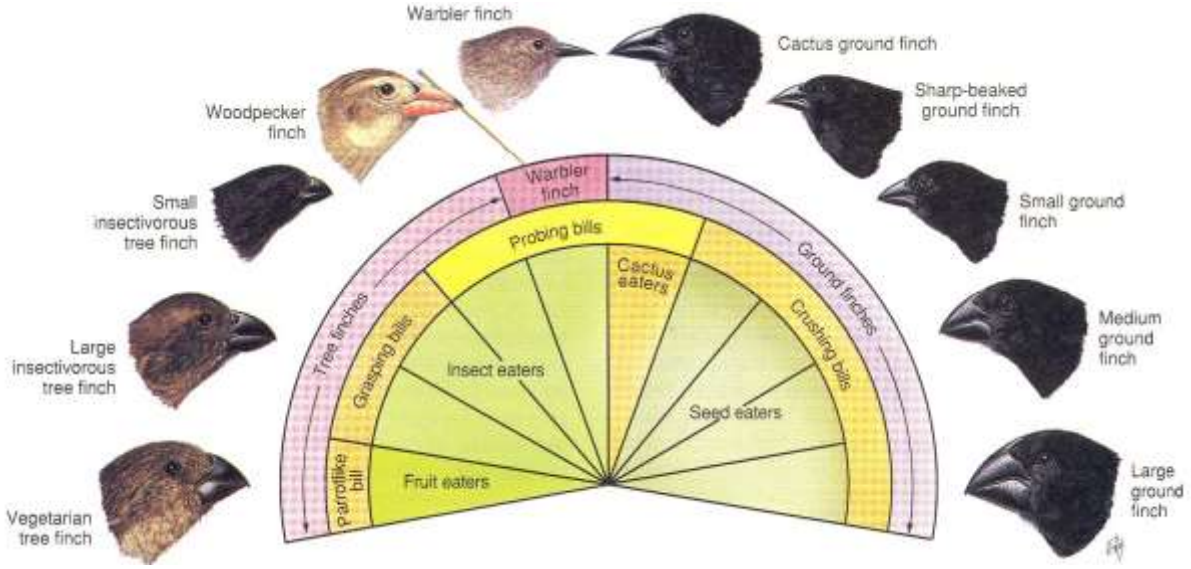
National 5 Biology

Unit 3 Life on Earth

3.6 Evolution of Species



Name _____

Class _____

Teacher _____

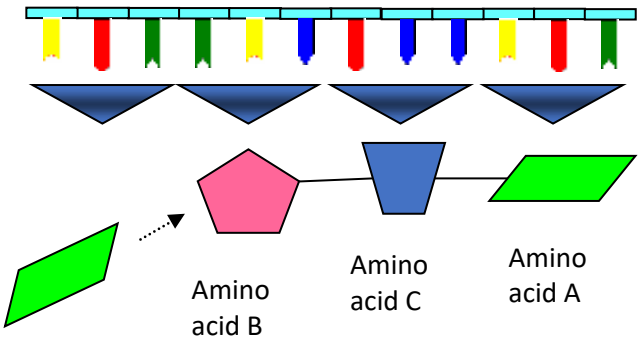
Evolution of Species

A species is a group of organisms that can freely interbreed to produce fertile offspring. Members of a species show variation and this variation is passed onto their offspring. The only way in which new variation can appear is when errors in genetic material arise through a process called mutation. All species that exist today have come about by the process of evolution. The idea of natural selection is used to explain the process of evolution, which has resulted in the variety of living organisms we see on earth today.

Learning intention

- To find out about mutations and the effects they have within nature.

REMEMBER:



Sets of **bases** on the **DNA** strand code for each……

…….. **amino acid** which join together to make a **protein** molecule.

Mutations

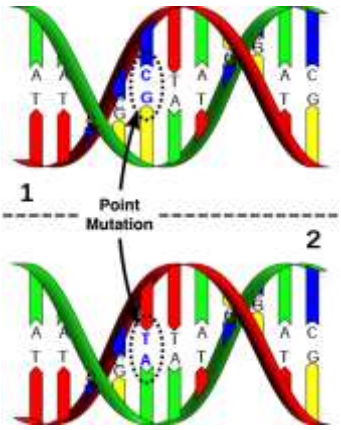
A mutation is a _____ change to the genetic material of an organism. They can affect _____ genes or _____ chromosomes. Mutations are **spontaneous** and the only source of **new alleles** in a population (this will become important later when we look at how organisms adapt).

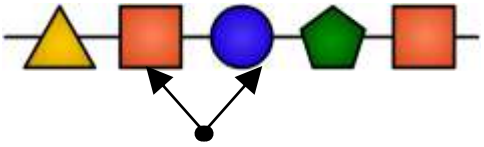
Mutations occur at very _____ frequency. However, environmental factors can increase the rate of mutations: e.g _____ and some chemicals.

Section of DNA where mutation has occurred. Mutation causes a change to the base pair.

Change to base pair alters the type of amino acid coded for.

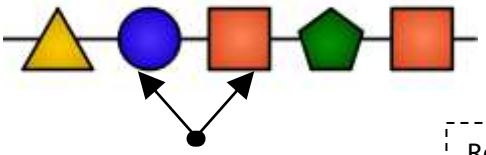
Altered sequence of amino acids results in the production of different proteins.





amino acids

Protein A



amino acids

Protein B

Remember **ROLF**
Mutations are of **R**andom
Occurrence and
Low
Frequency

Mutation can give an:

- _____- A useful mutation that could increase an organisms chances of survival.
- A _____- A harmful mutation that could decrease an organisms chances of survival. OR can be:
- **Neutral** - Have little effect on the organism with the mutation.

Free earlobe

Attached earlobe

Test your knowledge

1. State what is meant by the term mutation.

_____

_____

2. Explain what is meant by the following phrase ‘Mutations are spontaneous’.

_____

_____

3. Name the three types of mutation.

_____

_____

4. Give an example of an environmental factor that can increase the rate of mutation.

_____

Learning intention

- To find out about the relationship between mutations and adaptations in animals.

Adaptations

It is the new _____ produced by mutations that allow plants and animals to become better _____ to their environment.

What are adaptations?

An adaptation is an _____ characteristic that makes an organism well suited to survival in its environment/niche. For example:

Species	Adaptations
Cactus	Thick, waxy surface and spines instead of leaves to reduce water loss; wide spread and deep roots to obtain water; fleshy stem to store water.
Desert rat	Dry mouth and nasal cavities, no sweating to reduce water loss; long kidney tubules. Produces concentrated urine to reduce water loss.

Types of adaptations

A habitat is populated by organisms that are _____ to survive there.

Adaptations can be _____ (related to body parts) or _____ (related to how an organism behaves in its environment). For example:

Type of adaptation	Example
Structural	Arctic fox- thick fur coat to protect against the cold.
Behavioural	Hedgehog- hibernates over winter, helps it to survive harsh conditions.

Hint: Both tables shown here are for information only. You don't need to be able to able to give examples.

Adaptations are a part of the _____ process.

Learning intention

- To find out about variation within a population and how this relates to evolution.

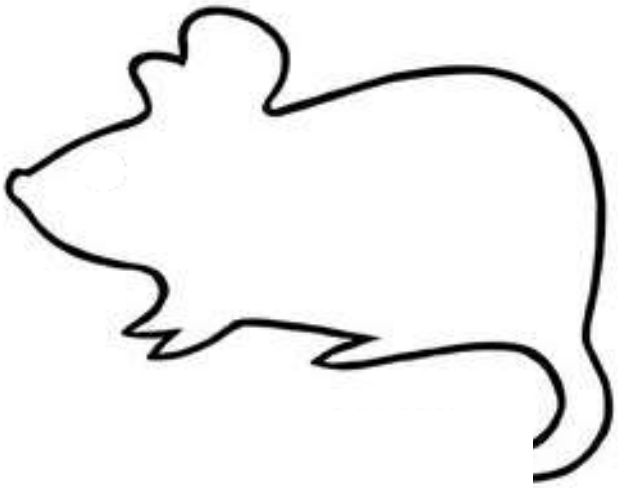
Variation

Although members of a species have many features in common they are not _____ to each other. Variation occurs as a result of _____ that create new alleles of genes. Mutations can be inherited if they occur in _____ that is passed on to the next generation. In populations that produce offspring by sexual reproduction, variation also occurs as a result of individuals receiving _____ combinations of alleles from their parents. Within a population there can be _____ variation. (see the survive-a-mouse challenge).The organisms _____ adapted to the changing _____ conditions survive to pass on their _____. These adaptations allow the population to _____ over time.

Survive-a-Mouse

Are you tough enough? Circle only one possibility for each gene. Add them to your mouse diagram below and get ready to fight for your survival! Good luck!

Feature (gene)	**Possibilities (allele)**
Size	Small / medium / large
Coat colour	Black / brown / grey / albino
Coat depth	Fine / medium / thick
Coat type	Curly / wavy / straight
Coat length	Short / medium / long
Eye location	More central to skull / more lateral (on sides)
Whiskers	10 / 15 / 20 each side of face
Whisker length	Short / medium / long
Number of pairs of premolars/molars	2 / 3 / 4
Tail length	Short / medium / long
Number of claws on hind feet	4 / 5
Claw length	Short / medium / long



Learning intention

- To find out about natural selection.

Natural selection

Natural selection is the survival of those organisms _____ suited to their environment.

Process of natural selection

The main stages are as follows:

1. Species produce _____ offspring than the environment can support due to the limited resources available.
2. Members of a species show _____ in their characteristics through the different mutations they carry.
3. As a result of limited resources, a _____ for survival follows as offspring compete for resources.
4. Natural selection, or survival of the fittest, results in the _____ of those organisms whose variation makes them best suited to their environment. Some individuals survive and others do not – this is survival of the _____.
5. The best adapted individuals in a population survive to _____, passing on the favourable alleles that confer the selective advantage. These alleles _____ in frequency within the population.

Learning intention

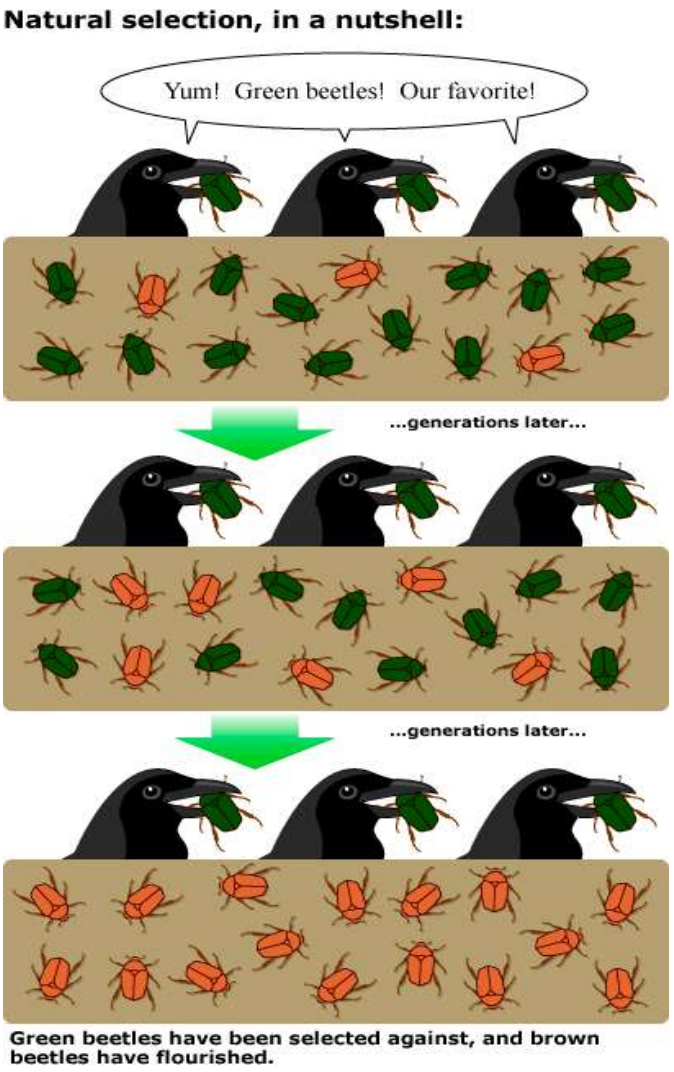
- To find out how survival of the fittest and selection pressure contribute to evolution.

Survival of the fittest

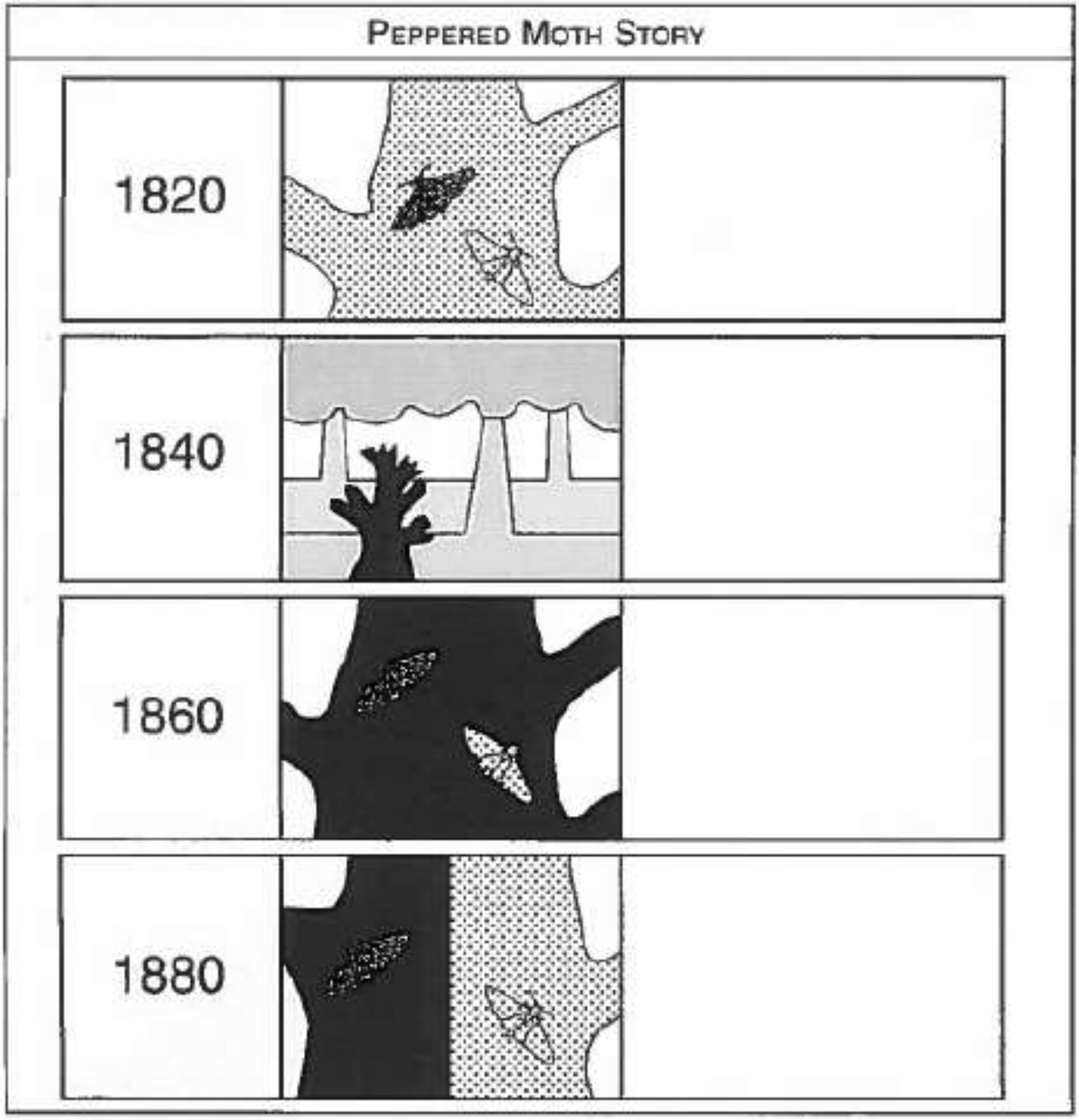
This occurs when species produce more offspring than the environment can sustain and there are selection pressures.

Selection pressure

Selection pressure is a factor which acts on _____ in a population. It results in the _____ of some individuals and the _____ of others. An individual which is most likely to survive when a particular selection pressure is applied is said to have a selective _____.



The peppered moth- an example of natural selection



Learning intention

- To find out about speciation.

Speciation

Speciation is the formation of ___ or _____ species from the original one species. It involves changes in genotype and phenotype that make an organism more _____ to its environment. It is brought about by the process of _____.

The process of speciation happens in a series of stages.

1. **Isolation**- A large interbreeding population becomes _____ into sub-populations by isolating barriers. There are three main isolation barriers. e.g.

	Formation of geographical features that divide populations e.g. sea, mountains
	Caused by changes in abiotic factors e.g. moisture levels, pH of soil, temperature
	Caused by differences in timing, location or complexity of mating rituals that prevents members of a population from mating, even if they are not geographically separated.

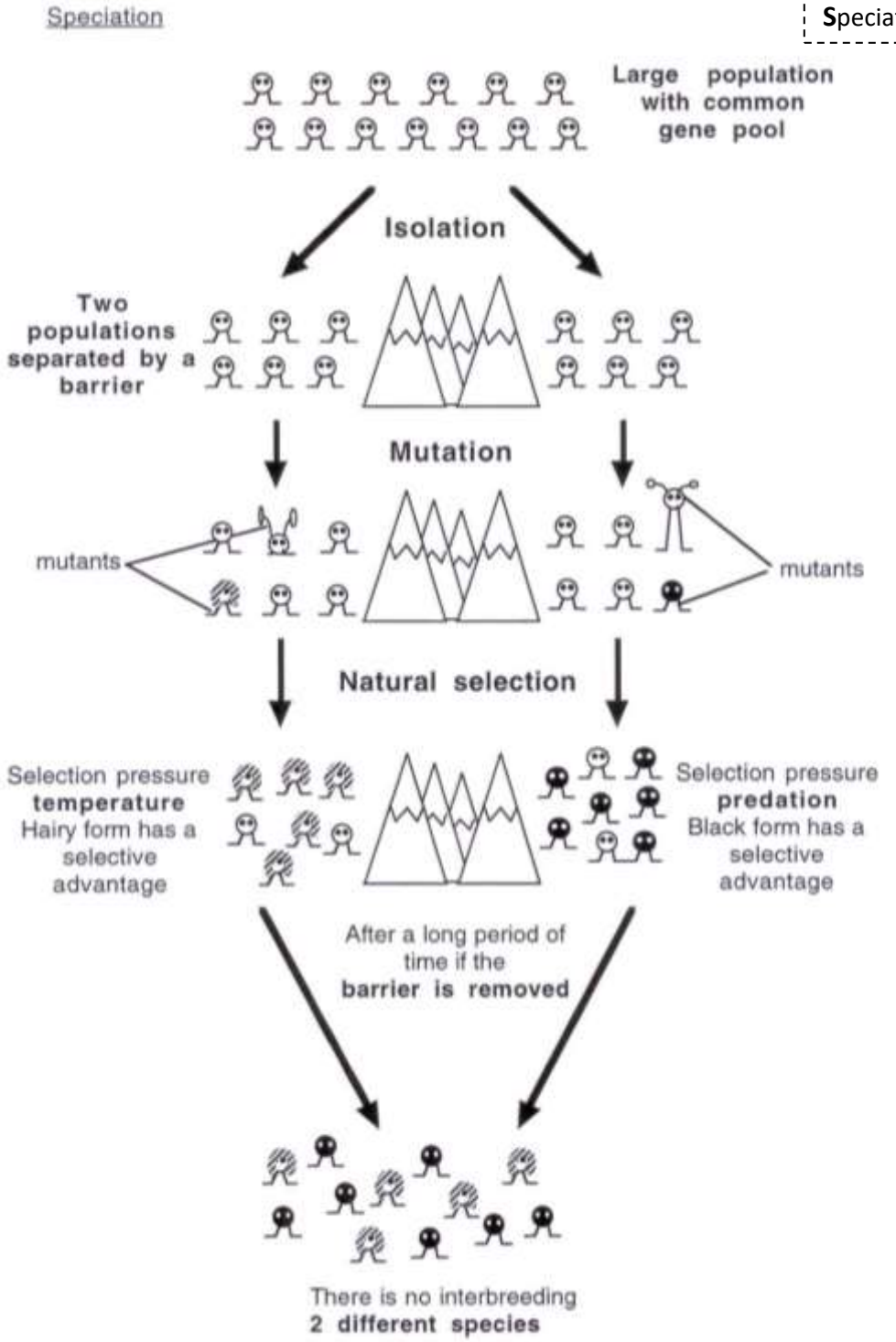
2. **Mutation**- Different mutations occur in each sub-population. Causes _____ alleles to appear in _____ population. Beneficial mutations occurring in one population will allow the mutant to _____.

3. **Natural selection**- Selects for _____ mutations in each group, due to _____ selection pressures. Those with favourable characteristics have an _____ over others. They survive, reproduce and pass on these favourable alleles to their _____.

4. **Different species formed**-Each sub-population evolves until they become so genetically different they are now _____ different species. Speciation has occurred.

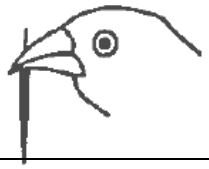
Remember **I'M** a **N**ew **S**pecies
To remember the order of events in speciation.
Isolation
Mutation
Natural selection
Speciation

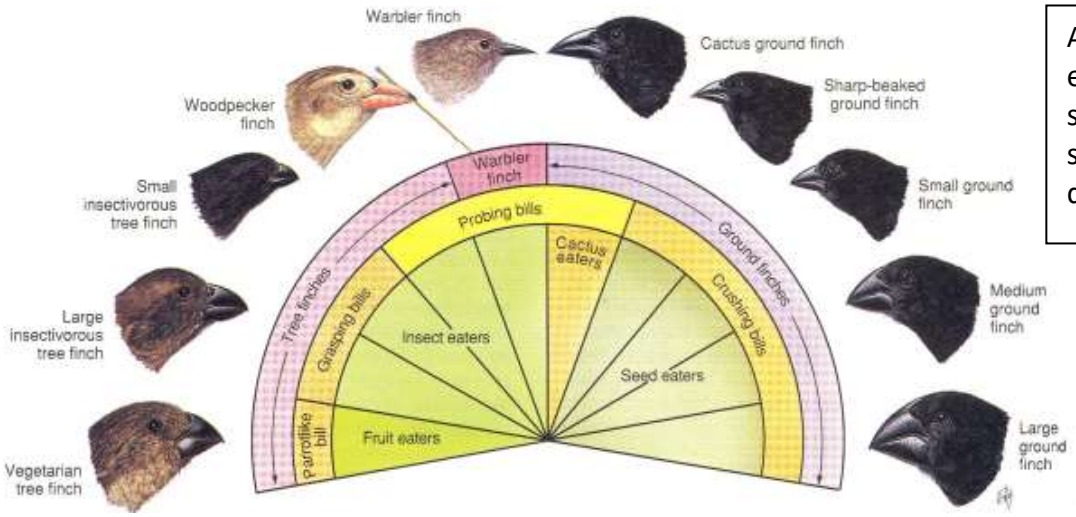
Example of speciation



Speciation in action: Darwin's Finches (Beak size and shape)

When visiting the Galapagos Islands, Darwin found many different species of finch. The mainland however had only one species of finch which was unable to exploit ecological niches already occupied by other birds. It is thought that the islands were colonised by a flock of mainland species carried there by freak weather conditions. The finches on the islands varied greatly in beak size and shape, depending on diet. On the islands the finches had no competitors and were able to exploit the available ecological niches. They must have evolved from a common ancestor.

Galapagos Finches			
Name			
Food			
Beak Diagram			
Beak Adaptation			
Island habitat			



All of these birds evolved from the same ancestor. Beak size and shape vary depending on diet.

Test your knowledge

1. Give the meaning of the term adaptation.

_____

_____

2. Explain the importance of mutations in the evolution of new species.

_____

_____

3. Explain what is meant by the terms selection pressure and selective advantage.

_____

_____

4. Give an account of speciation.

_____

_____

_____

_____

_____

_____

_____

_____

I can:	
State that a mutation is a random change to genetic material.	
State that mutations may be neutral, confer an advantage or a disadvantage to survival.	
State that mutations are spontaneous and are the only source of new alleles.	
State that environmental factors, such as radiation, high temperatures and some chemicals, can increase rate of mutation.	
State that new alleles produced by mutation allow plants and animals to adapt to their environment.	
Define an adaptation as an inherited characteristic that makes an organism well suited to survival in its environment/niche.	
State that variation within a population makes it possible for a population to evolve over time in response to changing environmental conditions.	
Species produce more offspring than the environment can sustain.	
State that natural selection or survival of the fittest occurs when there are selection pressures.	
Describe natural selection as the best adapted individuals in a population survive to reproduce, passing on the favourable alleles that confer the selective advantage	
State that favourable alleles increase in frequency within the population.	
State that speciation occurs after part of a population becomes isolated by an isolation barrier.	
Name isolation barriers as being; geographical, ecological or behavioural.	
Give examples for each type of barrier. E.g. ecological-pH, salinity or different habitats.	
State that different mutations occur in each sub-population.	
Describe how natural selection selects for different mutations in each group, due to different selection pressures.	
Explain that each sub-population evolves until they become so genetically different that they are two different species.