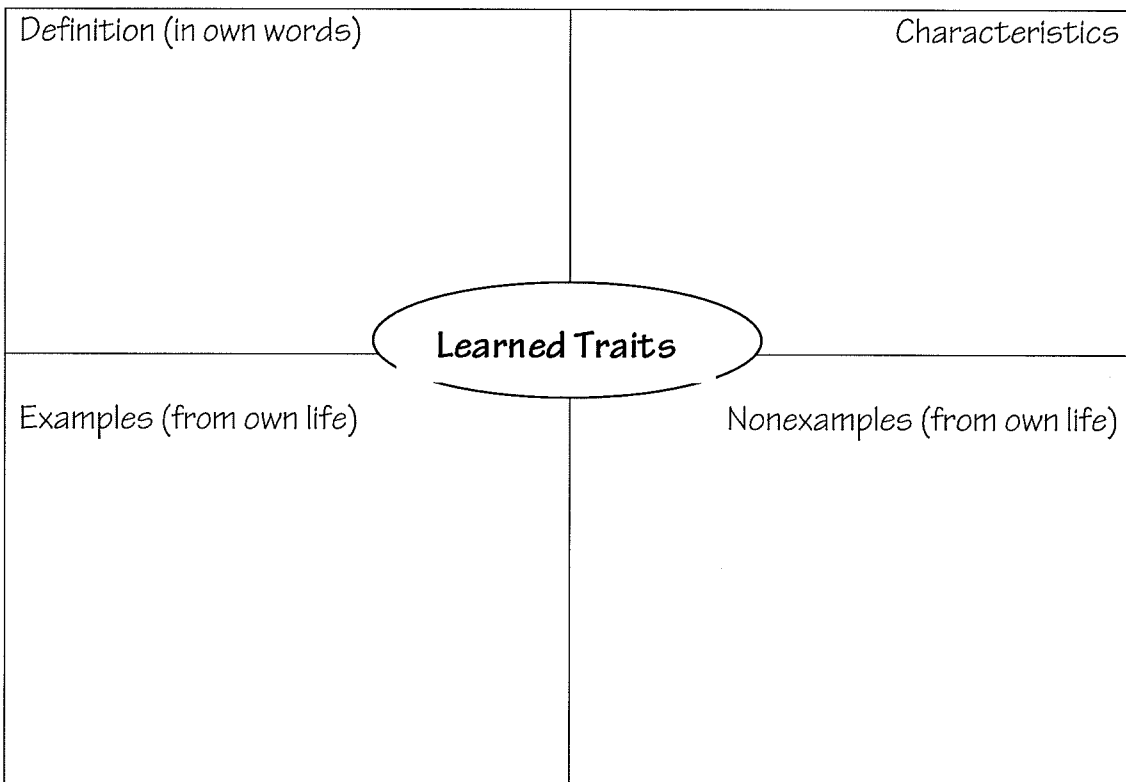
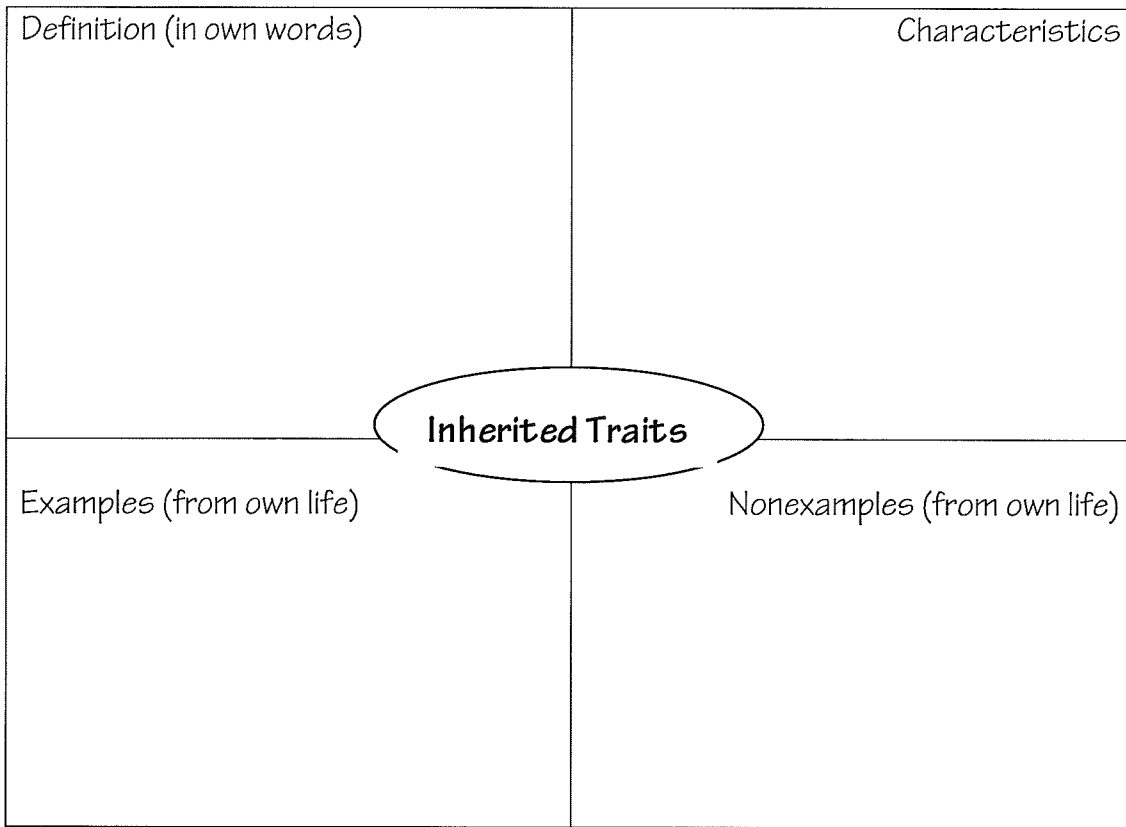
Collecting Data About Traits

- | | |
|----------|---------------------------------------------------------------|
| 4 points | exceptionally accurate/reasonable/logical, complete, detailed |
| 3 points | adequately accurate/reasonable/logical, complete, detailed |
| 2 points | somewhat accurate/reasonable/logical, complete, detailed |
| 1 point | not accurate/reasonable/logical, complete, or detailed |
| 0 points | not attempted |



Scoring Criteria: Collecting Data about Traits	Points 0-4
1. Brainstormed a list of characteristics or traits about themselves and classmates	
2. Marked the statements as fact or fiction	
3. Marked their own inherited traits with a check mark	
4. Compiled and recorded the data about their class population on each inherited trait	
5. Completed a graph to show the inherited traits of the class	
6. Listed the traits they believe are dominant based on the results.	
7. Corrected their fact or fiction votes on heredity statements	
8. Marked on the original list brainstormed which traits are inherited and which are learned	
9. Science Notes: Gave a definition of inherited traits in own words	
10. Science Notes: Listed at least two examples of inherited traits from own life	
11. Science Notes: Gave a definition of learned traits in own words	
12. Science Notes: Listed at least 2 characteristics of learned traits from own life	
13. Science Notes: Listed non-examples of learned traits from own life	
14. Write it: Listed which traits are dominant and which are recessive	
15. Write it: Explained how the data was used to determine dominant and recessive traits	
16. Write it: Explained whether or not the results would be the same with another class?	
17. Write it: Listed surprising results and gave an explanation indicating why the results were surprising.	
Total	__/56

Comments:



Inherited Traits and Learned Behaviors

Background information: You are all a member of a species known as *Narfus cillius*, commonly known as the Narfs. Narfs are very intelligent creatures with many amazing abilities. They are about 3 feet tall. They come in a variety of colors, but the two most common varieties are blue and green. They live in rainforest environments. Remarkably, they have the ability to learn skills very much like humans do. It is not uncommon to see them painting or playing basketball. Narfs are typically gentle creatures, but are sometimes fierce when challenged by a predator. Narfs are slow creatures, and they do not migrate unless forced out by unforeseen circumstances. They typically stay in the lower branches of trees. Narfs are omnivorous and will eat nearly anything. They have teeth very similar to human teeth. They prefer fruits from the trees, but can also eat small animals. Small animals are sometimes difficult for them to eat if their teeth are not extremely sharp.

Rules of the game: You will draw four inherited traits. These are traits that are part of your DNA and cannot be changed. Once they are drawn, there is nothing you can do about it. For each round, you may also draw one learned behavior. Perhaps this newly acquired skill will allow for survival, perhaps not. A situation will be read to you. Based on the situation, you will have to determine whether you will survive or not.

Traits:

Inherited traits	Learned behavior
	Situation 1:
	Situation 2:
	Situation 3:
	Situation 4:

Situation 1:

Would your inherited traits help you survive? (yes or no)	Why?
Would your learned behavior help you survive? (yes or no)	Why?

Is it likely that you would survive this situation? _____

Situation 2:

Would your inherited traits help you survive? (yes or no)	Why?
Would your learned behavior help you survive? (yes or no)	Why?

Is it likely that you would survive this situation? _____

Situation 3:

Would your inherited traits help you survive? (yes or no)	Why?
Would your learned behavior help you survive? (yes or no)	Why?

Is it likely that you would survive this situation? _____

Situation 4:

Would your inherited traits help you survive? (yes or no)	Why?
Would your learned behavior help you survive? (yes or no)	Why?

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Is it likely that you would survive this situation? _____

SITUATIONS (Teacher reads):

Situation 1:

All is well in the lush green rainforest. All narfs are enjoying a nice climate and abundant food sources. All of a sudden, disaster strikes! A giant narf eating monster attacks! The monster is scientifically known as *Killus narfus* and commonly known as the sharp tooth. The sharp tooth is far superior to other animals physically. It is extremely fast and very strong. It can jump high enough to reach the lower branches of trees in a single leap. The sharp tooth, as its name suggests, has very large sharp teeth for its carnivorous eating habits. The teeth look similar to that of a lion. The sharp tooth does, however, have poor eyesight. It can see mostly differences in color, but cannot make out shapes very well. It has an average sense of smell, but impeccable hearing. The sharp tooth does have one major weakness, music. Any music will put the sharp tooth immediately to sleep for long periods of time.

Situation 2:

Unfortunately, things are not going well for the entire narf species. Human poachers have been killing narfs for their incredibly soft fur. Many people enjoy narf fur coats, or even narf skin rugs. The green narfs have been particularly targeted. The green narfs have much softer fur. The poachers typically hunt with bow and arrow because guns will draw attention to their illegal poaching practices. Some narfs have extremely thick skin, which is difficult to penetrate with an arrow.

Situation 3:

Deforestation practices have been destroying the trees where narfs live and the fruits that they commonly eat. Some narfs are able to change food sources, but most narfs are not fast enough to catch live animals nor do they have sharp enough teeth. Some narfs have learned to garden and grow food which has allowed for the survival of some, but not the ones that do not know how to grow food.

Situation 4:

Many trees in the area where the narfs live have been destroyed. This has caused heavy flooding due to high levels of rainfall. Before, the rainfall would have been regulated by the dense trees and vegetation. This has caused pools of water to form in the area where the narfs live. Some of these pools can be quite deep, 6 feet or more. There are some food sources available at the bottom of these pools, so narfs that can dive or swim can easily get this food.

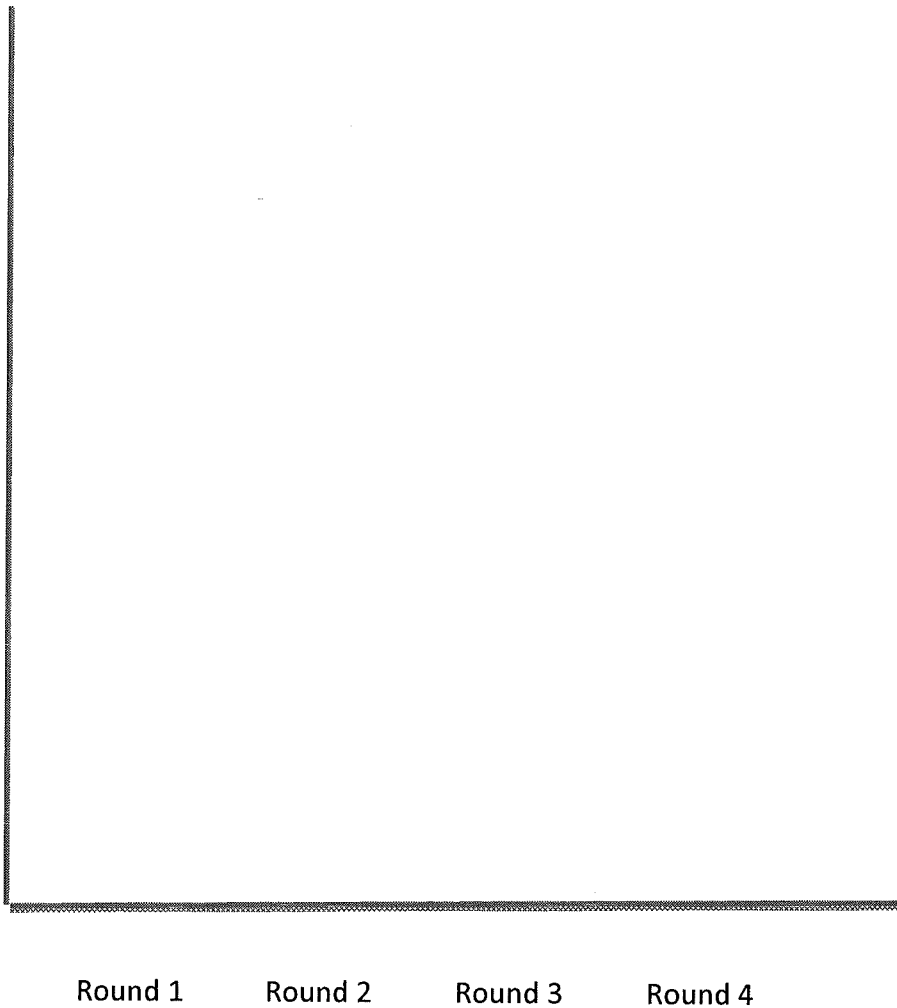
Looking at the Data

Class Data Chart

	How many students survived? List as a fraction	What percent of the class is this?
First Situation		
Second Situation		
Third Situation		
Fourth Situation		

Graph

Create a bar graph that shows what percent of students survived each of the four situations.



Conclusion Questions

1. Were you able to change any of your inherited traits at all in the game? Why or why not?
2. Were there certain traits that seemed to help you survive better than others?
3. Were there certain situations that seemed easier for the class to have survived than others? If so why do you think so?
4. Was it beneficial for you to be able to draw a new learned behavior for each situation?
5. What is the main difference between a learned behavior and inherited traits?

Learned Behaviors

Playing Piano	Gardening	Swimming
Playing the ukulele	Archery	Painting
Sewing	Fencing (sword fighting)	Long distance running
Weight lifting	Playing basketball	Singing
Campfire Cooking	Woodworking	Parkour
Drawing	Ride a unicycle	Juggling
Ballet Dancing	Good at Math	Fast reader
Playing guitar	Knitting	Nunchuck skills

Inherited traits (cut out)

Blue Fur	Green Fur	Extremely sharp teeth
Human-like teeth	Sharp claws	No claws
Thick skin	Thin skin	Blue eyes
Brown eyes	Able to digest meat	Unable to digest meat
Long legs	Short legs	Long arms (more than 3-5 ft)
Short arms (3 feet or less)	Webbed toes	Not webbed toes
Large lung capacity (can hold their breath for more than 1 minute)	Small lung capacity (can only hold their breath for less than 1 minute)	