Geographic Isolation and Speciation

Directions: Please read the following information carefully and answer all questions on a separate piece of paper using PEN!!!

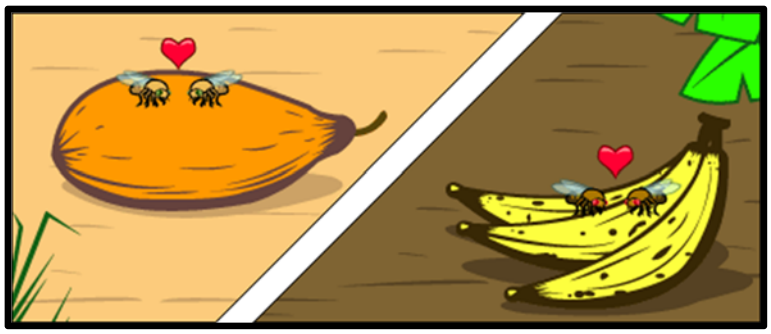
What is geographic isolation?

One population of organisms separated into two smaller populations by a physical barrier such as mountains, bodies of water, deserts, and valleys. Human modification of the environment can also cause geographic isolation of populations (such as shopping malls and large expressways).

How can geographic isolation lead to speciation (the dividing of one species into separate, distinct species over time)?

Remember! Species is defines as organisms that share the most common characteristics and are able to mate and produce offspring that are fertile (make their own offspring).

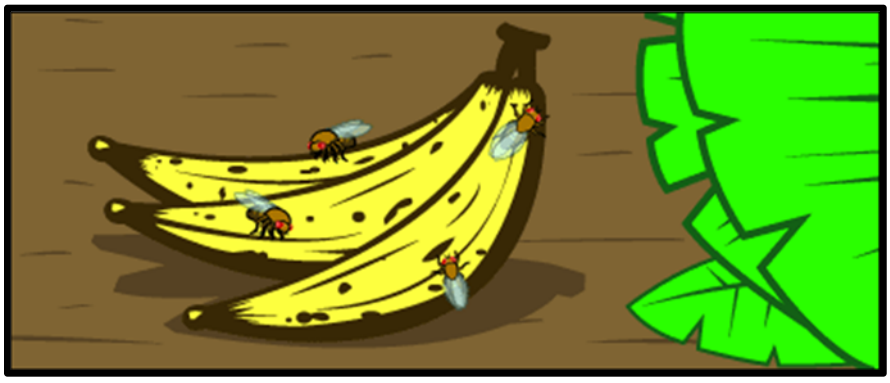
So, here's a little story to help you understand how geographic isolation can lead to speciation …….



A population of fruit flies are enjoying life and reproducing. Some of the fruit flies like mangos; some like bananas.

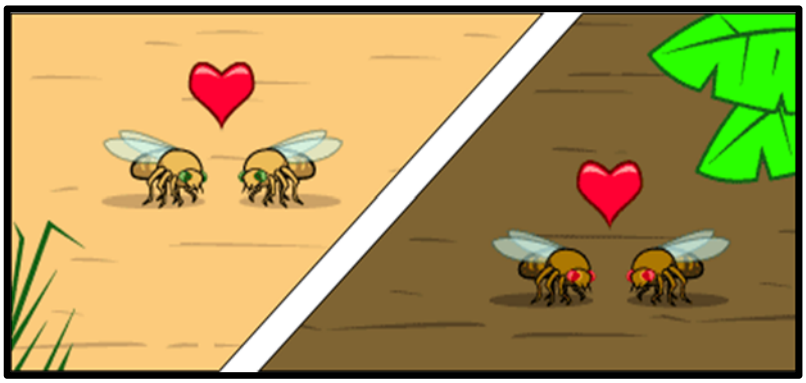
Today there are cheerfully laying their eggs in their favorite mushy foods when suddenly…

DISASTER STRIKES!



A hurricane washes the bananas and the immature fruit flies they contain out to sea. The banana bunch eventually washes up on an island off the coast of the mainland. The fruit flies mature and emerge from their slimy nursery on the lonely island.

The two portions of the population, mainland and island, are now too far apart for gene flow to unite them. At this point, speciation has not occurred — any fruit flies that got back to the mainland could mate and produce healthy offspring with the mainland flies.



The populations diverge: Ecological conditions are slightly different on the island, and the island population evolves under different selective pressures and experiences different random events than the mainland population does. Structural body features, food preferences, and courtship displays change over the course of many generations of natural selection.

Generations later, the fruit flies are happy going about their lives on the island when…….. DISASTER STRIKES AGAIN!

When another storm hurricane reintroduces the island flies to the mainland. The Island fruit flies cannot mate with the mainland flies since they've evolved different courtship behaviors. The few that do mate with the mainland flies, produce inviable (sterile) eggs because of other genetic differences between the two populations. The lineage has split now that genes cannot flow between the populations and they are now two separate species.

So what exactly happened?

1. Different fruits may have been abundant on the island.
2. The island population of fruit flies were “selected” to specialize on a particular type of fruit.
3. Those fruit flies that could not adapt to the changed environment died. Those that lived passed their genes to their offspring.
4. Over time, the island fruit flies evolved a different food preference than the mainland flies.
5. When the island fruit flies were re-introduced to the mainland population, they hung around the fruit they liked; the island population hung around the fruit they liked.
6. Chances of intermating (island fruit flies and mainland fruit flies) was reduced, so gene flow between the groups was stopped.
7. Once gene flow is stopped or reduced, larger genetic differences between the groups accumulate to a point that they are now **reproductively isolated** and can no longer mate and have viable offspring.
8. At this point the island and mainland fruit flies are considered two separate species.

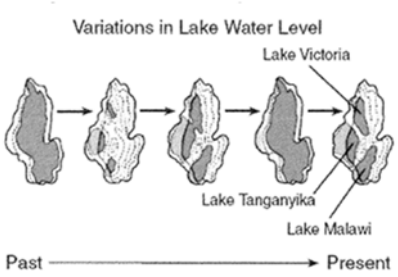
In the fruit fly example, some fruit fly larvae were washed up on an island, and speciation started because populations were prevented from interbreeding by geographic isolation. Scientists think that geographic isolation is a common way for the process of speciation to begin: rivers change course, mountains rise, continents drift, organisms migrate, and what was once a continuous population is divided into two or more smaller populations.

Adapted from http://evolution.berkeley.edu/evolibrary/article/evo_01/speciation

Questions: Please answer these questions on separate paper in FULL SENTENCES in PEN. They will be collected.

1. Although tigers and lions can be mated to produce offspring that are ligers, scientists do not consider ligers to be a separate species. Explain why.
2. Define geographic isolation.
3. A large highway is being planned to be built through a large expanse of desert. How could this barrier lead to geographic isolation?
4. What is reproductive isolation?
5. In a brief paragraph, describe how a geographic barrier can lead to speciation.
6. In order for speciation to occur, there also has to be genetic variations within each population that differ. Explain how genetic variations occur.

Base your answers to questions 7-9 on the information below and what you have learned about evolution.



The three great lakes in Africa (Victoria, Tanganyika, and Malawi) contain a greater number of fish species than any other lakes in the world. Lake Malawi alone has 200 species of cichlid fish. The diversity of cichlid species in these African lakes could have been caused by changes in water level over thousands of years. According to one hypothesis, at one time the three lakes were connected as one large lake and all the cichlids could interbreed. When the water level fell, groups of cichlids were isolated in smaller lakes as shown in the diagram. Over time, the groups of cichlids developed genetic differences. When the water levels rose again, the isolated populations were brought back into contact. Due to significant genetic differences, these populations were unable to interbreed. Variations in water level over thousands of years resulted in today's diversity of cichlid species.

7. Which discovery would support this explanation of cichlid diversity?
   (1) The water level changed little over time.
   (2) The local conditions in each of the small lakes were very different.
   (3) Differences between cichlid species are small and interbreeding is possible.
   (4) Once formed, the lakes remained isolated from each other.

8. As the water level of the lakes changed, many species of cichlids survived while others became extinct. State why some species survived while others became extinct.

9. Each cichlid population is genetically different from the other cichlid populations. State *one* reason for these genetic differences.