Zig Zag Education

Science

KS3


# Evolution

## Biology Topic Pack X for KS3 Science

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POD 12276

# Contents

# Teacher's Introduction

Welcome to the Key Stage 3 Evolution Topic Pack, which should be used in Year 9, or possibly Year 8, depending on your school's Science Scheme of Work. The pack has been designed to support learning of this topic by acting as an accompaniment to the teacher's classwork, and should engage students of all abilities. It can be given to students before lessons, or may alternatively be used as cover lesson work or homework, and the end-of-topic questions work well as a formative assessment. It is assumed that your learners will have **already covered** the following content, much of which will be covered in our KS3 Biology Topic Pack IX: Genetics:

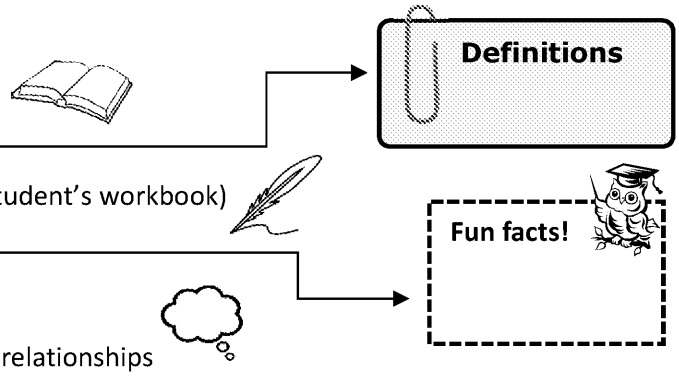
- how to make observations and measurements
- reproduction and life cycles, in summary form, of animals and plants
- heredity, DNA, genes and chromosomes

**The national curriculum points covered by this topic pack are:**

- differences between species
- the variation between individuals within a species being continuous or discontinuous, to include measurement and graphical representation of variation
- the variation between species and between individuals of the same species means some organisms compete more successfully, which can drive natural selection
- changes in the environment may leave individuals within a species, and some entire species, less well adapted to compete successfully and reproduce, which in turn may lead to extinction
- the importance of maintaining biodiversity and the use of gene banks to preserve hereditary material

The topic pack includes the following components:

- Explanations and examples of the key concepts
- Key scientific terms and definitions
- Comprehension questions (to be answered in a student's workbook)
- Fun facts
- Working scientifically – focus: studying variation, presenting data, and understanding cause–effect relationships
- Crossword
- End-of-topic questions (to be answered in a student's workbook)*
- Answers




This topic pack covers the material seen in the following two textbooks:

- *Activate 2* (Gardom Hulme at al.): Chapters 3.3, 3.4, 3.6, 3.7 (pp. 46–49; 52–55)
- *Activate 3* (Gardom Hulme at al.): Chapter 2.6 (pp. 32–33)
- *Exploring Science 7* (Levesley et al.): Chapters 7Da–7Db (pp. 50–55)
- *Exploring Science 8* (Levesley et al.): Chapter 8Da (pp. 50–51)

*August 2023*

* A write-on version of the end-of-topic questions is provided on the ZigZag Education Support Files system, which can be accessed via **zzed.uk/productsupport**

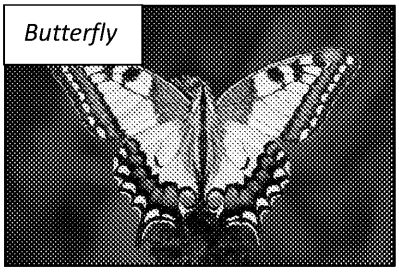
 

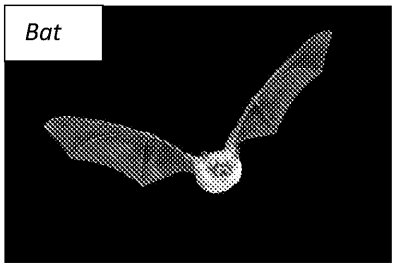
## Differences between species

Lions are different from oak trees.
Butterflies are different from jellyfish.
You can probably list many more organisms that are very different from each other.
Yet some are more similar. For example, a bat is quite similar to a bird.


*Lion*

All these organisms are from different **species**. A species consists of organisms that can breed together to produce **offspring** that are **fertile**. That means the offspring can also breed together.
For example, lions can breed together to make more lions, and their offspring can also reproduce to make more lions.
However, lions could not breed with wolves.


*Butterfly*


*Bat*

These differences, or any differences between organisms, are known as **variation**.

Variation can be **continuous variation** where any value within a range is possible.
One example of this is the height of adult humans. There will be a minimum and maximum height, but between these values, a person can be of any height. Most traits show continuous variation.

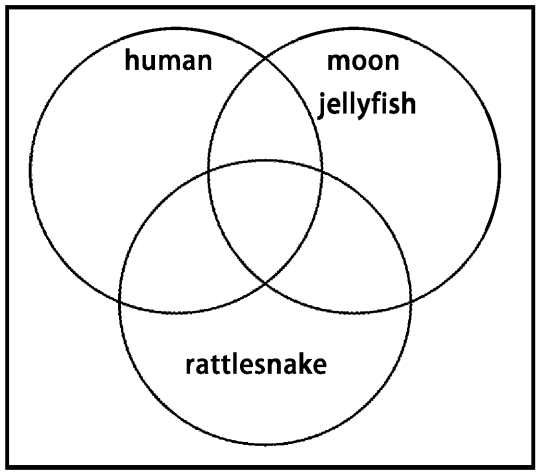
**Discontinuous variation** is less common.
One example is human blood groups.
A person can be group A, B, AB or O, but there are no values in between these.
Discontinuous variation is less common because most traits are affected by the environment, diet, lifestyle, etc. and these produce a range of continuous effects.

**Species:** consists of o
together to give offspr
**Offspring:** the new yo
by parents
**Fertile:** able to reprod
**Variation:** the differer
the differences can be
their genetics
**Continuous variation**
any value within a rang
in a certain age group
**Discontinuous variat**
take a limited number
blood groups

Q1: Give three examples of variation in cats.

Q2: Explain why cats are classed as a different species from dogs.

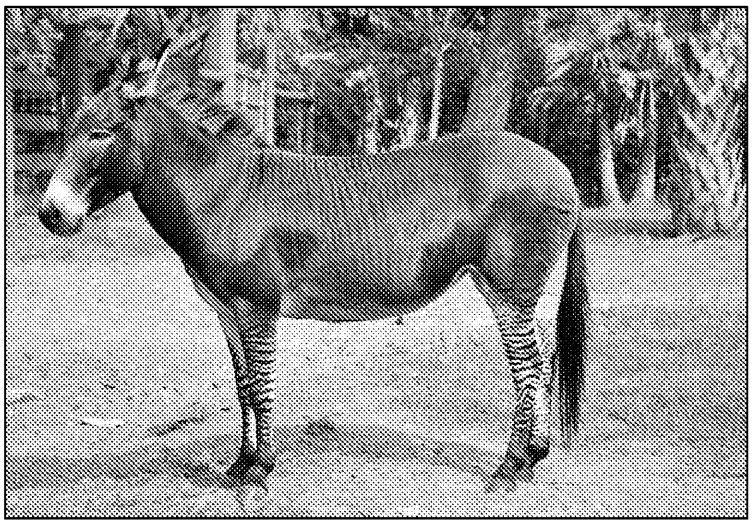
Q3: In a group of 3 or 4, draw a Venn diagram like this, with the same labels.




(a) Write some features of the organisms in the correct places on the Venn
from cells' would go in the centre, and 'has eyes' would go in the part t
rattlesnake but not moon jellyfish. You may need to do some research

(b) Why is it easier to think of things that are common to humans and ratt
moon jellyfish?

(c) Draw another Venn diagram yourself. Put different species or types of
diagram. Pass this to another member of your group for them to comp
else's. When you are finished, discuss what you each wrote.



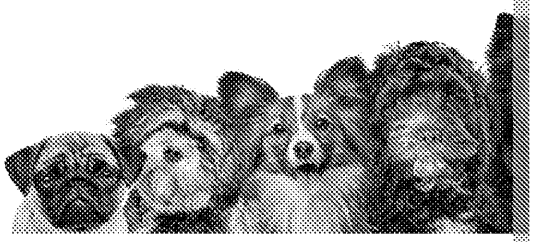
*Zonkey – a hybrid between a zebra and a donkey.*

**Fun fact!**
Some anim
species **can**
produce hy
breed with
but hybrids
donkey are

## Variation within species

Look at all the dogs in this picture.

These dogs are all from the same species, but they show considerable variation.



**Q4:** Write down two ways that the dogs in the picture show variation. Choose f
see in the picture.

**Q5:** The dogs are all from the same species. What does that mean?

Variation within species can be more important than just appearance. One example of this is in rabbits. Rabbits can get an infectious disease called myxomatosis. Before the 1950s, myxomatosis killed 99.8% of rabbits that were infected. **Genetic variation** in the rabbits saved the lives of the other 0.2% because their different genetics made them **resistant**. Nowadays, up to 50% of rabbits in any wild population are resistant to the disease. We'll see in the next section how and why this percentage has increased.

**Gen**
in th
indiv
**Res**
the
redu

**Q6:** Myxomatosis is a disease in rabbits caused by a virus. Viruses cause infecti
animal and then getting inside cells. They use certain proteins in the cell m
to do this. Suggest how genetic variation works to make some rabbits resi

Another serious effect of genetic variation occurs in bacteria. Since the 1940s, **antibiotics** like penicillin have been used to cure people of diseases caused by bacteria. This is because antibiotics kill bacteria or stop them multiplying. However, bacteria also have genetic variation, causing some of them to be antibiotic-resistant. That means antibiotics have no effect on them and so can no longer be used to cure these diseases. You will find out more about this in the next section.

The picture shows the bacteria that cause tuberculosis, as seen through a microscope. Most of them are now resistant to all known antibiotics!

**Q7:** Why is antibiotic resistance in bacteria such a big worry for the future?

**Fun fact!**
Being resistant to a disease is **not** the same as being immune to it. Resistance comes from genetics, whereas immunity comes from an

## Natural selection and evolution

Look back at the example of myxomatosis in rabbits in the last section.

Before the 1950s, 99.8% of rabbits would die after getting the disease, so only 0.

In the present day, up to 50% of rabbits survive. So, what has changed?

The answer is natural selection and evolution.

**Natural selection** is sometimes called 'survival of the fittest', but is better described as the increased survival of those individuals best **adapted** to their environment. Charles Darwin was the first scientist to publish a book about this theory, back in 1859.

**Natu**
surviv
adapt
**Adap**
enviro
**DNA:**
nucle
functi
passe
**Evolu**
inheri
many

Think about what will happen to a young rabbit that gets the disease. There are two possibilities because of existing genetic variation:

1. the rabbit may die before it gets the chance to reproduce
2. the rabbit may survive and reproduce

That means, if the rabbit has the **DNA** sequence to make it resistant to myxomatosis, then that DNA sequence will be passed on. As those rabbits that do *not* have this sequence will die, then their D from the population. Over many generations, the effect of this is to increase the the DNA for resistance. That is why almost 50% of rabbits are resistant to myxon 0.2% before the 1950s.

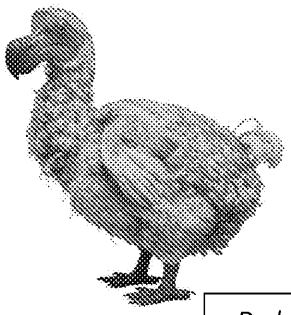
This process is called natural selection and the change that happens over many g

Q8: Explain what is meant by natural selection.

Q9: Explain what is meant by evolution.

Q10: Explain how bacteria are becoming resistant to antibiotics. Use the inform are becoming resistant to myxomatosis to help with your answer. Sugges reproduce, but do not breed, so do not use the word 'breed' in your answ

## How do organisms become extinct?



*Dodo*

When you think of **extinct** organisms, you prob
of the dodo.

These two examples illustrate how organisms
human involvement.

Dinosaurs became extinct before humans exist
in 1662 by human impacts: overhunting for fo
human-introduced species.

The causes of extinction are usually one or more of:

- destruction of habitat
- overhunting by humans
- new diseases
- new **predators**
- new competitors
- climate or environmental change

**Extin**
anyw
in cap
**Pred**
hunts

**Fun fact!**
Scientists estim
species becom
most of these

Q11: Describe what is meant by extinct.

Q12: List two ways that humans can cause organisms to become extinct.

One example of mammals to have become extinct without human involvement i
These were mammals that lived in North America 65–43 million years ago. They
that varied between the size of a cat and the size of a small bear. Scientists belie
become too specialised and could not adapt to **compete** with other animals that
Hence, the other animals were better at getting resources, escaping from predat
changes in the environment.

Dinosaurs are thought to have become extinct because of a **mass extinction event**. Some such events have been caused by asteroid impacts with Earth. These impacts fill the atmosphere with dust, blocking sunlight and causing plants to die. Animals then die because there are very few producers.

In summary, organisms become extinct if they die faster than they reproduce.

**Compete**
resource t
they will c
**Mass exti**
that sudde
many spec

Q13: List two ways that organisms can become extinct without human involve

Extinction reduces **biodiversity**. Biodiversity is good for the environment because it makes change less likely to have a lasting impact. For example, if a forest contains 20 species of tree (large biodiversity) and one of these is lost, then the overall impact of this change may be minimal. However, if there were only two species of tree (small biodiversity) then the loss of one would have a more dramatic effect.

**Biodive**
species
place ar
these sp
**Gene b**
organisr
eggs, se

Also, we could rely on species in unknown ways in future. For example, currentl
derived from plant products. Who knows what other medicines could be develo
want those plants becoming extinct before we find out!

In case of future extinction, scientists are starting to develop **gene banks**. These
important species, such as plant crops. Seeds and pollen grains, for example, are
time in deep-freeze conditions. Eggs from animals are also quite easily stored in
would mean that organisms could be grown again, should anything cause them t

Q14: Describe what is meant by a gene bank.

## Working scientifically – Studying variation, presenting da
## understanding cause–effect relationships

In this investigation, you will study variation in leaves.

Collect a large number of leaves from one type of plant. Aim to get more than 5
broad leaves, such as those from a chestnut tree or laurel hedge rather than nar
grasses. They can even be leaves that have just fallen, if you are doing this in aut

Decide on a distance measurement that you can make consistently for these leav
widest part, or it might be the length from the tip to the petiole (the stalk that co
Make this measurement for each leaf and write it down. At this stage, just write

Find the smallest and largest measurements that you have made. The difference between these is called the **range**. Divide the range up into 8–10 equal intervals. For example, if your leaves have lengths from 5–9 cm, then you could divide this into 5.0–5.4, 5.5–5.9, 6.0–6.4, 6.5–6.9, etc.

**Range:** t
largest a
set of da
**Histogra**
where th
and the h
number o
the bars

We will use these intervals to display the results in a graph called a **histogram**.

A histogram is like a bar chart, except:

- the horizontal axis has numbers that are in regular intervals
- the intervals on the horizontal axis have no gaps between them
- the bars on the chart are touching

Make a tally chart with your intervals listed in order. Now make a tally mark for e
the table. Write the number of leaves in this interval beside the tally once you a

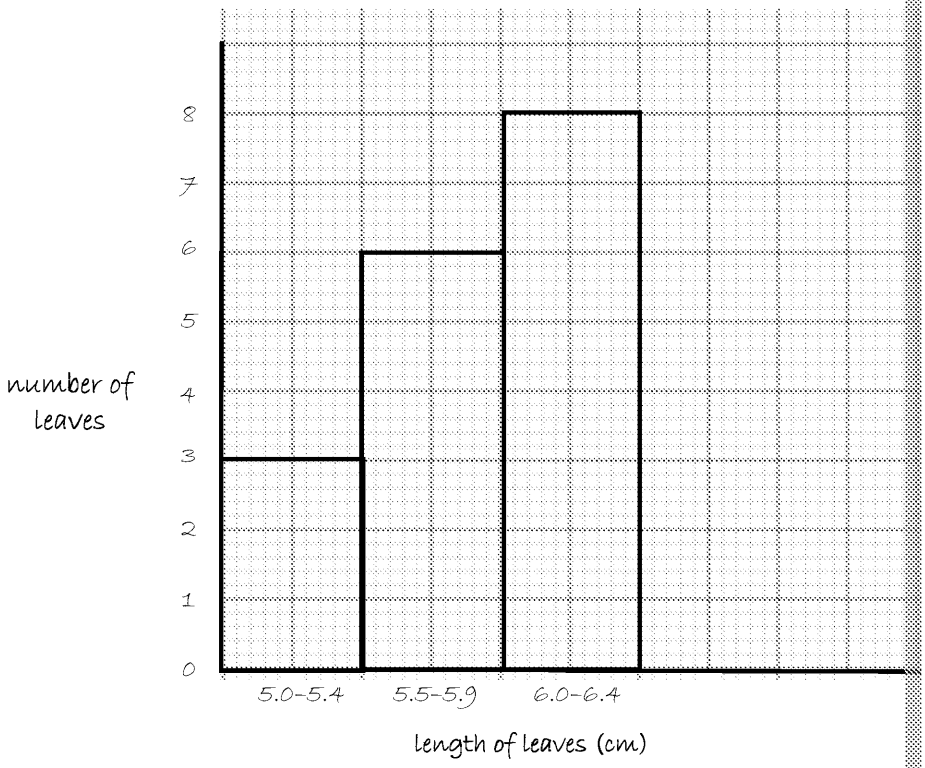
Your tally chart might look something like this:

| leaf length (cm) | tally | n |
|---|---|---|
| 5.0–5.4 | \|\|\| | |
| 5.5–5.9 | 𝍸\| | |
| 6.0–6.4 | 𝍸\|\|\| | |
| | | |
| | | |
| | | |

Once you complete your tally chart, you can draw your histogram. Remember:

- use a ruler and a sharp pencil
- make sure your scales on each axis have regular steps
- label each axis with numbers
- label each axis with what it shows and a unit if required

A histogram drawn from the tally chart above will begin to look like this:




**Q15:** On graph paper, draw a histogram of your results.

**Q16:** Explain why a histogram is a better way to present these results than a l

You can also do this investigation with many other features, such as the hand spa

**Q17:** Describe any difficulties that you had in making the measurements in a

**Q18:** Describe any safety precautions that you took during and after the inves

**Q19:** Describe the pattern in the variation shown in your results.

**Q20:** Suggest any improvements to the investigation that would make the re

## Working scientifically – Cause and effect

Sometimes in science we want to know whether one variable causes another to c
and effect.

For example, if you drop a ball from a greater height, it will take longer to reach t
height causes the time to change, so it causes an effect. This is a cause and effec

An example of something that has no cause and effect is turning the clocks forwa
Turning a clock forward by one hour at the end of March is when we see increasi
weather. However, turning the clock forward does not *cause* these changes.

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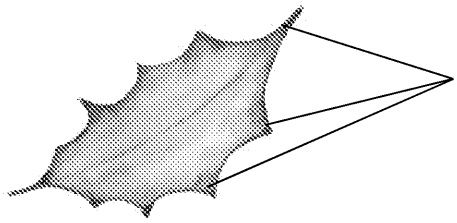
Q21: State whether each of these relationships is cause and effect or not.

(a) Older trees are usually taller than younger ones.

(b) Countries with higher carbon dioxide emissions have higher rates of

(c) In the USA, increased ice cream sales occur at the same time as increa

(d) Lung cancer is more common in people who smoke more tobacco.



prickl

*Holly leaf*

Q22: Holly is a plant with prickly leaves. A holly leaf is shown in the picture abo
A class of students collected leaves from holly plants.
They collected 10 leaves from each of the heights 1.0 m, 1.5 m and 2.0 m a
They counted the prickles on each of the leaves and worked out the avera
They found that the higher the leaves, the fewer prickles they had.

(a) Suggest a reason for this trend.

(b) Describe how the students could make their results more reliable.

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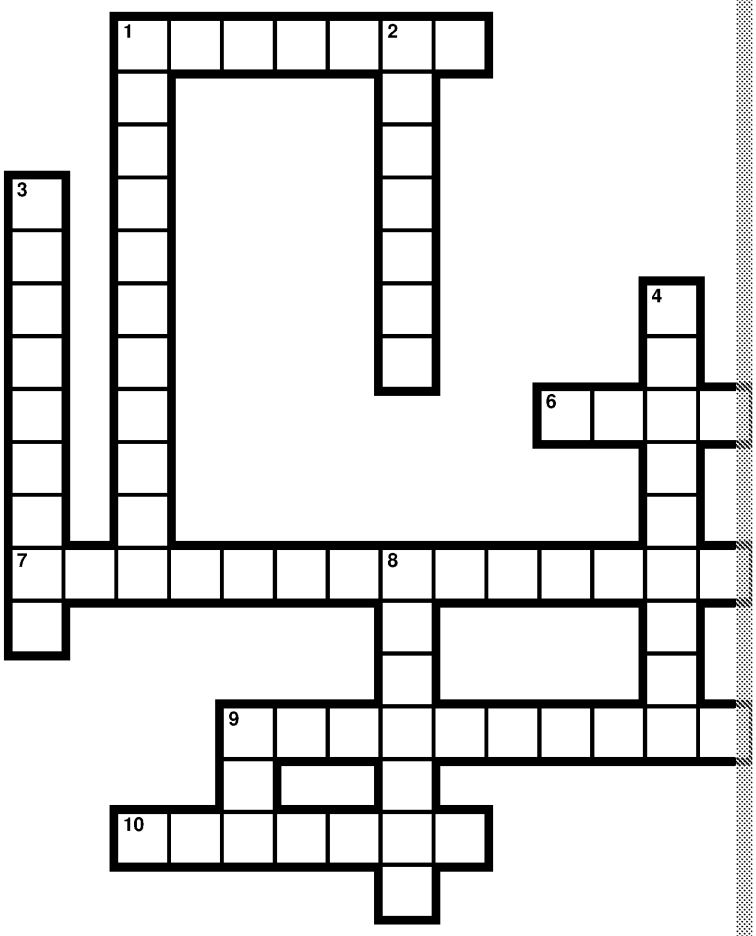
# Crossword




**Across**

**1** An organism that no longer exists anywhere is said to be _____ (7)

**6** Famous British scientist who wrote about the origins of different species (6)

**7** The process that drives evolution (7,9)

**9** The type of variation shown, for example, by human blood groups (13)

**10** An organism is said to be well _____ if it is well suited to a certain place or job (7)

**Down**

**1** An organism's surroundings (

**2** Animals of the same species _ and shelter (7)

**3** The general name for the you parents (9)

**4** The word used to describe dif

**5** The type of variation shown, human arms (10)

**8** Organisms that can breed tog offspring are said to be in the

**9** The substance inside the nuc new generations (3)

# End-of-topic Questions

1. Copy and complete this sentence using words from the list. You will not nee

   **family** **species** **feed** **compete**

   *Organisms that can _____ together to produce offspring that can re the same _____.*

2. Write the word that means differences between organisms.

3. Write the word used to describe an organism that is no longer found alive a

4. (a) Give **one** example of:
   (i) continuous variation in oak trees
   (ii) discontinuous variation in humans, other than blood groups
   (b) State what type of graph you would use to present the results in each c

5. Explain why a bar chart would be better than a line graph for displaying disc

6. What is the correct biological term for the idea of 'survival of the fittest'?

7. Describe what is meant by the term 'evolution'.

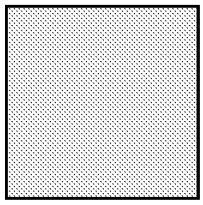
8. Suggest why some people do **not** believe in evolution.

9. Charles Darwin was a scientist who studied natural selection. He observed t more offspring than can possibly survive. Explain what this causes in the off

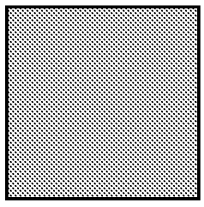
10. Wheat is an important plant crop for producing human and animal foods. E preserved in case the crop becomes very rare in the future.

11. Scientists carried out an experiment with wild mice. They collected hundred took them to two large open areas with different-coloured soils. The mice h colours, from light to dark. Coat colour in mice is inherited.

    The mice were released into the two areas at random. Mice could not move b not escape from the areas. The areas provided all the natural resources that t



area A with light-coloured soil



area B with dark-coloure

Both areas were open to birds, including some that prey on mice.

After many generations, the mice were observed.

- area A contained a higher proportion of light-coloured mice
- area B contained a higher proportion of dark-coloured mice
- the population numbers in the two areas were approximately equal.

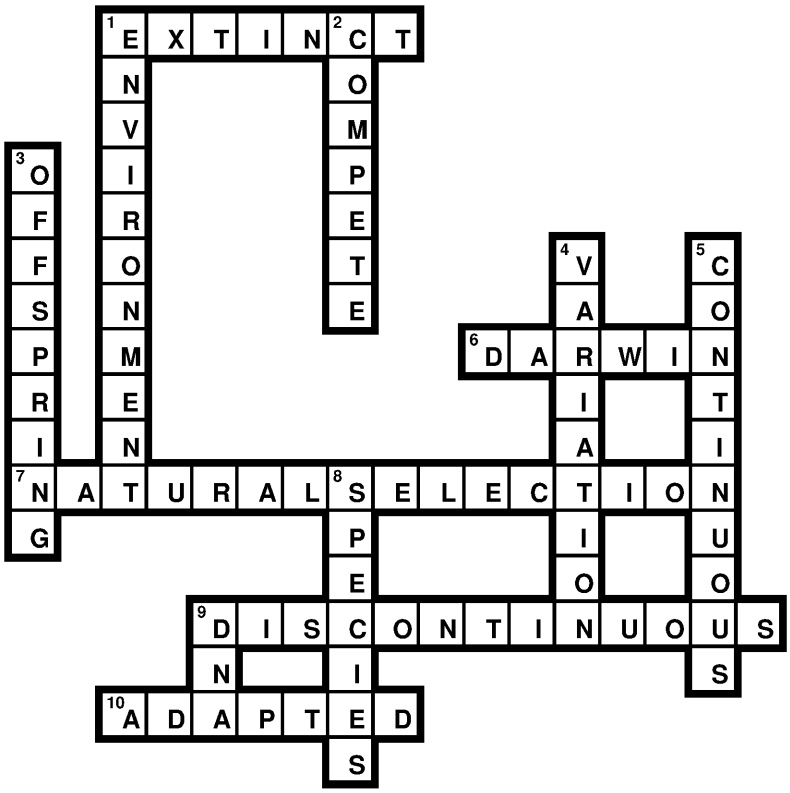
Explain what happened to change the proportions of colours of mice in each

# Answers

## Comprehension questions

1. *any three valid suggestions, e.g.*
   body mass / coat colour / ear shape / tail length / height / body length, etc.
2. (cats and dogs) cannot breed together
   they cannot produce fertile offspring
3. (a) this will vary
   **examples common to all three include:** does respiration / is living / can reproc
   **examples common to human and rattlesnake include:** has a skeleton / has a c
   **examples common to rattlesnake and moon jellyfish include:** moves without
   (b) humans and rattlesnakes are both vertebrates so are more similar *or* share mo
   with moon jellyfish
   (c) this will vary according to what organisms are chosen, but properties should b
4. *two from:*
   ear shape / head shape / head size / fur length / fur colour
5. dogs can breed together to produce offspring that can also breed
6. change to the protein (in the rabbit) that the virus uses / lack of this protein
7. more people will die from bacterial diseases / bacterial diseases will require some c
8. idea that organisms better suited to their environment are more likely to survive
9. changes in inherited traits in a species over many generations
10. there is genetic variation in bacteria
    those that are resistant to antibiotics will survive *or* those susceptible to antibiotics
    idea that the DNA (sequence) for resistance will be passed on *or* DNA that does not
    from the population
    over many generations the proportion of bacteria with the DNA (sequence) for resis
11. not found alive anywhere
12. *two from:*
    - habitat destruction
    - hunting
    - pollution
    - climate change
    - introduction of predators / competitor organisms / diseases
13. *two from:*
    - new disease
    - new predator
    - new competitor
    - climate change
14. collection of stored samples, e.g. seeds, embryos, tissues of important species
15. histogram should have:
    - axes in the correct orientation
    - axes labelled with units
    - linear scales
    - bars that are touching
    - bars that are the correct height
    - lines that are in pencil and ruled
16. the results are grouped into ranges
    the results are not linked by an independent and a dependent variable as in a line g
17. this will vary, but could be knowing where exactly to take measurements from
18. wear gloves / wash hands after handling leaves / take care if leaves have sharp part
19. this will vary, but could be a bell-shaped distribution with fewer numbers of leaves a
20. this will vary, but could be some way of standardising the points between which me
    suggestion of increasing sample size
21. (a) cause and effect
    (b) not cause and effect
    (c) not cause and effect
    (d) cause and effect
22. (a) any reasonable suggestion such as:
    leaves from higher are younger/smaller and have less time to grow prickles
    leaves from lower are more likely to be eaten and need more defence
    (b) collect more leaves from each height
    collect leaves from more heights
    repeat the investigation with holly growing in different areas

## Crossword




## End-of-topic questions

1. Organisms that can **breed** together to produce offspring that can reproduce are me
2. variation
3. extinct
4. a) (i) any reasonable suggestion such as height / width / trunk diameter / wate
   (ii) any reasonable suggestion such as eye colour / ear lobe shape / tongue-r
   b) histogram for continuous and bar chart for discontinuous
5. idea that bar charts are good for displaying discrete data whereas line graphs show
6. natural selection
7. a change in inherited characteristics over many generations
8. idea of creationism, although that word may not be used, e.g. a creator made all or
   do not change further
9. competition
   not enough resources *or* named resource such as food/water/shelter (but not mate
   only the best adapted (*or* strongest/fittest) will survive
10. gene bank(s)
    seeds/tissue stored
    in cold/deep-freeze conditions
    so they can be taken out and grown again if needed
11. natural selection
    idea that mice are better camouflaged if their coat colour matches the soil / mice ar
    their coat colour is different from the soil
    mice with the 'wrong' coat colour are more likely to be eaten
    mice with the 'correct' coat colour are more likely to survive
    mice that survive are more likely to reproduce
    gene/DNA for 'correct' coat colour is more likely to be passed on
    over many generations the proportions of colours change