



## Section 1: Variation

### • What is variation?

In biology, variation refers to the differences we can observe between individuals in a population. The differences might be physical (height, weight and colour), behavioural (aggression and obedience) or physiological (disease resistance and rate of metabolism).

Variation is sometimes classified as continuous or discontinuous. Continuous variation refers to differences in a population, which can range from one extreme to another, such as weight or height. An individual can be any weight between the two extremes. In discontinuous variation the differences are limited and fall within discrete categories, such as blood groups A, B, AB and O. Individuals have one of these blood groups and cannot have some intermediate type of blood group.

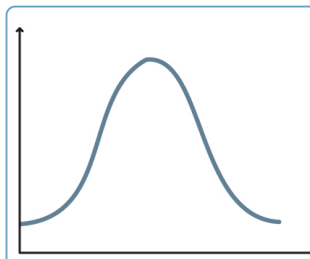


### DIAGRAM 01:



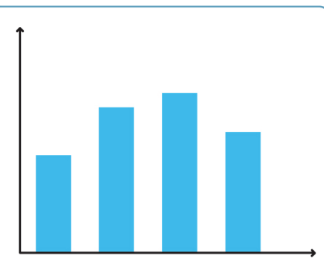
### Continuous and Discontinuous Variation

BIOLOGY • ADAPTATION AND EVOLUTION • ADAPTATION



#### Continuous Variation

No Distinct categories  
Tends to be quantitative  
Controlled by a lot of genes  
Strongly influenced by the environment



#### Discontinuous Variation

Distinct categories  
Tends to be qualitative  
Controlled by a few genes  
Unaffected by the environment

### • Suggested Films

- Variation
- FactPack: Classification

### Extension Question

Q1. Is skin colour an example of continuous or discontinuous variation?

Skin colour is an example of continuous variation. Skin can differ in colour from very pale to very dark.

• What causes these variations?

Differences within a population can be caused by genes, the environment, or a combination of both. Human blood groups, for example, are determined by the genes we inherit from our parents, whereas the language we speak is determined by the environment we grew up in. Our weight is determined by both our genes and our environment operating together.



Differences in blood type are determined by genes alone, not by our environment

• Suggested Film

– Variation

Extension Question

Q2. What causes variation in skin colour?

The differences we see in skin colour are caused by both genes and the environment. Different genes cause different amounts of pigmentation to be present in the skin, but exposure to sunlight can also have an effect.

• Why is variation important?

Variation in a population is essential in the long term, because it allows a species to adapt to changing conditions. If conditions change, some organisms will be better suited to those conditions than others, and so they are more likely to survive and reproduce. If the beneficial differences are caused by genetic factors, these can be passed on to the next generation, which will therefore be better adapted to the new conditions.

• Suggested Film

– Bizarre Adaptations

Extension Question

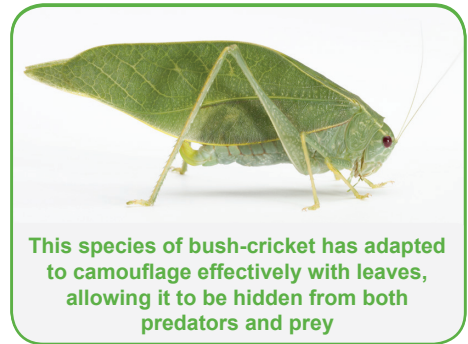
Q3. How do bacteria evolve to become resistant to antibiotics?

Antibiotics are chemicals used to kill bacteria. Although they are usually extremely effective at doing this, there are occasionally bacteria which survive because they show slight differences in their structure and chemistry. Those that survive are effectively selected for, and they go on to reproduce to form a population of resistant organisms. This is an example of evolution in action.

## Section 2: Adaptation

### • What is adaptation?

Adaptation refers to the way that organisms are suited to their environment. They may be suited in terms of their anatomy, behaviour and physiology. For example, many species of organism have colouration, which helps them to be less easily seen by predators or their prey. We call this adaptation camouflage. Similarly, some organisms will play dead when under threat. This is a behavioural adaptation which helps them to survive. All species show adaptations to their environment.



### • Suggested Film

– Adaptation

### Extension Question

Q4. Why do polar bears have white fur?

Polar bears have white fur so they can be less easily seen against the snowy background of the Arctic. This is an adaptation which helps them to catch prey and therefore survive.

### • How are organisms adapted to live in the polar regions?



These emperor penguin chicks have adaptations that let them survive the harsh polar climate

Despite the extreme low temperatures and limited supply of food, many organisms are able to survive and reproduce in the polar regions. Most show physical adaptations, which help to reduce heat loss. They tend to be well insulated with fur, blubber and feathers, and most are large in order to reduce their surface area to volume ratio. Many also show behavioural adaptations; some huddle together to conserve heat, while others hibernate through the coldest periods of the year.

### • Suggested Film

– Life in the Freezer

### Extension Question

Q5. What happens to animals when they hibernate?

Animals usually hibernate when it is very cold and when there is little food to be found. They become very inactive and their metabolic rate slows down in order to conserve food supplies. They often rely entirely on their body reserves of fat.

• How do organisms survive in the desert?

To survive in the desert, organisms need to stay cool and conserve water as much as possible. Many show remarkable adaptations to these conditions. Cacti, for example, can store water in their stems, and do not have leaves in order to reduce evaporation. Many animals only come out at night when conditions are cooler, and some, such as the desert rat, have the ability to lose very little water in their urine.

- **Suggested Film**  
– Life in Hot Deserts

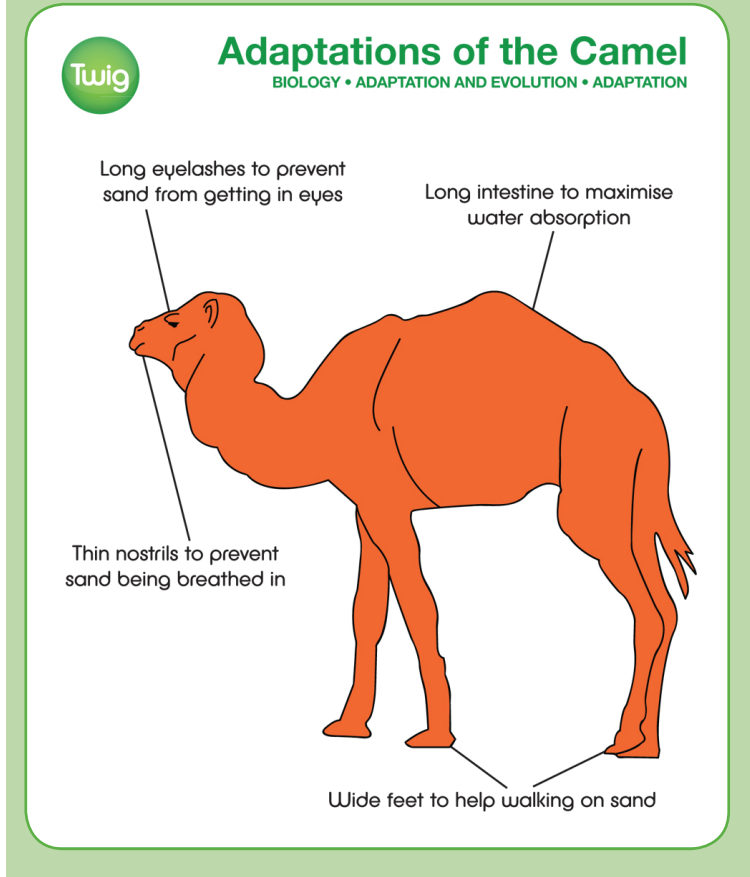
**Extension Question**

Q6. Why do some desert organisms have large ears?

As well as helping to funnel sound, large ears increase the surface area of an animal. This can help the organism to lose heat to its environment.

- **Suggested Film**  
– Adaptation

**DIAGRAM 02:**



**Section 3: Evolution**

• How do organisms evolve to adapt to changing conditions?

Organisms evolve through a process of natural selection. In any population we can usually observe differences in the anatomy, behaviour and physiology of the individuals. Some individuals are therefore likely to be better suited to a new set of environmental conditions, and so more likely to survive and reproduce. Some of their offspring are likely to inherit the same features which were advantageous to their parents, and so over time more of the population show the beneficial features. This is the process of evolution by natural selection.

**Extension Question**

Q7. Are organisms evolving in response to global warming?

There is substantial evidence that certain species, including some birds and insects, have evolved in response to the global warming of the past 150 years. Increased temperatures suit some organisms in a population more than others. Those better suited are more likely to survive and reproduce and thereby pass on their characteristics to the next generation.

• What is co-evolution?

Co-evolution occurs when two species evolve in response to the selection pressure from each other. This is classically seen in predator-prey relationships. Only the fastest prey can escape their predators, so over time the prey population evolves to become faster. Now only the fastest predators can catch any prey, so over time the predator population becomes faster.

Co-evolution is also seen between viruses and their host. Only those host organisms with the strongest immune systems might survive an infection, so over time the population evolves to become more resistant to disease. However, some viruses are able to survive, and these co-evolve as the hosts' defences change.



The development of the land iguana's sharp claws and climbing skills has led to the opuntia cactus evolving a slippery bark to reduce predation

• Suggested Films

- Predators and Prey
- FactPack: Super Predators
- FactPack: Super Prey

Extension Question

Q8. Are humans evolving?

Humans are definitely still evolving. Agriculture and modern medicine may have reduced some of the obvious selection pressures, but factors such as sexual selection and resistance to disease are still at work.

• What is sexual selection?



The colourful tail of the male peacock is designed to attract potential mates

To pass on its genes to the next generation, an organism has to attract a mate and reproduce. Any factor which helps to attract a mate, such as colourful plumage or a courtship display, will be selected for, and if caused by genes, passed on to the next generation. This explains many of the bizarre adaptations we see in the natural world.

• Suggested Films

- Sexual Selection
- FactPack: Deadliest Animals

Extension Question

Q9. Why do many male animals fight for a mate?

If you fight other males for mates and win, your genes will be passed on to the next generation. If you won the fight by being bigger, stronger and more aggressive, then the genes for those characteristics will be passed on to the next generation.

## • Quizzes

**Adaptation**
**Basic**

• Cacti store water in their stems. What kind of adaptation is this?

- A – physical
- B – behavioural
- C – genetic
- D – reproductive

• What type of adaptation is camouflage an example of?

- A – physical
- B – behavioural
- C – genetic
- D – reproductive

• What causes new characteristics to appear?

- A – selection pressures
- B – mutations
- C – variation
- D – evolution

• What is extinction?

- A – the death of an organism
- B – the evolution of an organism
- C – the evolution of a species
- D – the loss of a species

**Advanced**

• What type of adaptation is camouflage an example of?

- A – physical
- B – behavioural
- C – genetic
- D – reproductive

• Many birds have attractive plumage to attract mates. What type of adaptation is this?

- A – environmental
- B – behavioural
- C – genetic
- D – reproductive

• What causes new characteristics to appear?

- A – selection pressures
- B – mutations
- C – variation
- D – evolution

• What causes species to adapt to new conditions?

- A – death
- B – mutations
- C – variation
- D – evolution

## Variation

### Basic

• What is the term used to describe differences between individuals of a population?

- A – appearance
- B – variation
- C – genetic
- D – environmental

• Body weight is an example of what type of variation?

- A – genetic
- B – environmental
- C – continuous
- D – discontinuous

• Gender is an example of what type of variation?

- A – genetic
- B – environmental
- C – continuous
- D – discontinuous

• What causes inherited variation?

- A – genetic factors only
- B – environmental factors only
- C – genetic and environmental factors
- D – neither

### Advanced

• What is the term used to describe differences between individuals of a population?

- A – appearance
- B – variation
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• Height in humans is an example of what type of variation?

- A – genetic
- B – environmental
- C – continuous
- D – discontinuous

• Blood group is an example of what type of variation?

- A – genetic
- B – environmental
- C – continuous
- D – discontinuous

• What causes differences in height?

- A – genetic factors only
- B – environmental factors only
- C – genetic and environmental factors
- D – neither

• What causes differences in blood group?

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## • Answers

**Adaptation**
**Basic**

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- What is extinction?

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