

## Adaptations Lesson 2: *The Make*

### Educator's Resource Guide

#### Objective

In *The Make*, students will:

- Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. (MS-LS4-4)
- Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time. (MS-LS4-6)

#### *The Make* Activity

In *The Make*, students will:

1. Participate in a survival game that allows them to discover how different traits in a population increase some individuals' probability of surviving and reproducing in a specific environment.
2. Track and analyze data to describe trends in population based on advantageous/disadvantageous inherited traits.
3. Communicate their understanding that individuals with the traits that best fit their environment will be naturally selected and have a greater chance of survival.
4. Write and produce a mini nature documentary that explains natural selection and adaptation as witnessed during the bird beak activity.

**Time Required:** 220–230 minutes

#### Materials Required

- Student Guide
- Pencils, colored pencils, or markers

**Materials for Feeding Frenzy (Virtual):** [Click Here](#)

**Materials for Feeding Frenzy (In Class)**

- A sleeve of 9-oz clear plastic tumbler cups (about 25 cups)
- Plastic forks *Note: The cheaper the forks, the easier it is to break the prongs.*
- Froot Loops (1 box per class)
- Painter's tape
- Calculators (1/reporting station)
- Timer/stopwatch
- Whistle
  - 1 copy (printed/digital) of Appendix A: Let's Figure It Out! Finch Beak Feeding Frenzy
  - 3 clipboards with data charts (3 copies of Appendix B: Reporting Station Data Tables)
  - 1 printed copy of Appendix C: Master Class Data Table

**Materials for Nature Documentary**

- Paper/computer (for writing script for nature documentary)



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<ul style="list-style-type: none"><li>• Cell phones/tablets (for filming nature documentary)</li><li>• 1 copy (printed/digital) of Appendix D: Make a Nature Documentary!</li></ul> <p><i>Note: Overhead projector/document camera is useful for showing student data throughout the activity.</i></p>
<b>Safety Considerations</b>
None
<b>Science &amp; Engineering Practices</b>
<ul style="list-style-type: none"><li>• Developing and Using Models</li><li>• Constructing Explanations or Arguments from Evidence</li></ul>

## Agenda

### I. Show Slides 1–25 of the PowerPoint to introduce *The Make Activity* (10–15 minutes)

The PowerPoint will review essential concepts learned in *The Solve* and provide context for the students' upcoming *Make* challenge. Use suggestions in the "Notes" section of the PowerPoint to guide class discussion.

### II. *The Make Activity* (120 minutes)

Guide students through the natural selection game to model how adaptations can either be advantageous or disadvantageous for survival. **If students are doing this remotely, follow directions for the *Make* activity [here](#).**

As guided by the organizer, students will:

1. Participate in a game that emulates natural selection and adaptation on the Galapagos Islands. *See Appendix A for setup instructions.*
2. Analyze traits in finch populations over time through data collection and graphing. *See Appendices B and C for data tables and graph template.*

### III. Show Slides 26–40 of the PowerPoint to Review (10–15 minutes)

The PowerPoint will review essential concepts learned in *The Make* activity and allow students to apply what they've learned to new scenarios. Use suggestions in the "Notes" section of the PowerPoint to guide class discussion.

### IV. Discussion (20 minutes)

Students work in small groups, or as a whole class, to respond to the discussion questions below that summarize their understanding of *The Make* and connect students to the upcoming *Engineering* challenge.

**Note: In collaborative classrooms, this serves as the individual accountability in an otherwise group project.**

## Discussion Questions

Students will discuss the following questions located in their Student Guide and individually jot down their initial thoughts. Then, come together as a whole class to discuss their ideas. Encourage students to take notes and clarify their ideas during and after the discussion.

1. Which population of finches increased in this activity? *Answers will vary. It is likely that the population of 4-pronged finches will increase; however, answers may differ for classes.*
2. Which population of finches decreased in this activity? *Answers will vary. It is likely that the population of 2-pronged finches will decrease; however, answers may differ for classes. Interestingly, the 1-pronged finches may do well as they're able to gather loops by placing their single prong through the hole in the loop. The 2-pronged beaks cannot fit through this hole.*
3. How does inheriting a specific trait impact your likelihood of survival? *If you inherit a trait that is considered advantageous to your environment, your likelihood of survival would increase. For example, the elephants in Mozambique that have inherited the tuskless trait have an increased likelihood of survival. This is because they are less likely to be killed by poachers, who kill elephants for the ivory in their tusks. However, if you inherit a trait that is disadvantageous, your likelihood of survival will decrease, as with the moths that inherited the light-colored wing trait after the Industrial Revolution.*
4. Did any population of birds go extinct during the bird beak activity? If so, explain what factors may have contributed to their extinction. *Certain bird populations may have gone extinct because they were not able to compete with birds whose beaks were better adapted to the environment. Note: Students may bring up that birds who were not well-adapted were still able to get creative about the different ways they successfully "ate" their Wild Loops. This is a great opportunity to discuss behavioral adaptations, and how although certain traits may not be advantageous, individuals may be able to change their behavior to achieve the required goal.*
5. In general, what factors can cause a population to become extinct? Come up with as many examples as possible. *There are many factors that can cause a population to become extinct from an environment, such as environmental changes, an increase or other changes in predator population, and human interaction.*

## **V. Assessment (60 mins)**

Students write a script and create a nature documentary about the bird populations from "Wild Loop" Island. *See Appendix D for directions.*

## VI. Exit Ticket (10 minutes)

1. The finches in the Feeding Frenzy activity all competed for the same food source on the same island. Imagine this same starting population of finches flew to another island with the source of food being stick bugs (toothpicks). Would you expect the same trends in the finch populations over a series of five rounds (generations)? Explain your thoughts.

*Answers will vary. Some students may say that the trend will be the same; others may predict that it will differ, predicting that pincher-billed beaks would have greater success, since the beak is sharp and precise, being able to easily pick up toothpicks. The important component to student answers is that they're thinking about the impact of the environment on whether a trait is advantageous or not.*

2. Darwin observed finches with different beak types on different islands. How does the Feeding Frenzy activity help to explain Darwin's observations? *This activity helps to explain Darwin's observations because I saw that some inherited traits are more advantageous in certain environments. Darwin noticed that the population of finches on each island had adapted as they had inherited the most advantageous trait for their environment.*

3. For the Feeding Frenzy activity, food availability was the factor that determined which beak-types were advantageous. What other factors in an environment may determine whether specific traits are advantageous or not? (Hint: Think about all of the factors in an environment that are necessary for an individual to survive)

*Answers will vary. Potential answers include predators, water availability, mate availability, and environmental conditions such as temperature.*

4. In a snow-covered environment, a population of rabbits has the trait of having a white coat, while another population of rabbits has the trait of having brown fur. Assuming no environmental changes, do you expect the "white coat" trait to increase or decrease in the population? Relate your answer to natural selection.

*The population of white-coat rabbits will increase because the white coat is an advantageous trait that increases the rabbit's likelihood of survival and reproduction, thereby passing this trait onto the next generation. Those without this trait are less likely to survive and reproduce, which therefore makes this advantageous trait more prevalent in the population.*

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## The Make Assessment: Project Grade and Rubric Score Sheet – Adaptations

Project Submitted by \_\_\_\_\_

### Adaptations The Make Checklist: Content Concepts and Practices

Your Challenge: Participates in a selection and adaptation game.

- Correctly tracks data in table.
- Completes graph representing data.
  - Correctly labels x-axis and y-axis.
  - Appropriately includes all bird beak types.
- Successfully completes discussion questions.
- Completes final *The Make* activity.
  - Writes script that successfully addresses environment, food, and predators, and uses vocabulary from unit.
  - Creates nature documentary based on script to demonstrate population change during bird beak activity.

### Science & Engineering Practices

	Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
<b>Developing and Using Models</b>	Drawings, diagrams, or visual models include major misconceptions or have missing parts. Explanation of the model is minimal or not present.	Drawings, diagrams, or visual models include minor misconceptions or have missing parts. Explanation of the model is minimal.	Drawings, diagrams, or visual models are complete, but contain a minor misconception. Explanation of the model is complete but lacking complexity.	Drawings, diagrams, or visual models have no misconceptions and contain all details. Explanation of the model is complete and complex.
<b>Constructing Explanations or Arguments From Evidence</b>	Constructs an explanation with no clear sources of evidence.	Uses scientific principles and/or data from at least one source to construct or evaluate an explanation, but explanation contains minor misconceptions.	Uses accurate but incomplete scientific principles and/or data from multiple sources to construct or evaluate an explanation.	Uses accurate and complete scientific principles and/or data from multiple sources to construct or evaluate an explanation.

Teacher Comments:

Final Score:

Final Grade:

## Appendix A: Let's Figure It Out! Finch Beak Feeding Frenzy

In this activity, students will be acting as birds competing in a survival-of-the-fittest challenge to understand how different traits can be more advantageous in a given environment.

### To Prepare

- For each class, you will need 12 of each type of beak; 4-prong, 2-prong, and 1-prong. In order to prepare the 2-prong beaks, you will need to break off the two outer prongs on 12 plastic forks. For the 1-prong beaks, you will break off three of the prongs. *Tip: White plastic forks work best for this. Clear plastic forks tend to be too sturdy and therefore difficult to break.*
- Create a “feeding ground” in the center of your classroom using painter’s tape, brightly colored gym-floor tape (it peels up easily without leaving marks), or tables pushed together. The area should be big enough to fit 12 students at any given time. *Tip: Three students on each of four sides of a rectangular area works well. An area of 3 x 4 meters is ideal. If you don’t have this area available on the floor or tables, you can use a hallway or gym.*
- Select three students to be data recorders. Provide each of them with Appendix B: Reporting Station Data Tables, a clipboard, and a pencil. Each data recorder will record data for one beak type (1-prong, 2-prong, or 4-prong), and the stations should be labeled and placed around the room at unique tables.
- Randomly select your initial bird population, handing out four 4-prong beaks, four 2-prong beaks, and four 1-prong beaks. Each bird will also need a “stomach” (plastic cup).
- All students that are not birds or recorders will observe the activity outside the feeding area. Any student that doesn’t start as a bird will have the opportunity to participate in later rounds as they will be the result of “reproduction” of the Top 3 competitors.
- Carefully and evenly distribute half a box of WILD LOOPS in the feeding area.
- You will have Appendix C: Master Class Data Table ready to record data at the end of each round. The data recorders will report to you their data at the end of each round, and you will determine the Top 3 (to reproduce) and Bottom 3 (to be eliminated) of ALL the beak types.

### Instructions

1. Explain that birds can only hold the “beak” (fork) with one hand to collect WILD LOOPS into their “stomach” (cup).
2. Birds must keep their “stomach” (cup) above the feeding ground. (This is to prevent students from shoveling loops on the feeding ground into their cup. As an additional measure to prevent shoveling, you can choose to have students keep the cup behind their back until they’re ready to place the loops in the cup.)
3. Birds cannot touch, interfere with, or distract other birds intentionally.
4. At your signal (or whistle), the birds will collect as much food as possible.
5. After 30 seconds, repeat your signal (or whistle) to indicate that all birds must stop feeding and step outside the arena.

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6. Guide birds to their beak type “Bird Recording Station” to tally and report the total loops that they capture. **Only unbroken loops can be counted in the tally.** *Note: It is best to have your data recorders spread out in your classroom, so designate that each “Bird Recording Station” has a unique location in the room. This will prevent congestion as students move to their recording stations.*
7. Tell data recorders to bring their tally sheets to you so that you can quickly compare the tally sheets and determine the Top 3 and Bottom 3 competitors of the entire round (across beak types).
8. The Bottom 3 competitors will be crossed off on their tally sheets. They will be out of the game and will not be able to “reproduce” (add students into the activity). The Bottom 3 should return their beaks and their stomachs to you and carefully empty their “stomachs” back into the feeding area.
9. The Top 3 should be circled (*this will be important so that you can reference the data later*). The Top 3 competitors will then choose a student who has yet to play to “reproduce” as a bird that inherits their same beak type (i.e. if a 4-prong-beak bird is in the Top 3, they will choose a student observer to be a 4-prong-beak bird).
10. All birds must return unbroken Wild Loops back to the feeding area (evenly distributed).
11. Repeat steps 4–10 for five (5) generations total.

## Notes:

*If any student breaks any rule, they will immediately throw up any food they have collected. If they interfere with other birds, they will immediately be eaten by a predator (eliminated) from the game. In Generation 1, there will be four birds of each beak type: (12 birds total). In subsequent rounds the total number of players will stay the same but the individual beak-type populations could increase or decrease.*

*In the case of a tie, all individuals who tied will reproduce. If two individuals tie for last place, they will both die and exit the game.*



## Appendix B: Reporting Station Data Tables

### Bird Survival/Death Reporting Sheet \_\_\_\_\_ prong

Generation	Student Name	Number of Loops Captured
<b>1</b>		
	Total Loops Captured:	
<b>2</b>	Student Name	Number of Loops Captured
	Total Loops Captured:	
<b>3</b>	Student Name	Number of Loops Captured



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	Total Loops Captured:	
<b>4</b>	Student Name	Number of Loops Captured
Total Loops Captured:		

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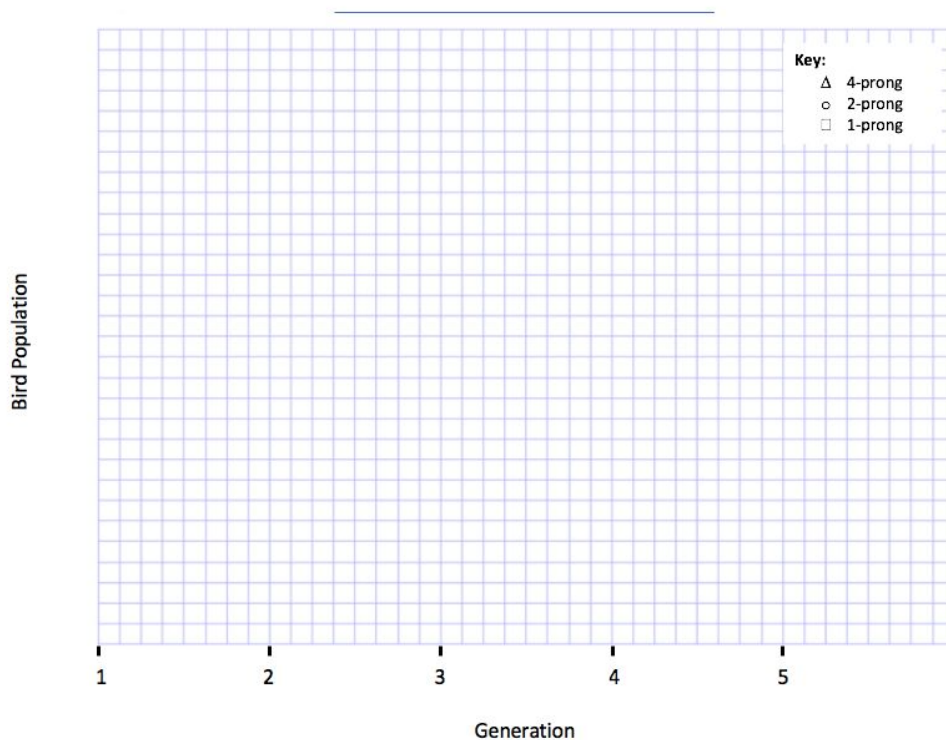
<b>5</b>	Student Name	Number of Loops Captured
Total Loops Captured:		

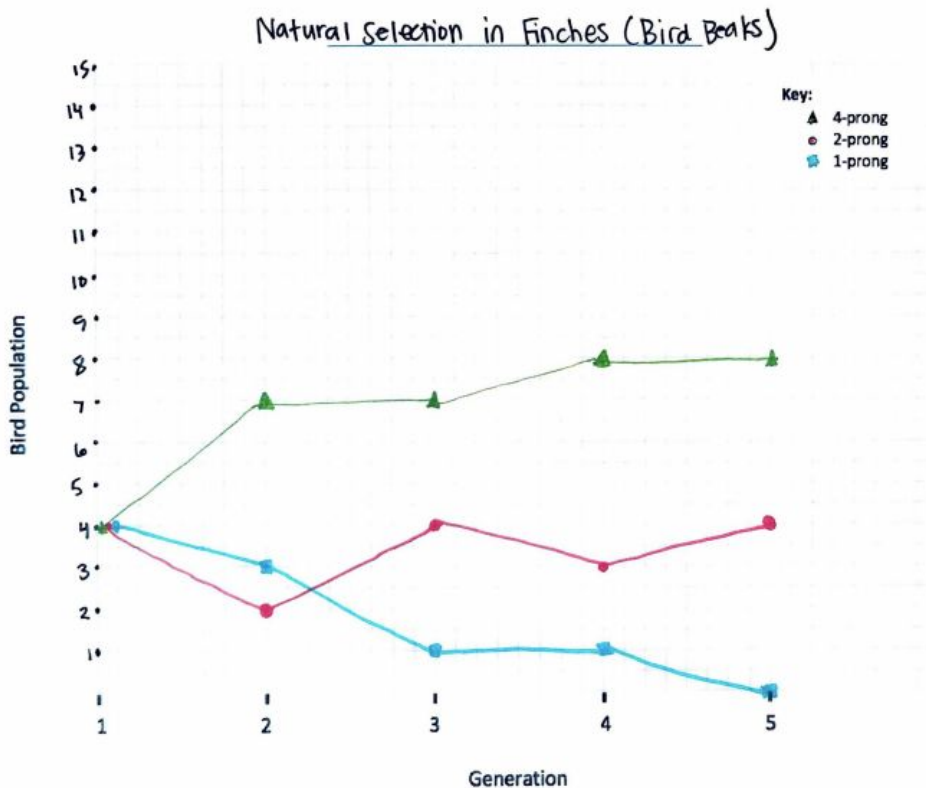
## Appendix C: Master Class Data Table

Data Table: Wild Loops

Generation	4-pronged birds		2-pronged birds		1-pronged birds	
	# Birds	# Wild Loops captured	# Birds	# Wild Loops captured	# Birds	# Wild Loops captured
1	4		4		4	
2						
3						
4						
5						

Your students will use the data from the Master Class Data Table and complete the graph below.





## Appendix D: Make a Nature Documentary!

You will have seen a brief nature documentary in *The Make* PowerPoint. Have students review the elements of it that were of most interest to them as well as how the narrator taught the audience about the environment in Singapore. After discussing the clip, students will form groups of 3–4 to write and film their own nature documentary.

To begin, students will reflect on the bird beak activity and write a script about how the population changed over time. They will need to include information/images about habitat, food sources, and other predators and prey that live on the island. Their writing should highlight the challenges to survival and reproduction and include vocabulary from the unit. The script should be long enough to use in a 3–5 minute video and contain a clear beginning, middle, and end. (*Note: If your students do not have time to film the documentaries, their scripts can act as the final Make activity.*)

Students must include:

1. Name of the documentary (ex. Rise of the \_\_\_\_\_ finch or Loss of the \_\_\_\_\_ finch).
2. Images or videos of the food and the feeding ground.
3. Information about the habitat and food sources.
4. Answers to the following questions:
  - a. What were the original and final numbers of the birds with each beak type?
  - b. What conditions caused the populations to change?
  - c. How did the distribution of traits change over time? What factor or factors caused the shift?
  - d. Which traits became more popular throughout the activity and which became less common? Why might that be?
  - e. What was the main food source in the environment of the island that the finches inhabited? Which traits were advantageous for the island? How do you know?
5. An explanation of how the activity highlights how a species adapts over time through natural selection.

## Appendix E: HHMI Biointeractive Extension Activity

Students can use the HHMI biointeractive, the Beak of the Finch, to see natural selection in action!

<https://www.hhmi.org/biointeractive/origin-species-beak-finch>