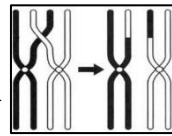


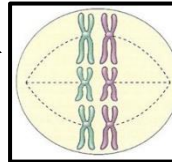
CAUSES OF VARIATION

Name FOUR **processes** that cause variation and then fill in the missing words.

1. **Meiosis**: because of
2. **Fertilisation** is random.
3. Random **Mating**.
4. **Mutations**.



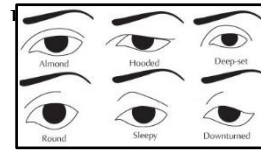
1.1 **Crossing over** process in **prophase 1**.



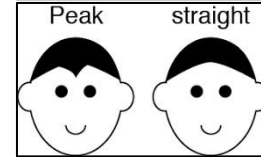
1.2 Random **arrangement** of chromosomes in **metaphase 1** or **metaphase 2**.

TYPES OF VARIATION

Name the 2 types of variation shown in each diagram



Continuous variation where there is a **range** of phenotypes eg eye shape



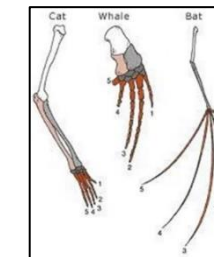
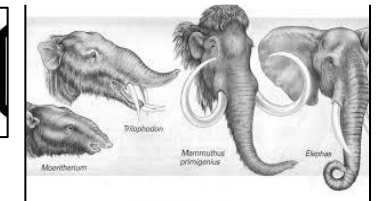
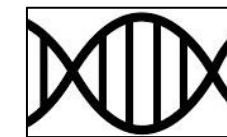
Discontinuous variation where there is **no/ a small range** of phenotypes. eg hairline shape

EVIDENCE FOR EVOLUTION

Name the 4 types of evidence that support evolution using the diagrams as clues.

1. **Genetics**

2. **Biogeography**



3 **Modification by descent** (homologous structures)

4. **Fossil record**

EVOLUTION THEORY 1:

LAMARCKISM

LAW 1: 'Law' of use and disuse.

Law of use: The **more** you use the structure/ organ/ body part, the bigger/ stronger/ more developed it is. eg. Long necks in Galapagos tortoises.

Law of disuse: The **less** you use the structure/ organ/ body part, the smaller/ weaker/ less developed it is. eg. Snake legs.

LAW 2: 'Law' of the inheritance of acquired characteristics

The characteristic that developed during the lifetime of the parent is an **acquired** trait and will be passed on to the offspring as it is **heritable**.

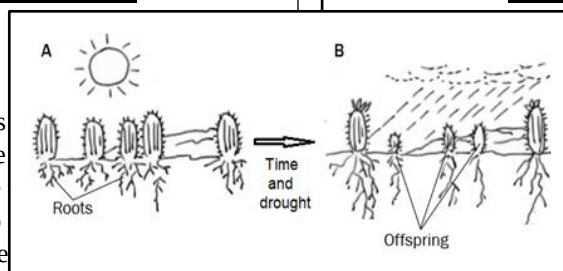
Why was Lamarck's theory rejected?

- **Acquired characteristics are not inherited / do not cause change to the DNA of an organism.** (genes are inherited, not acquired traits)
- **Lamarck's theory is deterministic / Organisms did not evolve because they want to.** (Lamarck had no evidence)

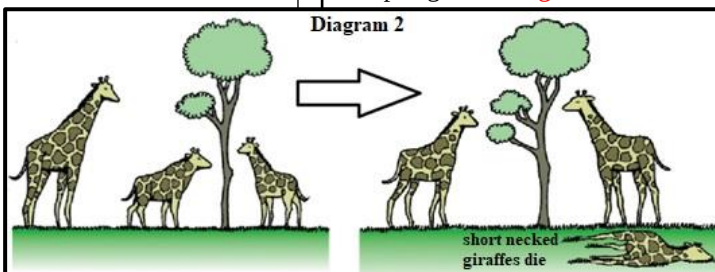
APPLYING THEORIES 1 and 3: Fill in the missing words below for the theories of **Lamarckism** and **Darwinism** (Natural Selection) for each of the two diagrams shown.

LAMARCKISM

Law of use.
All cacti had roots that were the **same** length to start. The roots had to **grow** to reach water so roots were **longer** over time in all cacti.



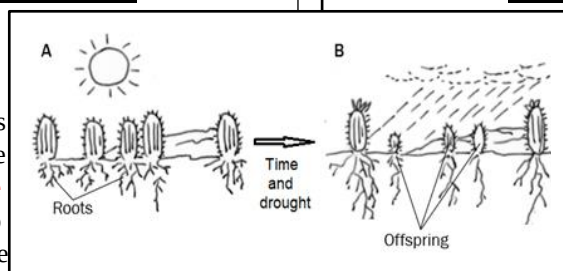
Law of Use.
All giraffes had the **same** length neck to start. They **stretched** to reach the high leaves and so **acquired** a long neck. This trait was and passed to **offspring**.



Favourable neck length: **long neck**
Unfavourable neck length: **short neck**. Long neck giraffes **survive** and reproduce passing the **long** neck on to their offspring.

DARWINISM

Law of use.
All cacti had roots that were the **same** length to start. The roots had to **grow** to reach water so roots were **longer** over time in all cacti.



Favourable neck length: **long neck**
Unfavourable neck length: **short neck**. Long neck giraffes **survive** and reproduce passing the **long** neck on to their offspring.

EVOLUTION THEORY 3:

Evolution by the process of NATURAL SELECTION / DARWINISM.

Describe the theory of evolution by the process of natural selection.

- **Organisms produce a large number of offspring.**
- **There is a great deal of variation amongst the offspring, some have the favourable trait and some don't.**
- **When there is a change in the environmental conditions or if there is competition,**
- **the organisms with the unfavourable characteristics, which make them less suited, die.**
- **The organisms with characteristics which make them more suited, survive reproduce and pass on the allele for the favourable characteristic to their offspring.**
- **The next generation will have a higher proportion of individuals with the favourable characteristic.**

Darwinism is also called **Gradualism**. Darwin called his theory **Descent with modification**.

Today we call it: The theory of evolution by the process of **natural selection**.

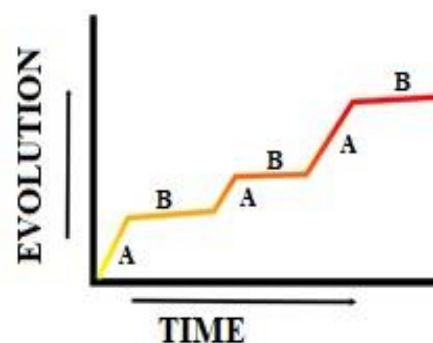
EVOLUTION THEORY 2:

PUNCTUATED EQUILIBRIUM

Describe the theory of punctuated equilibrium.

- Evolution involves **long periods of time where species do not change** or change gradually through natural selection (known as equilibrium).
- This **alternates with (is punctuated by) short periods of time where rapid changes** occur through natural selection
- During which new species may form in a short period of time.

APPLYING THEORY 2: Study the graph below and then answer the questions.



Use the graph to identify the phase at:

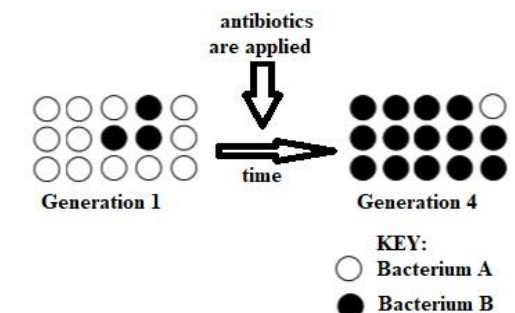
- A. **Punctuation** phase (rapid change; short time).
- B. **Equilibrium** phase (little or no change; long time).

Circle the correct words from those that are underlined:

1. At A, the species undergoes rapid/ no or gradual change over a long/short period of time.
2. At B, the species undergoes rapid/no or gradual change over a long/short period of time

PRESENT DAY EVOLUTION:

Tuberculosis (**TB** → **MDR-TB** → **XDR-TB**)



1. Which **process** of evolution is represented in the diagrams above? **Natural selection**.
2. The bacterium with the favourable characteristic is bacterium **B**, whereas the one with the unfavourable characteristic is bacterium **A** in the diagram.
3. Explain your answer in question 2 using the theory of natural selection.
 - In generation 1 there was variation amongst the bacteria, some had the favourable characteristic of antibiotic resistance (Bacterium B) and some did not (bacterium A).
 - Antibiotics were applied and bacteria A had the unfavourable trait and died because the antibiotic killed them.
 - Bacterium B had the favourable trait and resisted the antibiotic, so survived and reproduced passing on the favourable trait to their offspring.
 - The next generation (number 4) has a higher proportion of individuals with the favourable trait of antibiotic resistance.
 - The population gradually changed to be antibiotic resistant.