

EVOLUTION: NATURAL SELECTION

10 APRIL 2013

Lesson Description

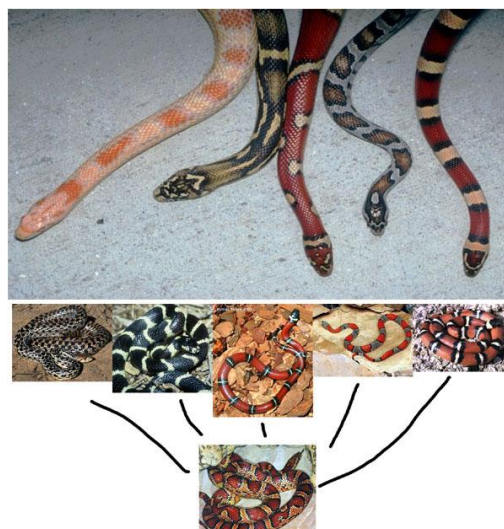
In this lesson, we:

- Cover the similarities and differences between natural and artificial selection,
- Discuss species as a definition
- Look at speciation as a mechanism for producing new species – allopatric /geographic isolation and sympatric speciation.
- Look at examples of reproductive isolation mechanisms
- Discuss different lines of evidence and the contribution of many scientists.
- Revise:
 - Fossil record (Grade 10)
 - Modification by descent (Grade 11)
 - Biogeography (Grade 11)
 - Genetics (Grade 12)
- Consider the differences in the appearance of organisms within a species due to variations caused by:
 - Meiosis (crossing over and random arrangement of chromosomes)
 - Mutations
 - Random mating
 - Random fertilisation

Key Concepts

Species concept: a group of organisms that **share similar characteristics** and **can interbreed** to **produce fertile offspring**

Speciation: The formation of a new species



Questions

Question 1

(Adapted from NSC Mar 2009 Paper 2, Question 2.3)

Describe how **speciation** occurs when a population becomes **separated** by a **geographical barrier**.

- Population has variety✓
- When they are together they can interbreed✓
- If a population is separated by a geographical barrier
- The population will split up into two groups✓
- And they will not be able to interbreed (barrier) ✓
- each group is exposed to the different environmental factors✓
- and therefore undergoes natural selection independently✓
- each group may become genotypically✓ and phenotypically different✓
- and even if they were to be together
- they may not interbreed✓/become reproductively isolated
- leading to the formation of a new species✓
- this is known as allopatric speciation✓

Key Concepts

So how does this all work?



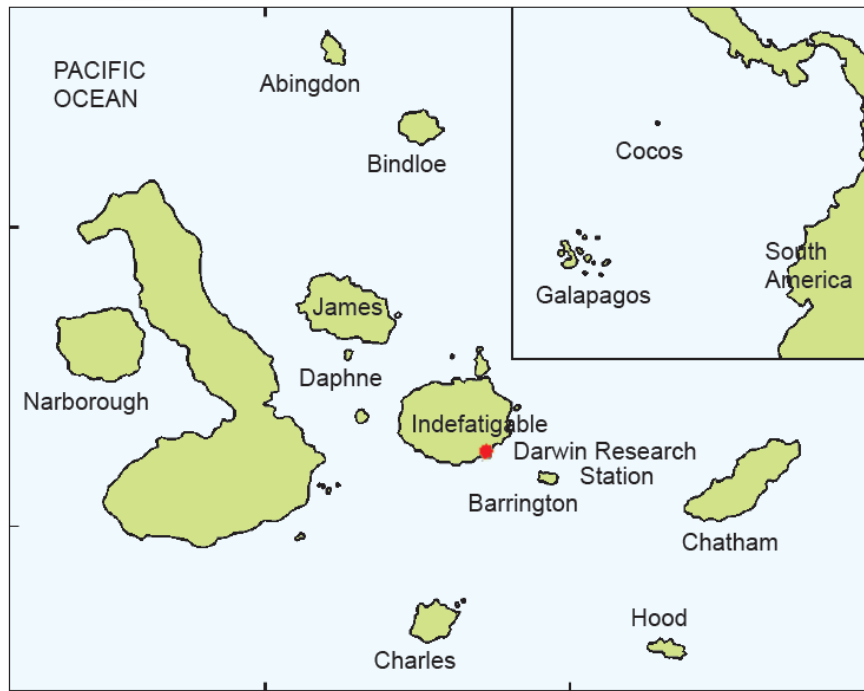


Figure 6.24: The Galapagos Archipelago, with small map inset showing its position in relation to South America. British pirates named the islands after British Admirals and ships, but they now have Spanish names. (MACMILLAN, Life Sciences for All, Grade 12, Pg 301)



Figure 6.26: A few of the 14 finch species that are descended from one parent species. (MACMILLAN, Life Sciences for All, Grade 12, Pg 302)

Questions

Question 2

(Adapted from NSC Nov 2011 Paper 2, Question 3.4)

Describe how **sympatric speciation** occurs.

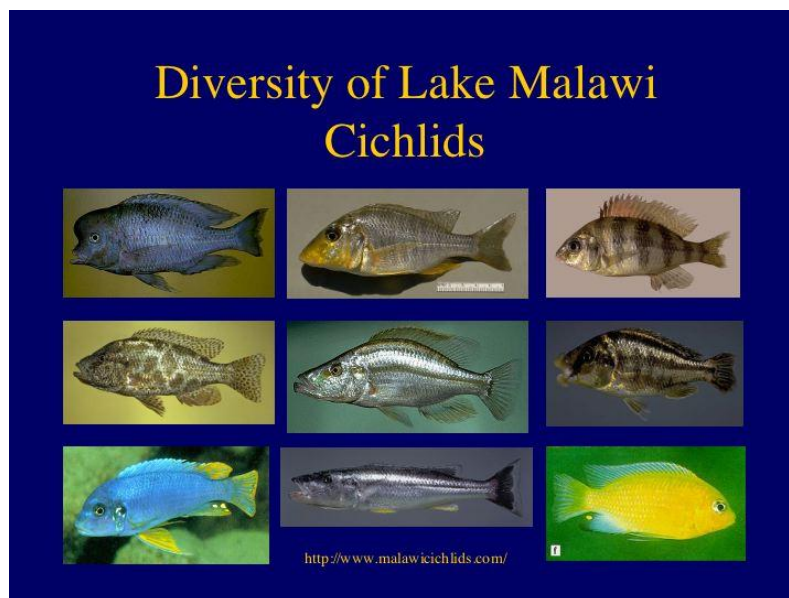
- There is variation in a population✓
- **Population occupies the same area✓ / No geographical barrier**
- **They may separate into different groups✓/ different niches due to differences in behavioural patterns/ feeding habits/due to polyploidy**
- Each group undergoes natural selection independently✓ and develops differently
- Genotypically✓ and phenotypically✓
- Gene flow /reproduction between the different populations does not occur/no interbreeding

- The differences that develop between the different populations prevent them from inter-breeding even if they were to mix – reproductive isolation mechanisms
- each group becomes a new species ✓

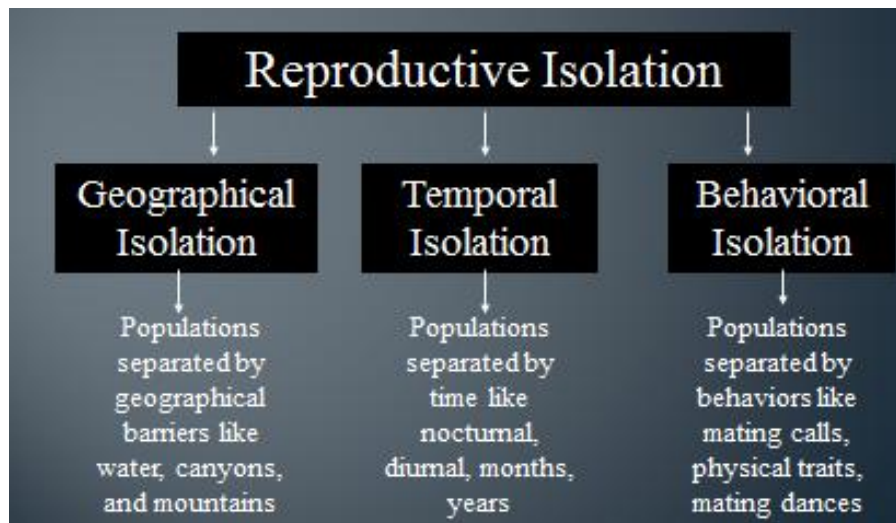
Key Concepts

Keywords

- Population together – can interbreed
- Variety
- Separate – physical barrier – allopatric, no barrier – sympatric
- Environment may differ
- Natural selection independently
- Genotypically, phenotypically different
- Population change over several generations – new species

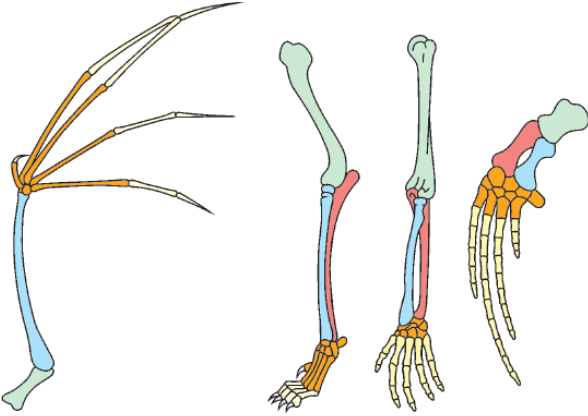
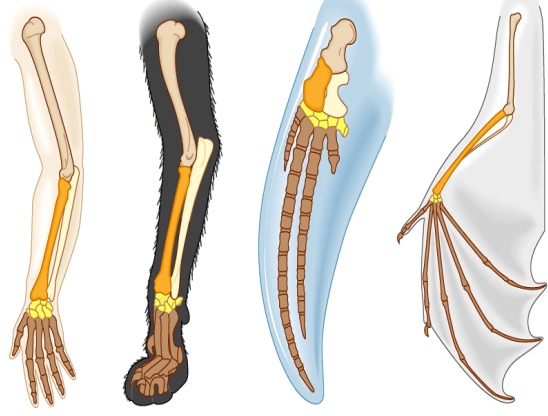
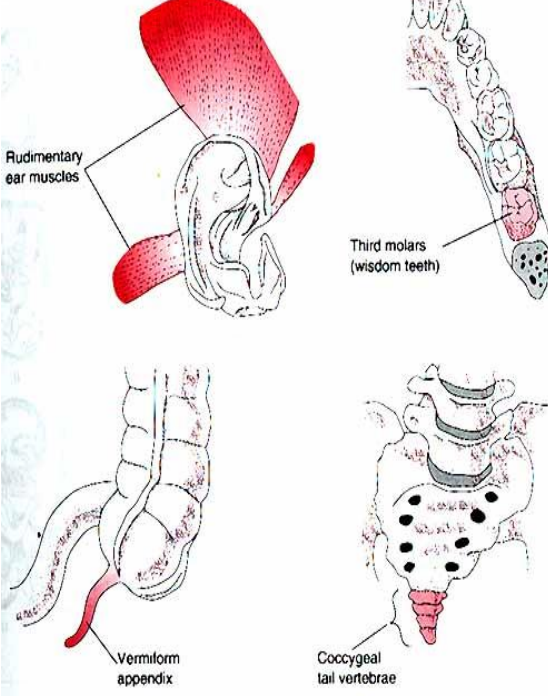


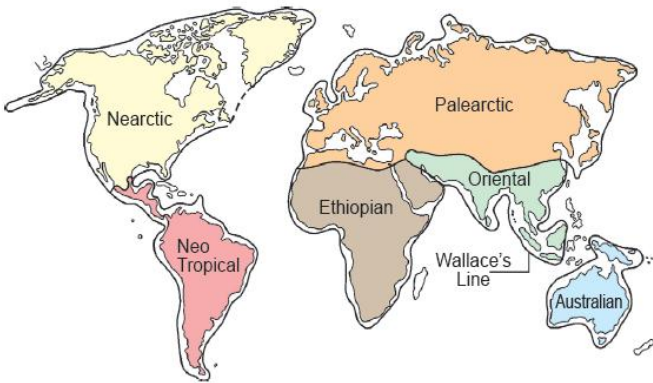
Ways to create a new species:



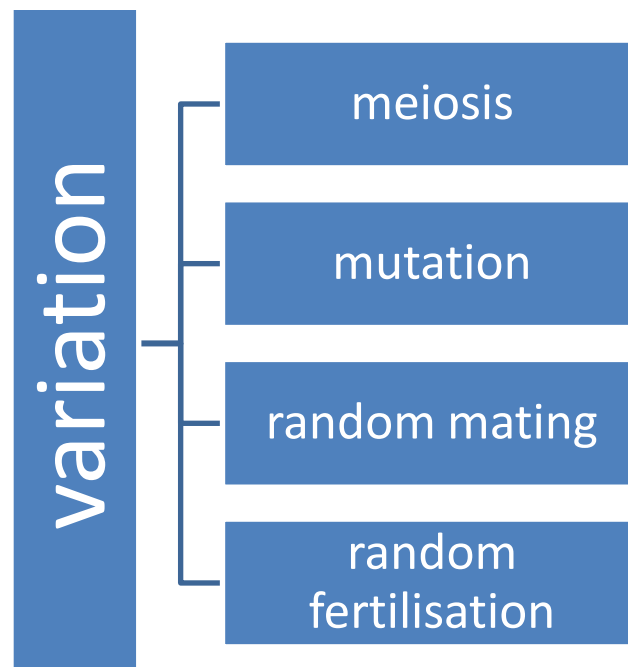
Evidence provided by scientists for Evolution

Special Areas of Interest	Evidence	Significance
Palaeontology	Various fossils 	- Fossils found in rock strata show a sequence or history of life on Earth. - Fossils over time show development of organisms. - Fossils provide evidence of life forms that existed in the past/that are now extinct. - Two types of dating: Relative Absolute /radiocarbon dating.

Anatomy	Homologous  Figure 6.8: The forelimbs of these mammals in different Orders have skeletons that consist of similar bones in the same relation to each other. (MACMILLAN, Life Sciences for All, Grade 12, Pg 284).	Similarities between the structures shows definite relationships
Analogous	 Human Cat Whale Bat Copyright © Pearson Education, Inc., publishing as Benjamin Cummings.	
Vestigial	 Rudimentary ear muscles Third molars (wisdom teeth) Vermiform appendix Coccygeal tail vertebrae	

Biogeography	Biogeography shows that species distribution can be explained by evolution:  Figure 6.9: Main biogeographical areas of the world. Each area has different kinds of animals and plants, which suggests they evolved in the places where they now exist. (MACMILLAN, Life Sciences for All, Grade 12, Pg 284).	Species in the same continent will show more similarity than those on different continents
Molecular Biology & genetics	- Identical DNA compounds - Similar sequence of genes - Similar portions of DNA with no function - Identical protein synthesis - Similar metabolic pathways	Points to common ancestor

Variation



Questions

Question 3

(Adapted from MACMILLAN, *Life Sciences for All, Grade 12, Pg 301*)

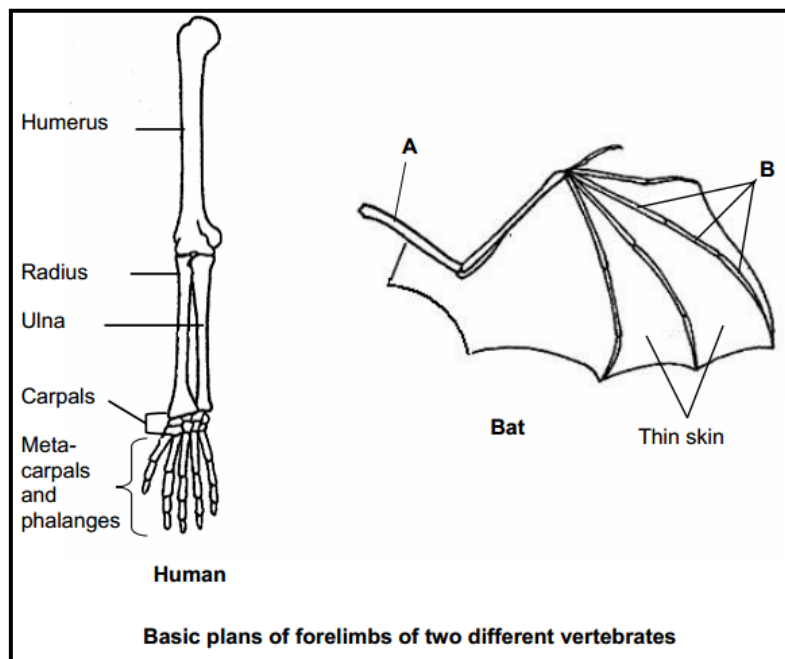
Choose the right term and select only the correct letter (or letters).

- 3.1. A mechanism that produces new species
- Fertilisation
 - Dominance
 - Gradualism
 - Speciation
- 3.2. Events that cause small changes in the phenotype or in the inherited behaviour of organisms
- Reproduction
 - Variability
 - Mutations
 - Inheritance
- 3.3. The origin of a new species can occur when there is:
- chromosomal crossing over
 - reproductive isolation of a population
 - adaptation
 - a phenotypic change

Question 4

(Adapted from Nov 2010, DOE, Question 1.4, Paper 2)

Study the basic plans of the forelimbs of two different vertebrates shown below.



- a.) Are the above forelimbs homologous or analogous structures?

(1)

- b.) Explain your answer to QUESTION (a). (2)
 - c.) Using the labels on the forelimb of a human as a guide, give the names of the letters A and B. (2)
 - d.) State TWO ways in which the forelimb of the bat is adapted for flying. (2)
- [7]**

Question 5

(Adapted from Nov 2011, NSC, Version 2, Question 2.2, Paper 2)

Describe how each of the following contributes to genotypic variation within a species.

- a.) Meiosis
- b.) Mutation
- c.) Sexual reproduction (8)

Question 6

(Adapted from June 2011, GDE, Question 4.1, Paper 1)

In an investigation a biotechnologist injected chimpanzee blood into a rabbit. The immune system of the rabbit recognised the chimpanzee blood protein as foreign and produced antibodies. The rabbit's antibodies were then extracted and developed as a serum. When the serum is added to blood samples in different test tubes removed from a variety of different animals, a precipitate forms. The more precipitate forms, the more closely related the animal is to the chimpanzee. Study the table below that shows the percentage precipitate formed in this investigation, and answer the questions that follow.

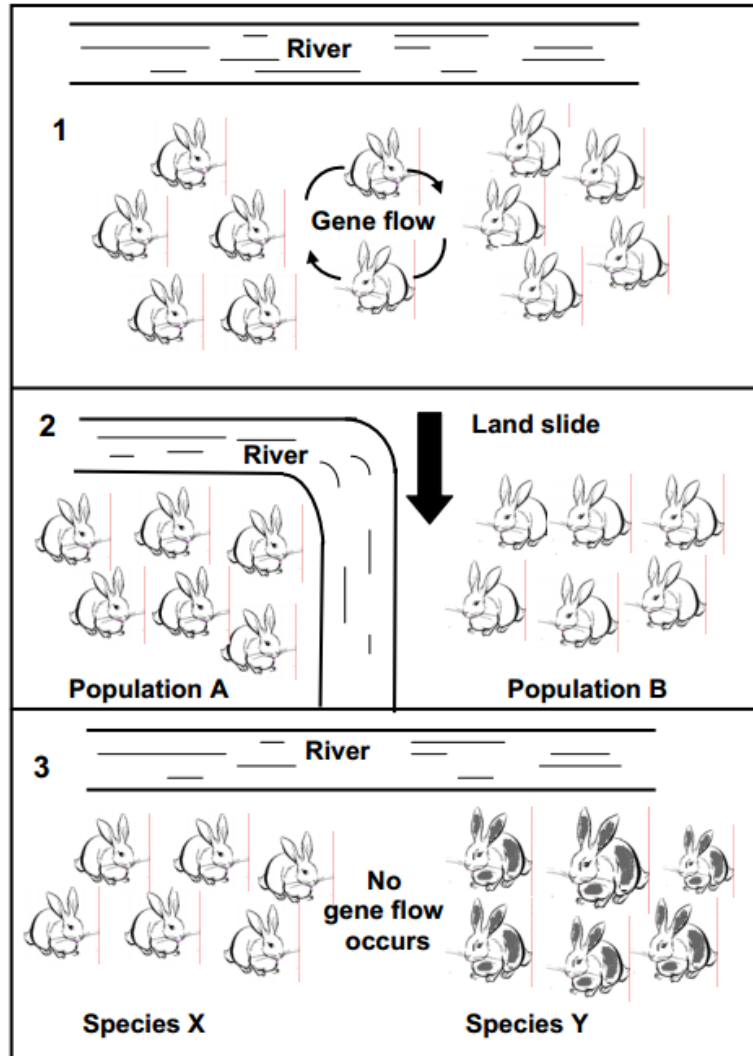
Animal species	Percentage precipitate formed
Gorilla	Very high
Baboon	High
Monkey	Moderate
Pig	Very low

- a.) What is the composition of the serum? (2)
- b.) According to the above information, which animal is least closely related to chimpanzees? Give a reason for your answer. (2)
- c.) Formulate a hypothesis for the investigation above. (3)
- d.) Name TWO variables that had to be kept constant in this investigation. (2)

Question 7

(Adapted from Nov 2010, NSC, Question 3.4, Paper 2)

Study the diagrams below showing a process of evolution. DIAGRAMS 1, 2 and 3 show the sequence of events that occurred in rabbit populations over many thousands of years.



- Name the evolutionary process represented by the sequence of events shown in DIAGRAMS 1, 2 and 3 above.
- Describe the process stated in QUESTION (a) using the diagrams above.

(1)
(5)
[6]