OIMB GK12 CURRICULUM

**6th Grade** **two 45 minute sessions**

# MODELING NATURAL SELECTION

**Oregon Science Content Standards:**

**6.2** Interaction and Change: The related parts within a system interact and change.
**6.2L.2** Explain how individual organisms and populations in an ecosystem interact and how changes in populations are related to resources.
**6.3** Scientific Inquiry: Scientific inquiry is the investigation of the natural world based on observations and science principles that includes proposing questions or hypotheses, and developing procedures for questioning, collecting, analyzing, and interpreting accurate and relevant data to produce justifiable evidence-based explanations.
**6.3S.2** Organize and display relevant data, construct an evidence-based explanation of the results of an investigation, and communicate the conclusions.

**Goals:**

- Students will be able to explain why different species might be found on different islands
- Students will be able to understand why some species are endemic to islands
- Students will be able to understand some of the very basic principles associated with natural selection

**Concepts:**

- Natural selection is a scientific process that can be observed.
- The presence of different species on different islands within an island chain could be attributed to natural selection.
- Species endemic to an island could be present on the island as the result of natural selection.
- The evolution of camouflage in a species can be attributed to natural selection.

**Materials:**

- A room big enough to run around
- 2 tables- one covered with green butcher paper and one covered with black butcher paper.
- 160 red squares (not more than ½" x ½"), 160 (each) blue, green, yellow, and black squares. They can be cut out of butcher paper or construction paper, but the green and black should match the green and black on the tables.
- Natural selection worksheet, one per student

- Colored Pencils for the bar graphs
- It is suggested that the chart and graph pages be projected so that the students can keep track of the data on their own charts, as it is generated by the class as a whole, and to show the students how to construct bar graphs if they are unfamiliar with their construction.

**Lesson Plan:**

**Session 1**

1. Before the lesson, prepare the class in the following way: Securely tape a large piece of green butcher paper on one table, and black butcher paper on a second table (or both on one long table). The size of the paper depends on the size of the table, but 3 feet square is probably the minimum size. A 3-foot section of butcher paper should do the trick. One square is green, and the other is black. Again, make sure the edges are taped down well. Across the green square, sprinkle 80 red, 80 yellow, 80 green, 80 blue, and 80 black squares, not larger than ½" x ½". Sprinkle the same number of colored squares across the black square. As the students walk into the room, have them walk past the two squares, and note all the colors in both squares.
2. Show the students examples of birds that are (were) endemic to New Zealand, that are found nowhere else on the planet, i.e. kiwis, takahe, and moas. Explain the natural history of New Zealand (There were no natural predators on the islands from the birth of the islands to the time that the Maori people first settled the islands. Many birds on the islands are flightless. Following the arrival of the Maori people, and the rats and dogs they carried on their wakas, some species, such as the Giant Moa, went extinct. The Europeans introduced stoats, which are continuing the decimation of native bird populations.)
3. What is a good *scientific* reason that the ancestors of the birds on these islands might have lost the ability to fly? Stress the word *scientific*. Talk about some of the students' ideas.
4. Explain to the students that a bird's ability to fly is controlled by its genes, or DNA. DNA is a blueprint that instructs a body to form wings, muscles, and other body structures. Some birds have DNA that instructs their body to make the body structures necessary to fly. Other birds have DNA that does not make the necessary body structures. DNA can also determine other things about birds' bodies (or our bodies). What other things does DNA 'control'? Point out that DNA can also determine what color things are. Point out different students in the room that have different colors of hair or eyes. The reason that a red-headed boy has different colored hair than a blonde-haired boy is because of differences in their DNA (unless their hair is dyed of course). Have the students think of other

animals that come in a lot of different colors. Tell them that, for this activity, they will be observing 'butterflies'. The 'butterflies' come in all different colors. What makes them all different colors? (Hopefully, they will say DNA. If not, you may need to go over this step again.)

5. Draw the students' attention once again to the two squares taped to the table. Read the following:
   Once upon a time, there was a chain of volcanic islands many miles away from the mainland. One spring, several butterfly cocoons were blown over to the island chain by a hurricane. Many butterfly cocoons landed on an island covered with thick forests. Other cocoons landed on an island that was very dry, with few plants.
6. Have the students answer Questions 1 and 2. Call for answers, and then tell the students that the green square represents the forest island, and the black square represents the dry island. The different colored mini-squares each represent a butterfly. Read the following:
   The butterflies reproduced for many generations on the islands until there were large populations of butterflies on both islands. Because of differences in their DNA, the butterflies, although all the same species, were many different colors. Then, one summer, several insectivorous birds flew over to the islands and began eating the butterflies as they flew around. The birds stayed. We are going to collect data on how the butterfly population on each of the islands changed after the birds came to the island.
7. Point out that there are the same number of each color of butterfly on both islands- 80 yellow on both, 80 red on both, etc. Have the students remind you about what it is that makes the butterflies different colors.
8. Have the students answer questions 3-7. Stress that, initially, the populations look the same.
9. Give the students the following instructions:
   You are the insectivorous birds that are going to eat the butterflies as you swoop by. You will stand up in a single file line along one wall of the room. You are going to run around the room 3 times. When you swoop down past an island (you will be told which one), you need to pick up a butterfly to eat. If you are too slow (if you aren't moving quickly as you pass the 'island'), you will be eaten by an island jaguar, and cannot participate until we move to the next island. Also, you need to use your beak to pick up the butterflies- your beak consists of TWO fingers. If any bird uses more than two fingers to pick up a butterfly as they swoop past, then they must be a mutant whose beak doesn't work correctly, and will die, and cannot participate until we move to the next island. Therefore, make sure at all times you are *running as you go past the table- don't slow down!* And that you *only use two fingers to pick up the 'butterflies'.* It is OK if you pick up

more than one butterfly as you swoop past, but if you don't get any butterflies at all after three times past the island, then you have starved to death, and cannot participate until we move to the next island. When you pick up a butterfly, keep it in your hand until you are given further instructions.

10. Once you have given these instructions to the students, quiz them to make sure that they understand their instructions and the rules. Then, carry out the activity (as described in step 9, and below). It is helpful if you stand by the paper squares to monitor which students have to sit out for further rounds because they were going too slow, using more than two fingers, etc.
11. Start with the students swooping past the BLACK (dry) island. After all students have run around the room 3 times, picking up butterflies from the BLACK square as they pass the table, count how many red butterflies were eaten (it is easy to do this if you have students hold the number of reds that they caught above their head. If they caught two reds, they need to hold up two fingers. If they caught four reds, they hold up four fingers, etc.) Count how many butterflies of each color were "eaten", and record the numbers. Have the students place the eaten butterflies on their desks, and then have them return to their line at the wall for another round. Carry this out up to 4 times, or until about 3/4 of the dots have been eaten- whichever comes first. At the end of each round, count how many of each butterfly color was eaten. After you have done this, discuss with the students which colors were eaten the most, and which were eaten the least (hopefully, that will be the black). Discuss why they think the blacks were not eaten very much (harder to see as they ran quickly past the table).
12. Repeat Step 11, but using butterflies from the GREEN square. As before, at the end of each round, count how many of each butterfly color was eaten. After you have done this, discuss with the students which colors were eaten the most, and which were eaten the least (hopefully, that will be the green for this round). Discuss why they think the greens were not eaten very much.

**Session 2**

1. Review what happened during the first session, with the birds swooping down eating butterflies off of each island.
2. Have students fill in their data tables with the data collected last time.
3. Have students make bar graphs of the (dark) columns in their data table, of the number of butterflies *left* (not eaten) at the end of each generation. It is helpful if they color these in with the matching colors. Then, the students can visually see which colors were left over at the end. It may be helpful at this point to also talk about the usefulness of bar graphs as a visual representation of data. (A series of bar graphs after each generation illustrates the process of change. Alternatively, the students could graph only the final population.)

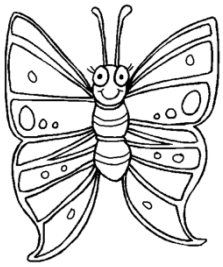
4. Discuss what happened to the two populations. Do they look the same now? What caused the two populations to become so different? (Different predation resulting in different survival.) Why does the population on one island now look different from the population on the other island? Discuss how, eventually, the populations on different islands can diverge to the point that they can no longer interbreed, and are no longer the same species.

**Assessment:** Students' learning is assessed using the Natural Selection worksheet and their graphs of the data collected in the activity, as well as from the discussion about the process of natural selection at the end of the activity. Review and reiterate with students important aspects from the lesson, and then see, through discussion, if the students are able to explain how the process of natural selection might have been responsible for the presence of so many flightless birds in New Zealand (few ground predators).

**GK12 Fellow:** Myndee McNeill (Modified and simplified from a lesson done with my high school students. That lesson was developed based on an activity I did at a Weber State University Earth Science Workshop many years ago.)

Name: _____

# Modeling Natural Selection: Butterflies



1. What colors would you mostly see in the butterflies' habitat on the first (forested) island?

2. What colors would you mostly see in the butterflies' habitat on the second (dry) island?

**Observations:**

3. Does it look like there are any more of one color than another on the first island?

4. Does it look like there are any more of one color than another on the second island?

5. **Do the populations on both islands look the same**?

**Make a prediction:**

6. What color butterflies do you think that birds on the black island will eat?

7. What color butterflies do you think that birds on the green island will eat?

**DO THE ACTIVITY AND COLLECT THE DATA IN THE CHARTS ON THE NEXT PAGE. Then we will answer these questions together.**

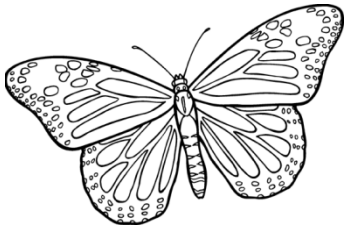
8. What colors of butterflies were eaten on the black island?

9. What colors of butterflies were **not** eaten on the black island?

10. What colors of butterflies were eaten on the green island?

11. What colors of butterflies were **not** eaten on the green island?

**12. Now, at the end of the activity, do the populations on both islands look the same?**



**Black Island**

| Color | Start with | # eaten? | # left? | # eaten? | # left? | # eaten? | # left? | # eaten? | # left? | # eaten? | # left? |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Red** | 80 | | | | | | | | | | |
| **Yellow** | 80 | | | | | | | | | | |
| **Green** | 80 | | | | | | | | | | |
| **Blue** | 80 | | | | | | | | | | |
| **Black** | 80 | | | | | | | | | | |

**Green Island**

| Color | Start with | # eaten? | # left? | # eaten? | # left? | # eaten? | # left? | # eaten? | # left? | # eaten? | # left? |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Red** | 80 | | | | | | | | | | |
| **Yellow** | 80 | | | | | | | | | | |
| **Green** | 80 | | | | | | | | | | |
| **Blue** | 80 | | | | | | | | | | |
| **Black** | 80 | | | | | | | | | | |

Make a graph of the butterfly populations on the black island and on the green island. (See example on the board)

Black Island Butterfly Population

Green Island Butterfly Population