

VANDERBILT STUDENT VOLUNTEERS FOR SCIENCE

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SURVIVOR

A Game of Traits and Natural Selection 2018-2019 VINSE/VSVS Rural

Goal: To explain how the environment helps determine what traits certain species possess.

Curriculum Alignment:

TN State Standards

- *GLE 0807.5.3* Analyze how structural, behavioral, and physiological adaptations within a population enable it to survive in a given environment.
- *SPI 0807.5.3* Analyze data on levels of variation within a population to make predictions about survival under particular environmental conditions.

NGSS Framework

- *LS4.B Natural Selection*
- *LS4.C Adaptation*

Outline

I. Introduction

- What is a trait?
- What is natural selection?

II. Activity

Students will make their creature and will identify its traits.

III. Activity

Students will play the game SURVIVOR (15-20 minutes)

IV. What Creatures Survived?

Students will look at score sheet and describe what happened to their creature (5 minutes).

What traits were most advantageous to survival? (3-5 minutes)

Instructor will define and explain natural selection (3-5 minutes)

.Instructor will give an example of natural selection (3-5 minutes)

V. Review

Materials Needed:

- 8 sets of Crazy Trait creature parts
- 1 set of Crazy Trait creature pictures (8 total) with traits listed
- 16 Handouts of pictures of light-colored and dark-colored peppered moths
- 1 set of SURVIVOR scenarios (#1-#11)

I. INTRODUCTION

Ask students what they know about Charles Darwin.

- English naturalist born in the 1800's
- Studied different forms of life around the world.
- Darwin proposed his theory of **natural selection**
- Concluded that organisms changed over time to better survive in their specific environments.
- "I have called this principle, by which each slight variation, if useful, is preserved, by the term Natural Selection." - Charles Darwin, *On the Origin of Species*

a. What is a Trait?

Ask the class the following:

1. Why do people look different from each other? *Answer: Because of differences in traits.*
2. Ask students to define the word **“trait”**.

Answers should include: Traits are mostly physical characteristics or features that organisms have, e.g., hair color.

A trait can be passed on to the offspring.

3. Ask students, “Why are there variations in a physical characteristic?”

For example, there are many differences in hair colors (brown, red, blonde, etc.).

Traits are influenced by genes. Genes carry information about traits which our parents have and pass down to us.

Different combinations of genes influence an individual’s features. These variations help make a person unique.

For example, there are different versions of a gene which influence hair color. Parents will pass down different variations of a gene to their children, causing each of them to possibly have a different hair color.

- Traits, however, aren’t *only* influenced by genes. How we live in the environment also determines our traits. For example, height and weight are influenced both by the genes we have from our parents and by what we eat.

b. What is Natural Selection?

Ask students what they know about Natural Selection. Answers should include:

- It is the process by which an organism’s traits are passed on or selected based on their environment.
- Some organisms have traits that allow them to better survive in their environment. For example, an arctic fox is white, which allows it to blend into its surroundings (snowy tundra). This “camouflage” makes it easier for the fox to hunt its prey, thus improving his chances of survival.
- The organisms that manage to survive then reproduce, passing on the genes for their advantageous traits to their offspring.
- If a gene leads to a trait that gives a significant enough advantage to the organism, then the organisms with that gene will eventually out-populate those without the gene
- This is why people describe the theory of natural selection as “the survival of the fittest”.

Traits that help organisms to survive in a specific environment are called adaptations.

An adaptation is an inherited trait that helps an organism survive.

Tell the students that you are going to show them a real-world example of natural selection.

1. Tell students to look at the handout of pictures of the peppered moths

Your Notes:

2. Prior to the 1800's, the peppered moth, found in England, was mostly light-colored. Dark colored moths were rare.
3. The peppered moth liked to hang out on tree trunks. Industrial waste created during the Industrial Revolution darkened tree trunks where these peppered moths lived.
4. Light-colored moths were spotted easily by predatory birds on the dark tree trunks and were eaten before they could reproduce.
5. In contrast, the dark-colored moths blended in better with the dark tree trunks, making it more difficult for the birds to spot them. Thus, the dark-colored moths survived and reproduced.

II. ACTIVITY – STUDENTS MAKE THEIR CREATURES.

Divide class into 8 groups.

1. Give each group a numbered Crazy Traits Creature picture with its traits.
2. Tell the group to build their creature according to the traits on the picture. The group's creature MUST be the same as in the picture.
3. After the creatures have been built, pass out the SURVIVOR Student Handout worksheet.
4. Tell students to circle the trait variations of their creature.

Trait	Variation 1	Variation 2	Variation 3
Leg Length	Short	Long	
Wings	Absent	Present	
Foot Shape	Webbed	Talon	
Tail Length	Short	Long	
Arm Length	Short	Long	
Antenna Shape	Knob	Star	
Antenna Length	Short	Long	
Beak Shape	Trumpet	Crusher	
"Hand" Shape	Claw	Paw	
Ear Shape	Mouse	Elephant	
Skin Color	Red	Purple	Blue
Eye Color	Red	Green	Stop-and-Go

Ask each group to give ONE example of a trait variation that they think will be beneficial and ONE example of a trait variation that they think will be detrimental to the survival of **their** creature. Record these answers on the board.

Some examples might be:

Trait	Variation	Beneficial for:	Detrimental for:
Leg Length	<i>Long</i>	Can run fast	Cannot hide in grassland
	<i>Short</i>	Can hide in grassland	Cannot run very fast
Wings	<i>Wings</i>	Can fly away	Are easily damaged
	<i>No Wings</i>	Not in the way when	Cannot fly away

Your Notes:

		walking through bushes	
Foot Shape	<i>Talon</i>	Can climb structures	Cannot swim in water
	<i>Webbed</i>	Can swim in water	Cannot climb structures
Tail Length	<i>Short</i>	Allows you to be nimble	Cannot swat flies
	<i>Long</i>	Can be used to fight the enemy	Makes a lot of noise when sneaking up on prey
Arm Length	<i>Short</i>	Short arms are stronger	Cannot reach food high off the ground
	<i>Long</i>	Arms slow you down running thru bush	Can reach food high off the ground
“Hand” Shape	<i>Claw</i>	Can pick up nuts	
	<i>Paw</i>	Can dig holes to lie in to keep cool	Cannot pick up nuts
Antenna Shape	<i>Star</i>		
	<i>Knob</i>		
Antenna Length	<i>Short</i>	Safe from lightning strikes	Cannot pick up cell phone signals
	<i>Long</i>	Can detect enemy	Can be struck by lightning
Beak Shape	<i>Crusher</i>	Can crush hard nuts	Cannot suck up nectar
	<i>Trumpet</i>	Can suck up worms	Cannot crush hard nuts
Ear Shape	<i>Mouse</i>	Easy to keep clean	Has lousy hearing
	<i>Elephant</i>	Has very good hearing	Ears stick and can be seen by predators
Skin Color	<i>Red</i>	Can hide in a field of red flowers	Scares off fish
	<i>Blue</i>	Blends with water so difficult for seagulls to find you for supper	
	<i>Purple</i>		Scares off fish
Eye Color	<i>Red</i>		
	<i>Green</i>		
	<i>Red and Green</i>		

III. Activity

- Students will now play the game of SURVIVOR.
- Explain that this game simulates how different creatures will “survive” in different environments.
- There are eleven scenarios that depict an environmental situation.
- In each situation, one variation of a trait will help some creatures survive and the other variation(s) of the trait will not help the others.

Your Notes:

It is important that the VSVS volunteers read the scenarios in sequential order (1, 2, 3...). The game is carefully scripted to have desired outcomes!

The Rules:

- All teams start with zero chips.
- A scenario is read by a VSVS member. Each creature possesses a trait that is either an advantage or disadvantage under the change in the environment.
 - Creatures that possess the advantageous variation will reproduce, represented by a green chip.
 - Creatures that possess the disadvantageous variation will get a red chip.
 - After each scenario, pass out a red or green chip to the groups.
- At the end of the game, students with more green chips than red chips have survived, but those with more red chips than green chips have gone extinct.
- The students will also keep track of the scores of each individual trait on the tally sheet.

Example: Scenario #1

A severe drought occurs during the wet season in your environment. Most of your main foods sources have died during the drought, leaving you with tough seeds to eat.

Ask students “what trait is advantageous for survival, what trait is disadvantageous”?

If you have a trumpet beak, you are unable to break open these seeds. If you have a crusher beak, you are able to break open these seeds, so you can better survive and reproduce.

Score: Crusher beaks +1, Trumpet beaks -1

Students with creatures 1, 5 and 7 all receive a red chip.

Students with creatures 2, 3, 4, 6, and 8 all receive a green chip.

Scenario #2

The lack of food during the drought has caused many of the creatures to find nourishment by feeding on hard shelled marine animals in the nearby ocean.

Ask students “what trait is advantageous for survival, what trait is disadvantageous”?

If you have paw hands, you have a difficult time cracking open shellfish to eat. If you have claws, you are able to easily open shellfish to eat, so your creature is more fit and able to reproduce.

Score: Claw hands +1, Paw hands -1

Students with creatures 2, 4 and 6 all receive a red chip.

Students with creatures 1,3,5,7 and 8 all receive a green chip.

Scenario #3

Tall trees in your environment have survived the drought. To eat berries nuts or leaves, you must climb high up into the trees.

Ask students “what trait is advantageous for survival and reproduction, what trait is disadvantageous”?

If you have webbed feet, you are unable to climb the tree. If you have talon feet, you are able to climb up the tree.

Your Notes:

Score: Talon feet +1(get green chip), Webbed feet -1(get red chip)

Scenario #4

The next wet season has finally came and brought with it plentiful rain. The rain nourishes a field a field of purple wildflowers.

Ask students “what trait is advantageous for survival, what trait is disadvantageous”?

If you have purple skin, you are able to hide in the field of wildflowers from predators. If you have red or blue skin, you are easily spotted and eaten by predators while in the field of wildflowers. The surviving creatures are more able to reproduce than those that do not survive.

Score: Purple skin +1(get green chip), Red or Blue skin, -1(get red chip)

Scenario #5

Various insects are attracted to star antennae because they mistake them for flowers to feed off of.

Ask students “what trait is advantageous for survival, what trait is disadvantageous”?

If you have star antennae, you are able to capture and eat bugs easily. If you have knob antennae, insects are not attracted to you and you are unable to catch the insects to eat them. The creatures that eat the bugs are more fit and able to reproduce.

Score: Star antennae +1(get green chip), Knob antennae -1(get red chip)

Scenario #6

Global warming has caused the sea level to rise. The high water levels have flooded your environment.

Ask students “what trait is advantageous for survival, what trait is disadvantageous”?

If you have talon feet, you are able easily climb to higher ground to dry land. If you have webbed feet, you are not able to climb to dry land. Those creatures that climb to higher ground have safer places to reproduce and care for their young.

Talon feet +1(get green chip), Webbed feet -1(get red chip)

Scenario #7

A new factory is being built in your habitat, destroying much of your resources such as shelter and food.

Ask students “what trait is advantageous for survival, what trait is disadvantageous”?

If you have wings, you are able to fly to a new habitat to find resources, providing more food for you and your offspring. If you do not have wings, you must walk a long distance to find resources.

Score: Wings +1(get green chip), No wings -1(get red chip)

Scenario #8

You have found a new habitat. While searching for food one day, you need to reach high for leaves in the trees. *Ask students “what trait is advantageous for survival, what trait is disadvantageous”?*

If you have long arms, you are able to reach the leaves, and stay fit so that you can reproduce. If you have short arms, you cannot get close enough to the tree leaves.

Your Notes:

Score: Longs arms +1(get green chip), Short arms -1(get red chip)

Scenario #9

A large forest fire is engulfing your environment. A member of your clan transmits a high frequency sound to warn you about the danger.

Ask students “what trait is advantageous for survival, what trait is disadvantageous”?

If you have elephant ears, you are able to clearly hear the warning, and survive on to reproduce. If you have mouse ears, you are not able to hear the warning.

Score: Elephant ears +1(get green chip), Mouse ears -1(get red chip)

Scenario #10

The forest fire is quickly consuming your habitat and you must escape.

Ask students “what trait is advantageous for survival, what trait is disadvantageous”?

If you have wings, you are able to quickly escape the fire and survive on to reproduce. If you do not have wings, you are not able to escape the fire.

Score: Wings +1(get green chip), No wings -1(get red chip)

Scenario #11

An abundance of acorns has fallen to the ground.

Ask students “what trait is advantageous for survival, what trait is disadvantageous”?

If you have a crusher beak, you can join in the feast, and you have plenty of energy to reproduce.

Score: Crusher Beak +1(get green chip), Trumpet Beak -1 (get red chip)

IV. WHAT CREATURES SURVIVED?

- Tell students to pair up a red chip with a green chip – they are effectively cancelling 1 advantageous trait with 1 disadvantageous trait.
- Set aside the paired chips. The remaining chips (all 1 color now) give you your final “score”.
- Report these totals to a VSVS member who will write them on the board. The totals should look like the following chart.

	Final score
Creature 1	1 (red chip)
Creature 2	3 green chips
Creature 3	9 green chips
Creature 4	1 red chip
Creature 5	7 red chips
Creature 6	7 green chips
Creature 7	1 red chip

Your Notes:

Creature 8 11 green chips

- Tell students that if a creature is holding only red chips, (and therefore had a negative final score), it has gone extinct. One group member should stand holding its extinct creatures for the class to see.
- If the creature is holding only green chips (and therefore had a positive score), that creature survived and reproduced. One group member should stand holding its survivor creature for the class to see.

Pass out Handout #1 showing the scores of the creatures.

Tell students that:

- all creatures with negative scores (and therefore extinct) are on the 1st row
 - all creatures with positive scores (and therefore alive and thriving) are on the 2nd row,
- Tell students to look at the pictures AND the tally sheet and ask which traits were the most advantageous to survival?
 - a. Students should reach the conclusion that “creatures” went extinct if their traits were not advantageous in the environment. On the other hand, traits which were advantageous helped the “creature” survive.
 - b. Students should conclude that the **most advantageous traits** are the crusher beak, talon feet, and wings. Each of these traits gave a best, positive net score at the end of the game of +2.
 - c. On the other hand, those with a trumpet beak, webbed feet, and no wings received the worst, overall net score for each of these traits.
 - d. When food was scarce, it was helpful to have a crusher beak that allows a creature to eat ‘hardy’ foods such as seeds and nuts.
 - e. Having Talon feet allowed a creature to scale certain objects.
 - f. Those with wings have greater mobility, allowing them to explore new habitats or escape from predators.

Explain that the students simulated natural selection.

Remind students of the definition of natural selection.

- a. The environment selects for certain traits. Creatures that had these advantageous traits would survive and reproduce.

Ask the students which of the creatures do they think will be best suited to survive in the future. (Tell students to look at both the tally sheet and the score sheet). According to natural selection, the creatures whose traits are selected for in the environment will pass their traits on.

- Looking at past events (the scenarios in the game), it would seem that creatures who have a crusher beak, talon feet, or wings will be best suited to the environment.
 - Since Creatures 3, 6, and 8 all have these traits, we would assume they would be the fittest to survive in the future. (In the SURVIVOR game, Creatures 3, 6, and 8 had the best score).
- b. In turn, the creatures that reproduced passed on genes to their children for traits which would help them survive. Remind students that these traits are called **adaptations**.

Your Notes:

- Ask the following questions to the class to conclude the lesson:
 - a. What is a trait? *Answer: Traits are mostly physical characteristics or features that you have, which can differ between people*
 - b. By what is a trait influenced? *Answer: Genes and environment*
 - c. What is natural selection? *Answer: The process by which an organism's traits are passed on or selected based on their environment*
 - d. How does natural selection work? *Answer: Variations in a trait that allow an organism to survive better are passed down to the organism's offspring*
 - e. How does environment influence survival? *Answer: Organisms with traits that help them survive in an environment are selected for, and organisms with traits that do not help them survive in an environment are selected against*
 - f. What is an adaptation? *Answer: A trait that helps an organism survive in a specific environment*

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Your Notes:

Scenario #1

A severe drought occurs during the wet season in your environment. Most of your main food sources have died during the drought, leaving you will tough seeds to eat. If you have a trumpet beak, you are unable to break open these seeds. If you have a crusher beak, you are able to break open these seeds, eat, survive and reproduce. **Score: Crusher beaks +1, Trumpet beaks -1**

Scenario #2

The lack of food during the drought has caused many of the creatures to find nourishment by feeding on marine animals in the nearby ocean. If you have paw hands, you have a difficult time cracking open shellfish to eat. If you have claws, you are able to easily open shellfish to eat. Creatures with claws survive to reproduce. **Score: Claw hands +1, Paw hands -1**

Scenario #3

Tall trees in your environment have survived the drought. To eat berries nuts or leaves, you must climb high up into the trees. If you have webbed feet, you are unable to climb the tree. If you have talon feet, you are able to climb up the tree. This enables you to survive and reproduce. **Score: Talon feet +1, Webbed feet -1**

Scenario #4

The next wet season has finally come and has brought plentiful rain with it. The rain nourishes a field a field of purple wildflowers. If you have purple skin, you are able to hide in the field of wildflowers from predators and survive to reproduce. If you have red or blue skin, you are easily spotted and eaten by predators while in the field of wildflowers. **Score: Purple skin +1, Red or Blue skin, -1**

Scenario #5

Various insects are attracted to star antennae because they mistake them for flowers to feed off of. If you have star antennae, you are able to capture and eat bugs easily, making you more fit to reproduce. If you have knob antennae, insects are not attracted to you and you are unable to catch the insects to eat them. **Score: Star antennae +1, Knob antennae -1**

Scenario #6

Global warming has caused the sea level to rise. The high water levels have flooded your environment. If you have talon feet, you are able easily climb to higher ground to dry land. If you have webbed feet, you are not able to climb to dry land. Many drown and cannot reproduce. **Talon feet +1, Webbed feet -1**

Scenario #7

A new factory is being built in your habitat, destroying many of your resources such as shelter and food. If you have wings, you are able to fly to a new habitat to find resources for you and your offspring. If you do not have wings, you must walk a long distance to find resources. You may be too exhausted to find a mate. **Score: Wings +1, No wings -1**

Scenario #8

You have found a new habitat. While searching for food one day, you need to reach high for leaves in the trees. If you have long arms, you are able to reach the leaves. If you have short arms, you cannot get close enough to the tree leaves. You may become too weak to reproduce. **Longs arms +1, Short arms -1**

Scenario #9

A large forest fire is engulfing your environment. A member of your clan transmits a high frequency sound to warn you about the danger. If you have elephant ears, you are able to clearly hear the warning. If you have mouse ears, you are not able to hear the warning. You may not be able to escape in time to reproduce. **Score: Elephant ears +1, Mouse ears -1**

Scenario #10

The forest fire is quickly consuming your habitat and you must escape. If you have wings, you are able to quickly escape the fire. If you do not have wings, you are not able to escape the fire. Only those that escape the fire are able to produce offspring. **Score: Wings +1, No wings -1**

Scenario #11

An abundance of acorns has fallen to the ground. If you have a crusher beak, you can join in the feast. Those with the trumpet beak are too busy looking for food to find a mate. **Score: Crusher Beak +1, Trumpet Beak -1**

Observation Sheet

Circle the Traits your creature has.

Trait	Variation 1	Variation 2	Variation 3
Leg Length	Short	Long	
Wings	Absent	Present	
Foot Shape	Webbed	Talon	
Tail Length	Short	Long	
Arm Length	Short	Long	
Antenna Shape	Knob	Star	
Antenna Length	Short	Long	
Beak Shape	Trumpet	Crusher	
“Hand” Shape	Claw	Paw	
Ear Shape	Mouse	Elephant	
Skin Color	Red	Purple	Blue
Eye Color	Red	Green	Stop-and-Go

Tally Chart

For each scenario, give a +1 or -1 in the tally box for the appropriate trait. At the end add up the net score.

Trait	Variation	Tally	Net Score
Leg Length	<i>Long</i>		
	<i>Short</i>		
Wings	<i>Wings</i>		
	<i>No Wings</i>		
Foot Shape	<i>Talon</i>		
	<i>Webbed</i>		
Tail Length	<i>Short</i>		
	<i>Long</i>		
Arm Length	<i>Short</i>		
	<i>Long</i>		
“Hand” Shape	<i>Claw</i>		
	<i>Paw</i>		
Antenna Shape	<i>Star</i>		
	<i>Knob</i>		
Antenna Length	<i>Short</i>		
	<i>Long</i>		
Beak Shape	<i>Crusher</i>		
	<i>Trumpet</i>		
Ear Shape	<i>Mouse</i>		
	<i>Elephant</i>		
Skin Color	<i>Red</i>		
	<i>Blue</i>		
	<i>Purple</i>		
Eye Color	<i>Red</i>		
	<i>Green</i>		
	<i>Red and Green</i>		

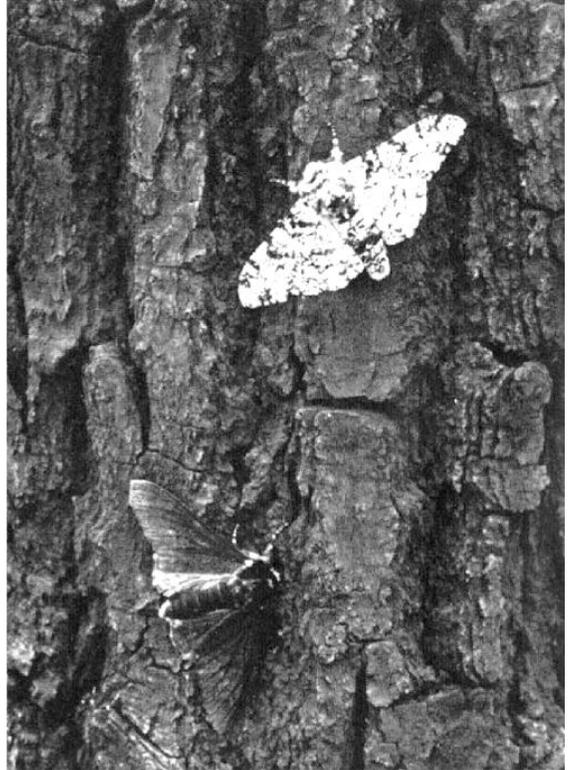
Tally Sheet (Answer Key)

For each scenario, give a +1 or -1 in the tally box for the appropriate trait. At the end add up the overall score in the tally box.

Trait	Variation	Tally	Net Score
Leg Length	<i>Long</i>		
	<i>Short</i>		
Wings	<i>Wings</i>	+1 +1	+2
	<i>No Wings</i>	-1 -1	-2
Foot Shape	<i>Talon</i>	+1 +1	+2
	<i>Webbed</i>	-1 -1	-2
Tail Length	<i>Short</i>		
	<i>Long</i>		
Arm Length	<i>Short</i>	-1	-1
	<i>Long</i>	+1	+1
“Hand” Shape	<i>Claw</i>	+1	+1
	<i>Paw</i>	-1	-1
Antenna Shape	<i>Star</i>	+1	+1
	<i>Knob</i>	-1	-1
Antenna Length	<i>Short</i>		
	<i>Long</i>		
Beak Shape	<i>Crusher</i>	+1 +1	+2
	<i>Trumpet</i>	-1 -1	-2
Ear Shape	<i>Mouse</i>	-1	-1
	<i>Elephant</i>	+1	+1
Skin Color	<i>Red</i>	-1	-1
	<i>Blue</i>	-1	-1
	<i>Purple</i>	+1	+1
Eye Color	<i>Red</i>		
	<i>Green</i>		
	<i>Red and Green</i>		

* Bolded traits are ‘important’ traits in the environment.

Peppered Moths



Arctic Fox





Creature 1
score = -1
 Leg - Long
 Wings
 Foot - Webbed
 Tail - Short
 Arm - Long
 Antenna - Knob
 Antenna - Long
 Beak - Trumpet
 Hand - Claw
 Ear - Elephant
 Skin - Blue
 Eye - Green



Creature 4
Score = -1
 Leg - Long
 Wings
 Foot - Webbed
 Tail - Short
 Arm - Short
 Antenna - Star
 Antenna - Long
 Beak - Crusher
 Hand - Paw
 Ear - Mouse
 Skin - Blue
 Eye - Red



Creature 5
Score = -7
 Leg - Long
 No wings
 Foot - Webbed
 Tail - Short
 Arm - Short
 Antenna - Knob
 Antenna - Long
 Beak - Trumpet
 Hand - Claw
 Ear - Mouse
 Skin - Purple
 Eye - Red



Creature 7
Score = -1
 Leg - Long
 No wings
 Foot - Talon
 Tail - Short
 Arm - Long
 Antenna - Knob
 Antenna - Short
 Beak - Trumpet
 Hand - Claw
 Ear - Mouse
 Skin - Purple
 Eye - Red and green



Creature 2
Score = 3
 Leg - Short
 No wings
 Foot - Talon
 Tail - Long
 Arm - Long
 Antenna - Star
 Antenna - Long
 Beak - Crusher
 Hand - Paw
 Ear - Elephant
 Skin - Red
 Eye - Red



Creature 3
Score = 9
 Leg - Short
 Wings
 Foot - Talon
 Tail - Short
 Arm - Long
 Antenna - Star
 Antenna - Short
 Beak - Crusher
 Hand - Claw
 Ear - Elephant
 Skin - Red
 Eye - Red and green



Creature 6
Score = 7
 Leg - Short
 Wings
 Foot - Talon
 Tail - Short
 Arm - Long
 Antenna - Star
 Antenna - Long
 Beak - Crusher
 Hand - Paw
 Ear - Mouse
 Skin - Purple
 Eye - Green



Creature 8
Score = 11
 Short
 Wings
 Talon
 Long
 Long
 Star
 Long
 Crusher
 Claw
 Elephant
 Purple
 Green