

Biodiversity in the Galapagos: TEACHER GUIDE

Why so many Ground Finches (*Geospiza*)?

General Preparation for the Ground Finches Activity

In this activity, students are asked to return to the phenomenon that instigated our Wormeaters the Sequel exploration: the mystery of ground finch biodiversity in the Galapagos.

*You'll need to provide each student with a copy of the **ExSp 04 Ground Finches Activity – Student Handout**.*

*You may provide the **ExSp 04 Ground Finches Map and Tree Data** as well as the **ExSp 04 Ground Finch Cards** resources to student pairs or groups of four, depending on how many students you'd like working together on the activity. Groups (whether 2, 4 or some other number) will choose a single pair of ground finch species (e.g. Vampire Finch and Medium Ground Finch) to compare.*

In their explorations of the habitat, diet and distribution of the two species they are comparing, student pairs/groups should be encouraged to offer some kind of explanation for why the two species exist (coexist) and perhaps how they diverged. Though one goal is clearly to apply their understanding of divergence (built in Wormeaters the Sequel) to the ground finch biodiversity phenomenon, the other goal here is to problematize the multiplicity of factors involved in the explanation. Be careful not to frame the activity as finding the “right answer” regarding divergence and distribution of the two species. Rather, we are trying to think about what is plausible given our expanded understanding of natural selection as a means to cause divergence between populations.

Furthermore, divergence itself does not explain the generation of new species unless it leads to reproductive isolation. This caveat is what we take up AFTER the ground finches activity in the ensuing learning segment. But your students may of course bring it up in the course of this exploration.

Guide to the Student Handout

Students are reminded of the phenomenon we introduced prior to the Wormeaters game:

*The medium ground finch (*Geospiza fortis*) lives on many of the islands in the Galapagos. Why then are there five other kinds of “ground finches” found among the islands as well? And how can our Wormeaters (the Sequel) game help us to understand this small piece of biodiversity?*

Prepare the Ground Finches Map / Data Table Handout. You can give a copy to each student or a single copy to pairs or larger groups depending on how you organize the activity.

Make sure you have the Galapagos Ground Finches Map and Data Table in front of you.



Also be sure you provide each work group with a set of the Ground Finch Data Cards found in the resources. They will need the specific diet and habitat information to make sense of ideas like divergence among the species. The data table below the map only provides very coarse information in that regard.

In your group, **pick one pair** (two species) from the six species listed in the data table to focus on. Then **work with your group to analyze the data** for these two species in order to answer the following questions.

Some pairings are going to lend to more straightforward responses to the questions that follow. If you find certain pairings confusing for your students, remove them the next time you engage in this activity. However, keep in mind the following: the goal here is not necessarily to generate a series of “correct” explanations or answers to the prompts on this handout. It is instead to have students attempt to apply their current ideas and understanding (most recently generated in the Wormeaters the Sequel game) to a real phenomenon. Their explanations may have holes, and the phenomenon might generate more questions than the class can answer. But they should be able to begin to apply their ideas about divergence and trees to the biodiversity in the Galapagos finches. Try to let them offer what they can here, understanding that you’ll have a chance to wrap up key ideas related to the model for speciation before the end of the unit. In the next learning segment, in fact, we’ll problematize how species might become reproductively isolated. So, this is not the end of the model-building by any means.

1. Why do you think both of these species exist on the islands? (Why not one?) Are there ways in which they are different?

Given they just explored divergence among populations of wormeaters due to differing diets, we expect students will focus on any dietary differences between their two chosen species. They will need the finch data cards in order to do so. However, in some cases there will be no clear dietary difference. For example, the common cactus finch and the Hispanola cactus finch have extremely similar diets. Their coexistence is best explained by the fact that they inhabit different islands in the archipelago. Let each team explore the data and answer these questions to the best of their ability. Try to avoid pushing for a correct answer and instead get them to support their inferences using the data as evidence. Reassure them that it is ok to still have questions and to want more data (which they may not have access to).

2. How might the results of our Wormeaters (the Sequel) game help you in your thinking about question #1? (*Hint: do different food sources—diets or habitat—play a role in your answer to question #1? If so, how?*) If you do not think the ideas from our game are part of the story for your two focal species, briefly state why.

Here we simply want them to talk about what role divergence plays in their answer to question #1. If they already got at that in their previous answer, have them restate it here. Again, we expect they will focus on divergence due to differing food sources (often called ecological or dietary divergence), but that may not be a key aspect of the story in the pair they’ve chosen. For this reason, it will be important for students to see the work other groups completed in their analyses of other pairings.

Next look carefully at the species tree on the back of the data sheet.

The back of the data sheet displays the evolutionary tree for the ground finches as it is currently understood. (See slides for references to source material.)

3. In our Wormeaters (the Sequel) simulation, the “divergence” (process of becoming different) among our classroom Wormeater populations was happening all at once (during the class period). What does the tree tell you about the process or timing of some of the divergence between the pair of ground finch species you chose? Record some thoughts from your group’s discussion here.

This is really a chance for them to dive back into their understanding (or lack of understanding) around trees and what they represent. Emphasis here is on getting some ideas down. Hopefully they see the unfolding pattern of divergence in the branches, one split at a time. Since the question asks them to speculate about the divergence between the two species they chose, students may struggle to answer this question. For example, if they compare vampire finches with large ground finches, they might be able to say something like “they split a long time ago”. This is relative to some of the more recent splits. You’ll want to take a look at what students are writing here and to listen-in on groups as a way to hear a bit about how they are interpreting trees. If there are real problems in their interpretation, consider taking up this tree again after the next learning segment (where you establish ideas around reproductive isolation and can map those events onto this tree).

4. In summary, why do you think so many species of ground finches exist?

Student explanations could go all sorts of different directions—ecological divergence due to differing foods (of course), migration and isolation, isolation and reintroduction, etc. This is a place where we are looking for reasoning and evidence, not a “correct” explanation.

5. Is the story of divergence between the two finch species you chose the same as what we saw in the game? Why or why not??

We hope that what might come out of this question is that the real situation is much more complex. There are many ways students could answer this question depending on which pair of finches they examined closely.

6. What questions do you and your group still have?

This is a catch-all space for students to record their questions. There may be many.

Make sure at least one member of the group is ready to share out a brief summary of your thinking and that everyone can relay at least one key idea that came up.