

EVOLUTION

Presentation Overview

Learning Outcome Addressed in this Resource

1. Describe the history and process of evolution

- describe the basic structure of deoxyribonucleic acid (DNA) with reference to the double helix, sugar-phosphate backbone, nitrogenous bases (A, T, C, G), complementary base pairing (A-T, C-G)
- explain the role of DNA in evolution
- discuss the evolutionary theories of past and present including the ideas of Lyell, Malthus, Lamarck & Darwin
- describe the five agents of evolutionary change: mutation, genetic drift, gene flow, non-random mating, and natural selection
- differentiate among and give examples of convergent evolution, divergent evolution, and speciation
- compare the gradual change model with the punctuated equilibrium model of evolution

Unit Outline

Below is a list of resources included for this presentation package. Please note that each category will show as a separate folder in your desktop once you have selected and opened the unit folder. Each item is listed in the recommended order of presentation.

<u>Powerpoint Presentations</u>	<i>Learning Outcomes and Achievement Indicators Addressed</i>
<ul style="list-style-type: none"> • Evolution: The role of DNA 	<ul style="list-style-type: none"> • 1 <ul style="list-style-type: none"> ○ describe the basic structure of deoxyribonucleic acid (DNA) with reference to the double helix, sugar-phosphate backbone, nitrogenous bases (A, T, C, G), complementary base pairing (A-T, C-G) ○ explain the role of DNA in evolution
<ul style="list-style-type: none"> • Historical and Current Theories to explain Variation 	<ul style="list-style-type: none"> • 1 <ul style="list-style-type: none"> ○ discuss the evolutionary theories of past and present including the ideas of Lyell, Malthus, Lamarck & Darwin
<ul style="list-style-type: none"> • Agents of Evolutionary Change 	<ul style="list-style-type: none"> • 1 <ul style="list-style-type: none"> ○ describe the five agents of evolutionary change: mutation, genetic drift, gene flow, non-random mating, and natural selection
<ul style="list-style-type: none"> • Evolutionary Types and Models 	<ul style="list-style-type: none"> • 1 <ul style="list-style-type: none"> ○ differentiate among and give examples of convergent evolution, divergent evolution, and speciation ○ compare the gradual change model with the punctuated equilibrium model of evolution

<u>Student Templated Worksheets</u>	Learning Outcome Addressed (refer to descriptions above)
<i>Please note: Achievement indicators addressed are similar to those of the powerpoint presentation above that they correspond with.</i>	
• Evolution: The role of DNA	• 1
• Historical and Current Theories to explain Variation	• 1
• Agents of Evolutionary Change	• 1
• Evolutionary Types and Models	• 1

Agents of Evolutionary Change

NAME _____

DATE _____

In this presentation of notes we will:

- describe the five agents of evolutionary change: mutation, genetic drift, gene flow, non-random mating, and natural selection

Mutation

What is a mutation?

Changes to the nucleotide sequence in the genetic material of an organism that occur because of



-
-
-

Mutations create _____ and can either be _____ according to the type of _____

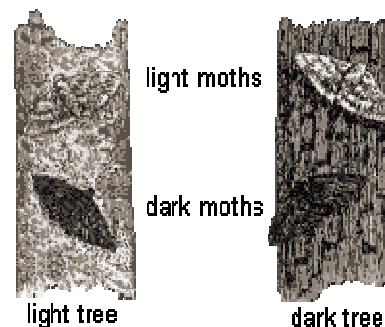
Most mutations are actually very minor and _____ and many mutations are _____

Mutations are the main provider of _____

If a mutation produces a variation that _____ it will be _____ . If the mutation is _____ it will be _____

Example: The Peppered Moth

The evolution of the peppered moth over the last two hundred years has been studied in detail. Originally, the vast majority of peppered moths had light coloration, which effectively camouflaged them against the light-colored trees and lichens which they rested upon. However, because of widespread pollution during the Industrial Revolution in England, many of the lichens died out, and the trees that peppered moths rested on became blackened by soot, causing most of the light-colored moths, or typical, to die off from predation. At the same time, the dark-colored, or *melanin*, moths, *carbonaria*, flourished because of their ability to hide on the darkened trees.



Once the gene has been selected for by the environment the gene will....

Over time, this process may result in.....

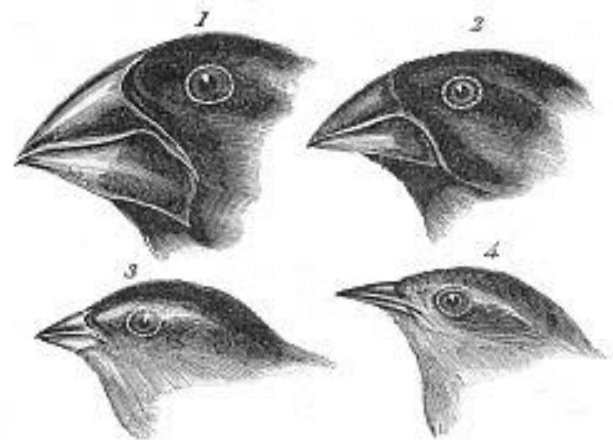
In other words, natural selection is the mechanism by which.....

The finches to the right were discovered by Darwin on his voyage on the HMS Beagle. He noted that each of the birds lived on a separate island in the Galapagos archipelago but seemed to be somewhat related. Each of the finches beaks seemed to be adapted to _____.

Darwin theorized that at one time all of the islands were _____.

Eventually the islands separated and over time the species experienced _____.

The environment (in this case food source) selected for _____.



- 1. Geospiza magnirostris
- 2. Geospiza fortis
- 3. Geospiza parvula
- 4. Certhidea olivacea

Finches from Galapagos Archipelago

Genetic Drift

What is Genetic Drift?

Genetic Drift depends upon

Genetic Drift can

Analogy of Genetic Drift

Try this as a class as you read it....

Imagine representing organisms in a population with a large number of marbles, half of them red and half blue. These two colors correspond to two different outcomes for a gene present in the population.

Put 10 red and 10 blue marbles in a jar; this represents a small population of these organisms. Each generation the organisms in this population will reproduce at random and the old generation will die.

To see the effects of this, randomly pick a marble from the jar and put a new marble of the same color as the one you picked into a second jar. After your selected marble has "reproduced", put it back, mix the marbles, and pick another. After you have done this 20 times, the second jar will contain 20 "offspring" marbles of various colors. This represents the next generation of organisms.

Now throw away the marbles remaining in the first jar - since the older generation of organisms eventually die - and repeat this process over several generations.

Since the numbers of red and blue marbles you pick out will fluctuate by chance, the more common color in the population of marbles will change over time, sometimes more red: sometimes more blue. It is even possible that you may, purely by chance, lose all of one color and be left with a jar containing only blue or red offspring.

When the jar only contains one color (one outcome for a gene), say red, the other outcome, in this case the blue, has been removed or "lost" and the remaining outcome (red) becomes fixed. Given enough time, especially in a small population, this outcome is nearly inevitable

Source: http://en.wikipedia.org/wiki/Genetic_drift

Gene Flow

Definition:

If genes are carried to a population where they didn't previously exist then...

Effects of Gene Flow on Evolution

Within a population:

Across populations:

Would sedentary organisms have a higher or lower rate of gene flow?

Non-Random Mating

Mating that has..

Occurs when the possibility that two individuals in a population will mate is..



Ex. Humans

In most human populations, people select mates

whether they be appearance, cultural values,
social rules, stature or personality

Non-random mating works ...

Agents of Evolutionary Change

NAME _____

DATE _____

In this presentation of notes we will:

- describe the five agents of evolutionary change: mutation, genetic drift, gene flow, non-random mating, and natural selection

Mutation

What is a mutation?

Changes to the nucleotide sequence in the genetic material of an organism that occur because of



- **Errors in DNA replication when making new cells**
- **Exposure to UV or radiation**
- **Mutagens and/or viruses**

Mutations create **variation in gene pools** and can either be **favorable or unfavorable** according to the type of **mutation and the environment**

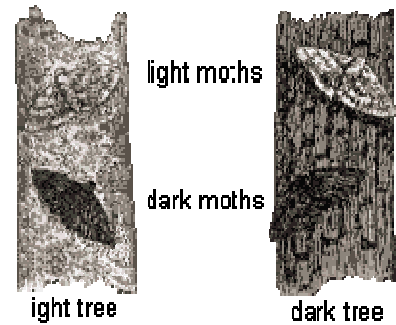
Most mutations are actually very minor and **do not impact an organisms fitness** and many mutations are **repaired by the cells before they become permanent.**

Mutations are the main provider of **new traits upon which natural selection will act.**

If a mutation produces a variation that is favored it will be passed on to future generations. If the mutation is unfavorable it will be reduced in frequency in a population.

Example: The Peppered Moth

The evolution of the peppered moth over the last two hundred years has been studied in detail. Originally, the vast majority of peppered moths had light coloration, which effectively camouflaged them against the light-colored trees and lichens which they rested upon. However, because of widespread pollution during the Industrial Revolution in England, many of the lichens died out, and the trees that peppered moths rested on became blackened by soot, causing most of the light-colored moths, or typical, to die off from predation. At the same time, the dark-colored, or *melanin*, moths, *carbonaria*, flourished because of their ability to hide on the darkened trees.



Since then, with improved environmental standards, light-colored peppered moths have again become common, but the dramatic change in the peppered moth's population has remained a subject of much interest and study, and has led to the coining of the term “**industrial melanism**” to refer to the genetic darkening of species in response to pollutants.

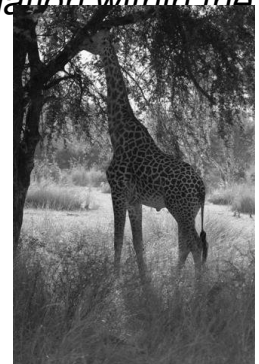
Example Source: http://en.wikipedia.org/wiki/Peppered_moth_evolution

Natural Selection

- Natural selection is the process by which... **environmentally favorable genetic traits become more common in successive generations of a population of reproducing organisms, and unfavorable traits become less common**
- Natural selection acts on the **observable characteristics of an organism**. The organisms that have the **favorable genetic traits** will go on to live and reproduce and likely **produce offspring with those favorable traits**.

Ex. Back to Lamarck's giraffe...

Where Lamarck would have thought that the giraffe was able to grow a longer neck, natural selection would state that due to genetic variation within the species, there were long and short necked giraffes. The giraffes with the longer necks were able to obtain larger amounts of food and therefore lived longer and healthier lives. They went on to reproduce until eventually there were only giraffes with long necks and the short neck gene had been eliminated.



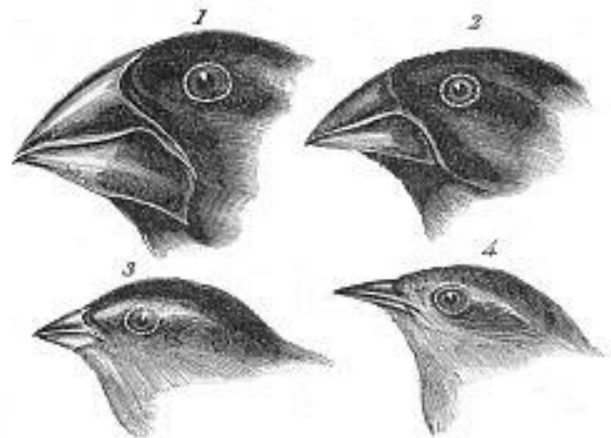
Once the gene has been selected for by the environment the gene will....
increase in frequency over the generations to come

Over time, this process may result in..... **adaptations that specialize organisms for particular ecological niches and may eventually result in the emergence of new species.**

In other words, natural selection is the mechanism by which..... **evolution may take place in a population of a specific organism.**

The finches to the right were discovered by Darwin on his voyage on the HMS Beagle. He noted that each of the birds lived on a separate island in the Galapagos archipelago but seemed to be somewhat related. Each of the finches beaks seemed to be adapted to **the type of food it ate.**

Darwin theorized that at one time all of the islands were **one and that only one species of bird existed.** Eventually the islands separated and over time the species experienced **genetic variations due to what we now know as mutations in genetic material.** The environment (in this case food source) selected for a **certain type of beak and thus over time new species emerged.**



1. Geospiza magnirostris
3. Geospiza parvula

2. Geospiza fortis
4. Certhidea olivacea

Finches from Galapagos Archipelago

Genetic Drift

What is Genetic Drift? **Random variations in which organisms manage to reproduce leading to changes over time in the genetic make-up of a population**

Genetic Drift depends upon **a SMALL population size as there is more of a chance for change to occur permanently. In larger populations there is more of a normalizing effect which counteracts genetic drift.**

Genetic Drift can **over shadow natural selection in small**

Analogy of Genetic Drift

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Source: http://en.wikipedia.org/wiki/Genetic_drift

Gene Flow

Definition: any movement of genes from one population to another

If genes are carried to a population where they didn't previously exist then...
genetic variation in that population increases

Effects of Gene Flow on Evolution

Within a population: **introduces to reintroduces genes to a population which increases genetic variation**

Across populations: **by moving genes around it can make distant populations genetically similar to one another which reduces the occurrence of speciation (the emergence of a new species)**

Would sedentary organisms have a higher or lower rate of gene flow?

Non-Random Mating

Mating that has **NOT occurred due to chance and therefore has had human interference**



Occurs when the possibility that two individuals in a population will mate is **not the same for all possible pairs of individuals**

Ex. Humans

In most human populations, people select mates **non-randomly for their specific traits** whether they be appearance, cultural values, social rules, stature or personality

Non-random mating works **against natural selection as it is not only the environment selecting for certain traits.**