

Teacher Notes for Analyzing Finch Data

The students will use the finch graphs to help explain **why the finches changed over time**. There are several strategies you can use to help students analyze the data:

- Divide the class into groups of four students and only give them a subset of the graphs at a time. Let them work and struggle with the graphs. After sharing with their lab partners discuss as a whole group before moving on to the next set of graphs.
- Divide the class into groups of 5-6 students, each of these groups will be split in half and will get one of the subsets of the graphs. Share with all group partners and then discuss as a whole class.
- Divide the class into groups of four students; each student is responsible of explaining one graph to the whole group.

Tools for guiding the narrative:

1. Have the students record their explanations directly on the graphs or to a timeline so they have written records of their thoughts.
2. Students can use the white boards to draft the narrative.
3. The final version can be written on a poster board.
4. Sharing the stories: This could be structured in a number of different ways depending on how much time you have –gallery walk, rotate around to several other groups, switch with one other group, etc. The goal is simply to give students an opportunity to see and give feedback to the explanations of at least one or two other groups.

Some general questions that can help guiding student progress:

- What does the title of the graph tell you?
- What do the **x** and the **y** axis labels tell you?
- Notice the time period? What happened during this specific time period?
- What can you learn from the graphs?
- What relationships can you find in the graphs?
- Describe the graph in one or two sentences.
- What are you trying to figure out? What is the driving question? *Why did the beaks in finches change over time?*

More specific questions:

- How do the beak depth distribution differ?
- How does the size of the population differ? (Number of finches before and after the drought)
- How does the population changed after the drought in terms of size and beak depth?
- Why did the depth of the beak changed after the drought?
- Follow up: If the finches that survived the drought reproduce, what would the distribution of beak depth of the offspring be?

What is the graph showing?

Distribution of beak depth for finches born in 1976 and 1978:

- **Variation** in beak depth within a population. This is the phenomenon.
- Average beak depth changed from 1976 to 1978. Finches born in 1976 had a smaller beak depth (9.2mm) compared to the average finch born in 1978 (9.7mm).
- The distribution of beak depth changed; in 1976 the curve is wider compared to 1978.
- Fewer finches in 1978.

Seasonal rainfall in Daphne Major:

- Differences between the wet (lots of rain) and dry (little rain) season.
- Very little rain during the wet season of 1977, year of the drought.

Beak depth of parents and their offspring:

- Offspring tend to inherit the depth of their parents beak. Parents with larger beaks will tend to have offspring with larger beaks.
- Parents in 1978 tended to have larger beaks than parents of 1976.

Seed size chosen by finches of different beak depths (1976):

- Finches with different sizes of beak depth have different preferences for the size of seeds they will choose.
- Finches with smaller beaks will tend to choose smaller seeds, and finches with larger beaks will tend to choose larger seeds.

Distribution of beak depth of finches born in 1976:

- A large portion of the population died during the drought.
- The finches that died tended to have smaller beaks compared to the finches that survived.
- There was a long decline in population size after the drought.

Population size of finches between 1975-78

- Decline in the population size of finches in Daphne Major.
- The vertical lines show the amount of variation for each point.

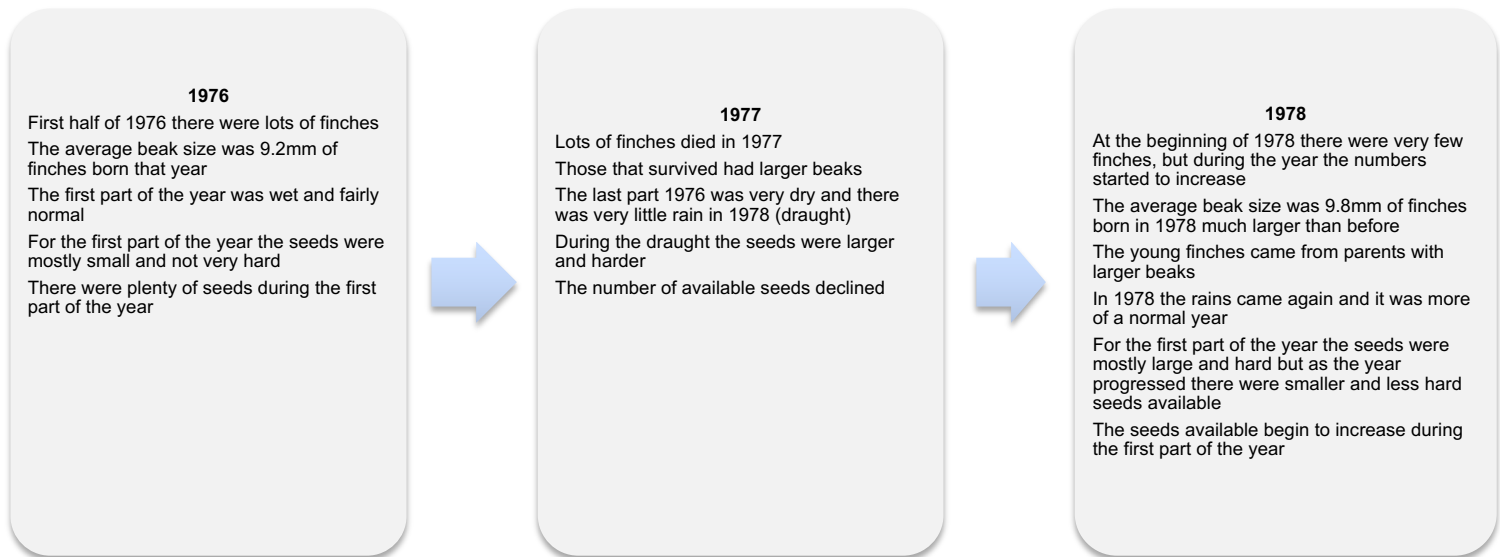
Total seed biomass available for finches to eat between 1975-78

- Significant decline in seed abundance available for finches by the end of 1977 early 1978.
- The vertical lines show the amount of variation for each point.

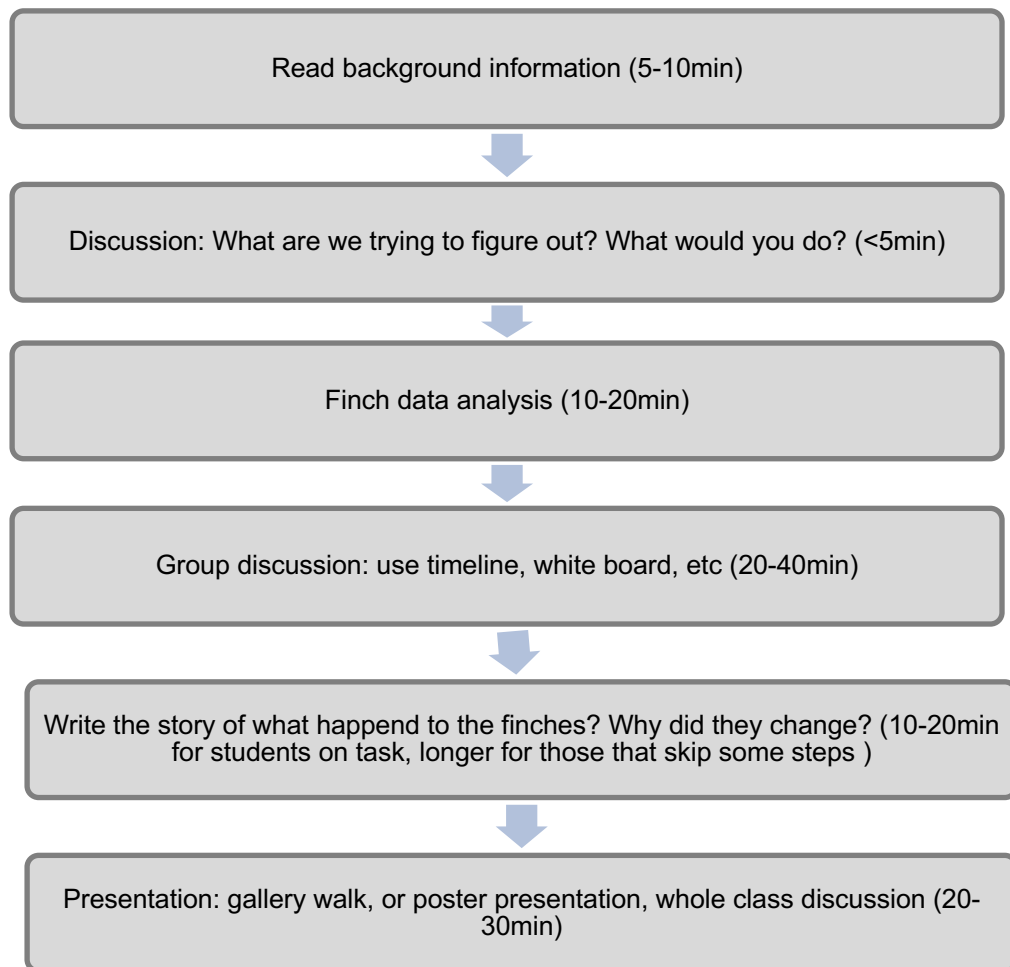
Average size and hardness of available seeds between 1975-78

- In 1977 seeds tended to be larger and harder compared to 1976 and 1977
- The vertical lines represent the variation in seed size and hardness at a specific point.

Example of a timeline



Finch activity suggested timeline



The finch story

During the year 1977 the population of medium ground finches on the tiny Galápagos island of Daphne Major fell by more than 60%. Why did so many finches die during 1977? More importantly, why were the surviving finches able to survive? Students will examine several sources of data that could be used to construct possible explanations to answer these two questions. These data include rainfall amounts, seed types and amounts, and several kinds of physical (e.g. beak depth) data about the ground finches. There is no single piece of data that students might look at that would generate a solution. Instead, students will have to coordinate multiple sources of data to understand what happened to the finches and why some could survive when most could not.

Grant's explanation for what happened to the ground finches on Daphne Major during 1977 is that the wet season of 1977 essentially never happened, causing a severe and prolonged drought. This drought drastically diminished the supply of seeds these finches rely on for food. Not only were the amount of seeds greatly diminished, but the type of seeds drastically altered. The soft seeds preferred by the finches were quickly eaten up, leaving only a hard-shelled seed known as tribulus. Tribulus seeds are covered by a hard, spiked shell that encloses four to five seeds that the finches can eat. Only the finches with larger than average beaks were able to open tribulus shells. By the end of 1977, only the largest-beaked birds in this population had survived. When they mated during the following wet season, their offspring tended to inherit larger beaks; consequently the average beak size in the population increased. **That is natural selection in a nutshell.**

Taken from: Sandoval W.A. 2003. Conceptual and epistemic aspects of students' scientific explanations. Journal of the Learning Sciences.