



## Evolution

A fresh approach to the teaching of evolutionary principles at this level. Through a variety of engaging and thought-provoking activities, students are invited to explore and critically evaluate the wealth of evidence for our current understanding of evolution.

### Suitability:

- Grades 10-12
- Community College

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*Biozone's unique formula encourages self direction, while dovetailing with traditional resources.*

## Chapters


- The Origin & Evolution of Life
- Mechanisms of Evolution
- Patterns of Evolution

## Features

- **Introduction to the topic:**  
A concise introduction to the concepts in the activity.
- **Easy to understand diagrams:**  
Highly visual, clearly annotated diagrams improve the accessibility of information.
- **Consolidation and branching out:**  
Activities provide information to consolidate basic knowledge, while allowing scope for exploring. Differential instruction becomes easier and students at all levels are encouraged to be 'thinkers'.
- **Write-on format:**  
Activities provide information to consolidate basic knowledge, while allowing scope for exploring.
- **Tear-out pages:**  
Each page has a perforation to allow easy removal for marking, or placement in a ring binder.
- **Activity Code:**  
Each activity is coded to identify the skills required for its completion.

### The Species Concept

The concept of a species is not as simple as it may first appear. Understanding the relationship between closely related species, such as the cheetah and leopard, is a complex task. This activity explores the concept of a species and the factors that influence its definition.



**Geographical distribution of related species**


**Interbreeding between species**

1. Describe the type of barrier that prevents the three species of jaguar from interbreeding.
2. Describe the factor that has prevented the cheetah from interbreeding with other feline species (apart from the jaguar).
3. Describe a possible contributing factor to the occurrence of interbreeding between the cheetah and leopard.
4. The cheetah is a widely distributed species. Explain why the North American population is considered to be part of the same species as the northern European and African populations.

Code: A 2

### Population Bottlenecks

Population bottlenecks occur when a population's size is reduced for a short period of time. This can lead to a loss of genetic diversity and an increase in the frequency of certain alleles.



**Modern Examples of Population Bottlenecks**

1. Endangered species are often subjected to population bottlenecks. Explain how population bottlenecks affect the ability of a population of an endangered species to recover from its plight.
2. Explain why the lack of genetic diversity in cheetahs has increased their sensitivity to disease.
3. Describe the effect of a population bottleneck on the potential of a species to adapt to changes (i.e. its ability to evolve).

Code: PA 3

### Sympatric Speciation

Speciation can occur without geographical isolation. This activity explores the mechanisms of sympatric speciation, including polyploidization and disruptive selection.

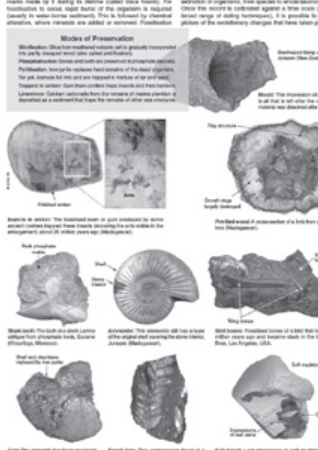


1. Explain what is meant by sympatric speciation. (Do not confuse this with sympatric speciation.)
2. Explain how polyploidy may cause the formation of a new species.
3. Identify an example of a species that has been formed by polyploidy.
4. Explain how disruptive selection may cause the formation of a new species.

Code: A 2

### Fossil Formation

Fossils are the remains of organisms that have lived in the past. This activity explores the conditions required for fossilization and the types of fossils that can be formed.



1. Explain the process of fossilization. (Do not confuse this with fossilization.)
2. Explain how fossilization may occur in different environments.
3. Identify an example of a fossil that has been formed by fossilization.
4. Explain how fossilization may occur in different environments.

Code: A 1

## Content Overview

### THE ORIGIN & EVOLUTION OF LIFE

- Life in the Universe
- The Origin of Life on Earth
- Prebiotic Experiments
- The Origin of Eukaryotic Cells
- The History of Life on Earth
- Fossil Formation
- The Fossil Record
- Dating Fossils
- DNA Hybridisation
- Immunological Studies
- Other Evidence for Evolution
- The Evolution of Novel Forms
- Comparative Anatomy
- Vestigial Organs
- Biogeographical Evidence
- Oceanic Island Colonisers
- Continental Drift and Evolution

### MECHANISMS OF EVOLUTION

- Genes and Evolution
- Adaptations and Fitness
- The Modern Theory of Evolution
- Darwin's Theory
- Natural Selection
- Selection for Human Birth Weight
- Industrial Melanism
- Heterozygous Advantage
- Sexual Selection
- Darwin's Finches
- Gene Pools and Evolution
- Gene Pool Exercise
- Population Genetics Calculations

- Analysis of a Squirrel Gene Pool
- Changes in a Gene Pool
- The Founder Effect
- Population Bottlenecks
- Genetic Drift
- Artificial Selection
- Polyploidy in the Evolution of Wheat
- The Species Concept
- Reproductive Isolation
- Allopatric Speciation
- Sympatric Speciation
- Evolution in Bacteria
- Stages in Species Development
- The Species Life Cycle

### PATTERNS OF EVOLUTION

- Patterns of Evolution
- The Rate of Evolutionary Change
- Homologous Structures
- Convergent Evolution
- Coevolution
- Pollination Syndromes
- Geographical Distribution
- Adaptive Radiation in Mammals
- Adaptive Radiation in Ratites
- Origin of New Zealand Parrots
- Adaptive Radiation in Wrens
- Evolution in Springtails
- Ancient New Zealand Landscapes
- Evolution in NZ Invertebrates
- Evolution in *Hebe*
- Extinction
- Causes of Mass Extinctions

**71 Homologous Structures**

The similarities existences between groups of organisms is determined mainly by structural similarities called homologous structures. Evolutionists believe that the forelimbs of vertebrates from a common ancestor with that feature. The bones of the limbs of different vertebrates are composed of similar bones arranged in a comparable pattern. This is evidence of a common ancestry. The early land vertebrate were amphibians and possessed a limb structure called the pentadactyl limb. A limb with five digits or toes (some soft, all vertebrates but not all mammals, have limbs that have evolved from this same limb pentadactyl limb). This also explains the pentadactyl limb known as adaptive radiation, since the limb can plan has been adapted to meet the requirements of different niches.

**Generalised Pentadactyl Limb**

The diagram below shows the basic arrangement of bones but they have different names. In many cases bones in different parts of the limb have been highly modified to give it a specialised locomotory function.

**Specialisations of Pentadactyl Limbs**

1. Briefly describe the purpose of the major anatomical change that has taken place in each of the limb examples above:

(a) Bird wing: Highly modified for flight. Forelimb is shaped for aerodynamics lift and feather attachment.

(b) Human arm: \_\_\_\_\_

(c) Seal flipper: \_\_\_\_\_

(d) Dog paw: \_\_\_\_\_

(e) Man's hand: \_\_\_\_\_

(f) Bat wing: \_\_\_\_\_

2. Describe how homology in the pentadactyl limb is evidence for adaptive radiation: \_\_\_\_\_

3. Homology in the behaviour of animals (e.g. example, sharing similar courtship or nesting (builds) is sometimes used to indicate the degree of relatedness between groups. Suggest how behaviour could be used in this way: \_\_\_\_\_

Code: A 2

**42 Selection for Human Birth Weight**

Selection pressures operate on populations in such a way as to reduce mortality. For humans, giving birth to a smaller, lighter foetus results in a smaller, lighter foetus. This is a good example of stabilising selection. This activity explores the selection pressures acting on the birth weight of human babies. Carry out the steps below.

**Step 1:** Collect the birth weights from 100 birth records from your local newspaper or on the internet. You are looking for only babies weighing the same amount (within 100g) as the baby you are studying. If you cannot collect 100 records, you can use a smaller number of records (e.g. 50 or 25). The number of records you use should be recorded in the table below.

**Step 2:** Group the weights into each of the 10 weight classes (of 5.0 kg increments). Calculate the percentage of the total number of babies in each weight class (e.g. 17 babies weigh 3.5-4.0 kg so that is 17/100 = 17%).

**Step 3:** Graph these in the form of a histogram for the 10 weight classes (the graph is provided). Do not use the scale printed on the left vertical axis.

**Step 4:** Create a second graph to plot the percentage of newborn babies in relation to their birth weight. Use the scale on the right to plot the data provided below.

**Step 5:** Draw a line of best fit through these points.

Weight (kg)	Mortality (%)
1.0	90
1.5	80
2.0	70
2.5	60
3.0	50
3.5	40
4.0	30
4.5	20
5.0	10
5.5	5
6.0	2
6.5	1
7.0	0
7.5	0
8.0	0
8.5	0
9.0	0
9.5	0
10.0	0

1. Describe the shape of the histogram for birth weight: \_\_\_\_\_

2. State the optimum birth weight in terms of the lowest newborn mortality: \_\_\_\_\_

3. Describe the relationship between the newborn's mortality and the birth weight: \_\_\_\_\_

4. Describe the selection pressures that are operating to control the range of birth weight: \_\_\_\_\_

5. Describe how medical intervention methods during pregnancy and childbirth may have altered these selection pressures: \_\_\_\_\_

Code: PDA 2

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