

Natural Selection *at a glance:* (approximately 7-10 traditional class days)

| LS | Model Move | Est Time (min) | Overview | What did we figure out? |
|----|------------|----------------|---|---|
| 1 | P | 15-20 | Present the phenomenon of species' traits changing over time. In this learning segment students will observe the phenomenon that traits change over time. The slides contain a brief overview of three stories of population change: one about changes in the frequency of certain colors variants in peppered moths over time, another about antibacterial resistance, and another about an increase in average beak depth in Galapagos Ground Finches (which students will return to in segment 3). | We explored the idea of changes within a population over relatively short periods of time and identified this as a phenomenon that we want to try and explain. We generated a shared way to describe this phenomenon. |
| 2 | P→Q | 10-15 | Students will have opportunities to generate some questions they have about their observations of the three stories. The goal is for students to identify a question that allows them to explore the underlying mechanism causing the change in traits. The question can be similar to, "How do traits/species/characteristics change over time?" The final question should be posted somewhere in the classroom and written on the students' doodle sheet so that they have a constant reminder of what they are investigating. | After examining the phenomena in learning segment 1 we spent some time generating a question that will guide our work as we move through the triangle |
| 3 | Q→M | 15-20 | Students brainstorm initial ideas to answer the driving question. Students should begin brainstorming initial explanations for what might have led to the observed changes in the three stories. We hope to tap into students' curiosity and prior knowledge. This will be a <u>very</u> speculative process, some ideas will be great, some not that great, some will be well developed others not. At this point the purpose is to surface their thinking and not to evaluate the ideas. In the subsequent learning segments, we will explore the ideas in more depth and decide if they should stay, go, or be revised. | We explored our initial ideas about how traits change in populations over time and put our ideas in writing so we can refer to them as we learn more. |
| 4 | P | 45-50 | Investigation of the Galapagos Finches. With the driving question in mind, students look more closely at the Galapagos finches. After reading background information individually, student groups will review graphs on weather, food, and finch beak size (depth). [note: these resources are | We explored a comprehensive dataset related to the change in the distribution of finch beak size on the Galapagos in the 1970s. We organized the data so that we could see what happened with regard to rainfall, distribution of the trait, seed availability, etc. Next, we will discuss what all this might mean and will continue to refine our ideas about trait change over time. |

| | | | | |
|---|-----|---------|--|--|
| | | | in a separate zip file below from other NS resources]. | |
| 5 | P→M | 30-40 | Students work together to construct an explanation (or “story”) accounting for what happened with the finches. They will make those ideas public and utilize evidence to support their claims, compare their ideas to those of other groups and then return to the initial model they developed in Segment 3. The class will work together to refine general model ideas based on the specific case of the finches. | We used our detailed exploration of the finches on Daphne Major to first develop a causal account for what happened to them over time and then we used these ideas to revise our initial model for how populations change over time. |
| 6 | M | 250-300 | Students have a range of opportunities to further investigate specific ideas in their model in service of evaluating and revising their model. This segment consists of a series of activities that will help students to explore and deepen their ideas about trait change to see if they are also seen across other species. | We continued to refine our model for trait change over time in populations by using some simulations and investigations. We now have a complete model that we are ready to apply and refine by returning to the finches. |
| 7 | M→P | 40-50 | Students use their model to create a new and improved model-based explanation to answer their question about the finches. | Originally, we wrote our stories about what happened to the finches as a way to generate some model ideas. Then we spent some time testing and revising those ideas and in this learning segment we took our more formalized model and used it in a more explicit way to re-visit our finch stories. Our goal was to make sure we addressed all the elements of our model in our finch explanation. Next, we’ll take a look at some other ideas and compare them to our current model. |

Continued on next page...

| | | | | |
|----|-----|-------|--|---|
| 8 | M | 20-30 | <p>Comparison of the class model with two other models. After generating their own model for change over time, students are ready to compare it to two other models proposed more than 100 years ago. <i>Why do traits in populations change over time</i>, has been and still is the “driving question” for many researchers. We provide two different models developed in the 1800s for students to compare with their own model. They can use the text version of the models (Models of Species Change Over Time) to underlie differences and similarities. One was proposed by Lamarck, the other by Darwin and Wallace separately.</p> <p>Before comparing the models, it is a good idea to give students the historical background of when and why these ideas were proposed.</p> <p>Why did it take Darwin so long to come up with this model if it took students just few weeks/hours? These two short videos will provide some answers and are an optional resource for you to use:</p> <p>Who was Charles Darwin (6:30 min)</p> <p>The life of Alfred Russel Wallace (7:00 min)</p> | <p>We compared historical models for trait change to our model and to each other. We can now use our refined ideas to take one more pass at our finch explanations.</p> <p>We compared historical models for trait change to our model and to each other. We can now use our refined ideas to take one more pass at our finch explanations.</p> |
| 9 | M→Q | 10-15 | <p>Students will revisit their finch explanations one more time to remove any statements or ideas that may be Lamarckian and/or not consistent with Darwin’s theory of natural selection. We will also return to our general model statements and revise them, if necessary.</p> | <p>Just like scientists, we revisited our explanations to tune them and make sure everything we said is consistent with a Darwinian viewpoint. Next, we see if our model is useful when explaining phenomena other than the finches.</p> |
| 10 | M→P | 20-30 | <p>Application of the model. Students will apply their model to explain a new phenomenon. Now that students have experience in applying their model to a phenomenon (the finches’ beaks), choose between two scenarios about different phenomena for students to explain using their model of natural selection. Or this would be a good opportunity to add in a socially relevant scenario that is geared toward your students in more specific ways.</p> | <p>We had an opportunity to apply our model of natural selection to at least one other scenario.</p> |