

# GCSE

## Edexcel GCSE in Science Environment

(Concept approach)

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## Scheme of work for Topic 1: Environment

LESSON 1: The five kingdoms							
Spec code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
B1 a 1.11	7A Cells. 7D Variation and classification. 9C Plants and photosynthesis. 9D Plants for food.	Recall the difference between animals and plant cells.  Know the five kingdoms.  Know the key characteristics of the main kingdoms.  Know that humans are mammals.	<b>Starter</b>  Is sea anemone an animal or plant? What features suggest that this might be a plant? What features suggest that this organism may be an animal? What do students perceive as animal characteristics? What, then, are fungi, bacteria and viruses?  <b>Main</b>  Give students a variety of specimen organisms or pictures of organisms to sort into different groups. At each stage the students need to consider very carefully the criteria they use to sort different groups. Sort the organisms into two groups. Gradually increase the number of groups.  <b>Plenary</b>  Pictures of different organisms to be sorted.	Picture of sea anemone.  Pictures of 30 different organisms.  <i>The Living World</i> Michael Roberts pages 28–32 has over 50 small pictures of organisms to cut and paste a work sheet.  ISBN 0174384076  Pictures of 20 different animals.	Explain the principles of classification of organisms and the difficulties encountered in attempting to do so.	WO: ☒2.1 ☒2.2 ☒2.3	
<b>Homework:</b> The duck billed platypus — this is a difficult organism to classify. Students should decide which group of vertebrates they would put this into? And explain your reasons.							

## Scheme of work for Topic 1: Environment

LESSON 2: Chains, webs and pyramids							
Spec code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
B1 a 1.1 B1 a 1.3	7C Environment and feeding relationships. 8C Ecological relationships. 9C Plants and photosynthesis. 9D lants for food.	Recall the nature of a food chain and a food web.  Recall that food webs are composed of (possibly) many food chains.  Understand that energy is lost along a food chain.  Understand, build and interpret pyramids of numbers and biomass.  Energy is lost due to respiration, excretion and not eating the whole organism.	<b>Starter</b>  Display a simple food web and ask students to draw as many food chains as possible.  <b>Main</b>  As a simulation or analogue, use four cups with holes in to represent four organisms. Place them 10 metres apart. Students transfer water from one cup to another. What does the water represent? What happens to the water as you move along the food chain? Why is that energy lost? What does this tell you about the limits to the length of a food chain? Students should describe and explain the simulation/analogue and make the links between the energy and water and suggest limits to the length of a food chain.  Experiment sheet 1.2 — Making pyramids of numbers and biomass.  <b>Plenary</b>  Make links between pyramids of biomass and energy lost in a food chain to explain why it is more cost effective for a farmer to produce a field of wheat than a field of beef cows.	Bucket of water. 24 cups with holes in. Measuring cylinders.  1 m <sup>2</sup> or 0.5 m <sup>2</sup> quadrat, large white sorting tray, trowel, scissors, plastic beakers, hand lens, forceps, pooter, balance, and identification keys.	Describe food chains quantitatively using pyramids of biomass.  Explain why it is more cost effective, in terms of energy, to produce a field of wheat compared with producing a field of beef cows.	N: 2.1 2.2 2.3	Return animals to their natural habitat unharmed after the data collection.  Wash hands after experiment.
<b>Homework:</b> Students to find an example of the longest food chain they can. They should state how many organisms there are in the chain and what limits the length of the food chain?							

## Scheme of work for Topic 1: Environment

LESSON 3: Competition							
Spec code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
B1 a 1.3 B1 a 1.4	7C Environment and feeding relationships. 8C Ecological relationships. 9C Plants and photosynthesis. 9D Plants for food.	Recall what organisms within a species will compete for. Understand that organisms of different species are often interdependent. Understand the difference between 'inter' and 'intra' specific competition. Be aware that species are all interrelated and that they have an effect on each other's population. Organisms require food and shelter.	<b>Starter</b> Students to suggest the sorts of things that an organism would need to survive. <b>Main</b> Define inter- and intra-specific competition. Create scenario where rabbits and foxes live on an island and ask students to plot what they think will happen. Describe and explain the snowshoe hare and lynx graph. What will limit the population of the snowshoe hare? How does this effect the population of lynx? Why don't the lynx eat all the snowshoe hare? Use Sunflower's interactive software to generate data for students to represent graphically. <b>Plenary</b> Discuss red squirrel and grey squirrel competition since the introduction of the grey squirrel. Discuss other examples of inter- and intra-specific competition.	Sunflower Software Sunflower Learning. 34 Western Road Thames Ditton KT7 0HN 0845 1 300 680 www.sunflowerlearning.com	Describe how organisms in an ecosystem compete with each other for resources. Explain population data in terms of predator-prey interdependence and intra-species competition.	C 2.1 N 2.2	
<b>Homework:</b> Students to suppose that a population of rabbits overran an island. Suggest three different ways to reduce the rabbit population. What are the advantages and disadvantages of each method?							

## Scheme of work for Topic 1: Environment

LESSON 4: Human impact on the environment							
Spec code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
B1 a 1.2 B1 a 1.4 B1 a 1.5	7C Environment and feeding relationships. 8C Ecological relationships.	Recall what organisms within a species will compete for.  Understand the difference between 'inter' and 'intra' specific competition.  Students to understand that when land is managed the biodiversity can decrease, eg farms.  Students to gather field data and use field techniques.	<b>Starter</b>  How had early man/native rainforest tribes impacted on their environment? Compare this to how modern man impacts on today's environment.  <b>Main</b>  Field quadrats on the school field. Compare the biodiversity of plants in managed and unmanaged areas such as across a path or across a football pitch and the margins of the pitch to show the human influence on distribution and diversity.  Biological Sciences Review February 2002 has data on tonnes of salmon farmed compared to tonnes of Atlantic salmon caught over an 18 year period. The trends are obvious. Why might this be the case? What other information might you require?  <b>Plenary</b>  Review learning.	0.5 m2 quadrats identification keys.  Biological Sciences Review February 2002 Vol 14 No 3  Atlantic Salmon fisheries website <a href="http://www.asf.ca">www.asf.ca</a>	Describe how organisms in an ecosystem compete with each other for resources.  Explain population data in terms of predator-prey interdependence and intra-species competition.  Using secondary data, explain how human activity can affect the environment, especially changes in the population size and in economic and industrial conditions.	N: 2.2 2.3	
<b>Homework:</b> Students to complete the practical write up. They should plot and discuss the distribution of two organisms on a graph.							

## Scheme of work for Topic 1: Environment

LESSON 5: Using computer models to predict population sizes							
Spec code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
B1 a 1.6	7C Environment and feeding relationships.  8C Ecological relationships.	Computer simulations can be, and have been, unreliable when estimating growth in populations.  Analyse data and see trends and patterns.  Make decisions as to what can be done to reduce human impact on the environment and other organisms.	<p><b>Starter</b></p> <p>Display the S-shaped logistic growth model. Discuss how reliable this model would be in predicting population sizes.</p> <p><b>Main</b></p> <p>See Activity sheet 1.5.</p> <p>There are many examples of computer models on the web. The following two have used real data:</p> <ul style="list-style-type: none"> <li>evaluate data from computer models to predict over-wintering mallard populations <a href="http://www.rspb.org.uk/youth/learn/catalogue/numeracy/evaluating_predictions.asp">www.rspb.org.uk/youth/learn/catalogue/numeracy/evaluating_predictions.asp</a></li> <li>predictions of crop loss due to possible future extreme rain events <a href="http://www.gsfc.nasa.gov/topstory/20021022cropdamage.html">www.gsfc.nasa.gov/topstory/20021022cropdamage.html</a></li> </ul> <p>Evaluate the conclusions drawn.</p> <p>Students can use a computer model by inputting their own parameter: Use the internet model XGROW to predict changes in population size due to competition or predation. This could be used with real data and comparison made with historical events.</p> <p><b>Plenary</b></p> <p>Evaluate the advantages and disadvantages of the XGROW model. How accurate do you think your conclusions are? Can the model be used to predict the rise or decline of particular species? What other factors may be involved?</p>	<p>Internet access: <a href="http://www.cquest.utoronto.ca">www.cquest.utoronto.ca</a></p> <p>Alternatively type 'xgrow' in <a href="http://www.google.com">www.google.com</a></p>	Demonstrate how an understanding of computer models may be used to study populations, and to show an awareness of the advantages and disadvantages of such models compared with real data.	N: 2.2 2.3  ICT: 2.2	
<p><b>Homework:</b> Students to research an organism that has become extinct or become an endangered species in the last 500 years. They should find the main cause of its extinction or why it has become endangered.</p>							

## Scheme of work for Topic 1: Environment

LESSON 6: Natural selection — 1							
Spec code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
B1 a 1.9	9A Inheritance and selection	<p>Understand examples of adaptations in both animals and plants.</p> <p>Recognise adaptations and how they can give that organism an advantage.</p> <p>Understand how the successful individuals are more likely to survive and breed passing on their traits to the next generation.</p>	<p><b>Starter</b></p> <p>Provide students with three different habitats: tropical island, adrift at sea, arctic tundra. How have humans been able to survive being stranded in these conditions? Discuss ideas.</p> <p><b>Main</b></p> <p>See Demonstration sheet 1.6 for demonstration of natural selection.</p> <p>Discuss industrial melanism and the peppered moth.</p> <p><b>Plenary</b></p> <p>Picture of a carefully selected organism. Students to suggest its environment.</p>	200 cocktail sticks: 100 pre-soaked in red food colouring and 100 pre-soaked in green food colouring, 16 metre rules, and stopwatch.	<p>Explain the principles of natural selection to include:7</p> <ul style="list-style-type: none"> <li>• how individuals within a species have characteristics that promote more successful reproduction</li> <li>• over generations the effects of natural selection can produce changes within a species and new species from variants that are better adapted to their environment</li> <li>• species that are less well adapted to a changing environment may become extinct.</li> </ul>	<p>C: 2.1</p> <p>WO: 2.1 2.2 2.3</p>	Ensure all cocktail sticks are removed or stamped down after student collection.
<p><b>Homework:</b> Students to research the key adaptations of a selected organism and discuss how these adaptations benefit the organism.</p>							

## Scheme of work for Topic 1: Environment

LESSON 7: Natural selection – 2							
Spec code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
B1 a 1.8 B1 a 1.10	9A Inheritance and selection.	<p>Evolution can be a slow process.</p> <p>Much of the evidence for evolution is found in the fossil record.</p> <p>The fossil record is open to interpretation and incomplete.</p> <p>There are conflicting views regarding the process of evolution.</p>	<p><b>Starter</b></p> <p>Observe a range of fossils. When and how were they formed? What can they show us?</p> <p><b>Main</b></p> <p>Even though evolution is a long process it is a continuous process. Is there any evidence that it is happening now? Discuss breeding of dogs or racehorses to get the best characteristics. Discuss the evolution of the 2005 bird flu virus to invade the human population.</p> <p>Discuss the contributions of Darwin, Wallace, Owen, Huxley and Wilberforce to the theory of evolution. What barriers did they have to overcome to get their theories accepted?</p> <p><b>Plenary</b></p> <p>Quiz/word game.</p>	<p>Range of fossils.</p> <p>Useful websites: www.nhm.ac.uk follow the links for nature-online and evolution and www.evolutionpages.com</p>	<p>Explain that fossils provide evidence for evolution.</p> <p>Discuss why Charles Darwin experienced difficulty in getting his theory of evolution through natural selection accepted by the scientific community in the 19<sup>th</sup> century.</p>	<p>C: 2.1 2.2</p>	
<p><b>Homework:</b> Students to write up the contributions of scientists and barriers to the development of the theory of evolution.</p>							

## Scheme of work for Topic 1: Environment

LESSON 8: Making new varieties							
Spec code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
B1 a 1.7	9A Inheritance and selection.	<p>Recall the process of natural selection.</p> <p>Know examples of selective breeding.</p> <p>Understand the principle of genetic engineering.</p> <p>Consider the ethical issues regarding selective breeding and genetic engineering.</p>	<p><b>Starter</b></p> <p>If a 'superhuman' were created by genetic engineering, what would he/she look like?</p> <p><b>Main</b></p> <p>Define and differentiate between the terms natural selection, selective breeding and genetic engineering.</p> <p>Students to work in groups of three. Each student to research a topic: natural selection, selective breeding or genetic engineering. In each case the student should detail the process, highlight the process with a specific example, the technical aspects, the advantages and disadvantages. They should produce a summary handout and explain their findings to the others in the group.</p> <p>Consider the ethical issues of each.</p> <p><b>Plenary</b></p> <p>Summarise the research from each group.</p>	<p>There are numerous websites to choose from depending upon the ability of the students.</p> <p>Some examples include: www.biome.ac.uk and www.biology-online.org.</p> <p>Search for 'genetic engineering'</p> <p>Paper based resources can be used from text books such as <i>GCSE Double Science: Biology Revision Guide</i> Richard Parsons (editor) ISBN 1841466026</p>	Compare natural selection, selective breeding and genetic engineering in terms of changing the characteristics of a species.	C: 2.3	
<b>Homework:</b> Summarise the main points from each group.							

## Scheme of work for Topic 1: Environment

LESSON 9: Organic farming							
Spec code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
B1 a 1.12	7C Environment and feeding relationships. 8C Ecological relationships.	<p>Students must understand what is involved in organic farming.</p> <p>Understand the advantages and disadvantages of organic food.</p> <p>To understand why organic products are more expensive.</p> <p>To understand why organic products are becoming so popular.</p>	<p><b>Starter</b></p> <p>Discuss photos or video clips of rotting or pest infested fruit. How can the fruit be made more economically viable? Are pesticides the answer?</p> <p><b>Main</b></p> <p>Discuss news items such as ‘Indian children exposed to pesticides lose memory’, ‘Symptoms of poisoning in children exposed to insecticide headlice treatments’, ‘Health complaints among sheep-dippers’, ‘New research on the possible link between organophosphates and ME’.</p> <p>Discuss the costs of organic food production, such as lower yields, labour intensive production and higher tax levies.</p> <p>Discuss the claims and criticisms of organic foods, such as tastier, more nutritious and GMO free.</p> <p><b>Plenary</b></p> <p>Summarise the pros and cons of organic food.</p>	<p>www.ivillage.co.uk Type ‘organic food’ in the search bar, then click on the relevant results.</p> <p>www.wikipedia.org Type organic food in the search bar.</p>	<p>Discuss the ethics and principles of organic farming and explain why organic products are more expensive than non-organic produce.</p>	<p>C: 2.1 2.1</p>	
<p><b>Homework:</b> Students to find out if it is only food that is available as an organic option. They could then research other items produced organically.</p>							

## Scheme of work for Topic 1: Environment

LESSON 10: Genetically modified organisms							
Spec code	Links and concept building from KS3	Learning objectives	Teaching activities	Resources	Learning outcomes	Key skills	Safety issues
B1 a 1.13	9C Plants and photosynthesis. 9D Plants as food.	Understand reasons for GM. Know how GM is achieved. Understand the concerns and risks of GM.	<p><b>Starter</b></p> <p>Students to list fears and possibilities of GMO.</p> <p><b>Main</b></p> <p>Recall the reasons for genetic modification (topic 1 lesson 8). Include examples such as herbicide resistance, rapid ripening of fruit, frost tolerance, pre-coloured flowers, viral resistance.</p> <p>Briefly describe the principals of genetic modification.</p> <p>Discuss the environmental and health risks associated with GM plants.</p> <p>Students to produce a FAQ leaflet, based upon the fears and possibilities listed earlier. This may be done as a paper activity or as a presentation.</p> <p>Peer assessment opportunity to evaluate each others leaflets.</p> <p><b>Plenary</b></p> <p>Review main points in leaflets.</p>	Useful website: www2.essex.ac.uk	Understand that crop plants can be genetically modified and the reasons for doing so.	C: 2.3 ICT: 2.3	
<p><b>Homework:</b> Students to compare the advantages and disadvantages of GM and selective breeding.</p>							

## Experiment 1.2: Pyramids

### What you will learn from this experiment

- 1 How sampling methods can be used to collect plants and invertebrates.
- 2 Data handling skills.
- 3 To construct pyramids of numbers and biomass from real data.

### What you will know when you finish this experiment

- 1 The most effective way of collecting plants and a range of different invertebrates.
- 2 How to organise data collected from your experiment.
- 3 How to present your data in the most appropriate way.

### How you may be assessed

- 1 How you sample your organisms.
- 2 How you present your raw data.
- 3 How you construct your pyramids.
- 4 Your ability to evaluate your results and conclusions.

### What you do

- 1 Select an area and position your quadrat carefully.
- 2 Collect the leaf litter, or cut plants at the base, and place in a white tray. Record the number of individual plants.
- 3 Search carefully and remove all the animals present. Smaller animals may be removed with a pooter, larger animals may be handled with forceps or fingers. Place in suitable containers, such as plastic beakers.
- 4 Weigh the plant material.
- 5 Sort the animals into two groups: primary consumers (herbivores) and secondary consumers (carnivores).
- 6 Weigh the groups of animals separately and record the total number of animals in each group.
- 7 Return the animals to their habitat.

### Instructions on how to construct pyramids of numbers and of biomass

A horizontal scale is chosen to represent either the numbers of organisms present per square metre or the biomass present per square metre. The lower block represents the producers (plants), the middle block the primary consumers (herbivores) and the upper block the secondary consumers (carnivores).

- 1 What are the limitations to your experiment?
- 2 How could you have improved your results?

Consider the advantages and disadvantages of using pyramids of numbers and biomass to represent an ecosystem.

### Suggestions for further work/homework

- 1 Use this method to compare two communities, such as different areas of leaf litter. It is important that comparable samples are used in each case.
- 2 How could you adapt this method to construct pyramids of numbers and biomass in a pond?

## Experiment 1.2: Pyramids

### Note for teachers and technicians

#### Aim

The aim of this investigation is to build pyramids of numbers and biomass from data the students collect themselves.

#### Previous skills, knowledge and understanding required

Food webs are composed of several food chains and how food chains can be quantified using pyramids of numbers.

#### Skills, knowledge and understanding

- 1 The most effective way of collecting plants and a range of different invertebrates.
- 2 How to organise data collected from their experiment.
- 3 How to present their data in the most appropriate way.

#### Equipment and chemicals required

- 1 1 m<sup>2</sup> or 0.5 m<sup>2</sup> quadrat.
- 2 Large white sorting tray.
- 3 Trowel.
- 4 Scissors.
- 5 Plastic beakers.
- 6 Hand lens.
- 7 Forceps.
- 8 Pooter.
- 9 Balance.
- 10 Identification keys.

#### Health and safety issues

Return animals to their natural habitat unharmed after the data collection. Wash hands after the experiment. When choosing appropriate sites consider the impact of students on the environment. Permission may be necessary from landowners. Take care when climbing over fences and stiles. Remember that the students will probably be wearing school shoes, not Wellington boots or hiking boots.

#### Delivery strategies

The ecological community chosen will depend upon accessibility, but the exercise could be carried out in woodland or open grassland.

#### Links with Key Stage 3 (KS3)

This experiment builds on the following skills, knowledge and understanding from KS3:

- SC2.5e Food webs are composed of several food chains and how food chains can be quantified using pyramids of numbers
- 7C Environment and feeding relationships
- 8C Ecological relationships.

## Activity 1.5: Taking the Mystery Out of Computers

### What you will learn from this activity

How to use a graph to predict what will happen by assuming that the data are reliable and that present trends will continue.

### What you will know when you finish this activity

- 1 How computer models work, although computers can handle a lot more data at once and take into account more factors.
- 2 Useful as it may be, a computer model is still only as good as the data put in by humans and the program (also made by humans).

### How you may be assessed

- 1 Use of your ICT skills.
- 2 Graph drawing.
- 3 Concluding and evaluating skills.

### What you do

Make your own population model by plotting a graph using the figures below with years *AD* along the x-axis (along the bottom) and world population on the y-axis (up the left hand side). Make the x-axis extend to at least 2100 *AD*. You will see why shortly.

Year (AD)	World population (billions of people)
950	0.25
1802	1.00
1927	2.00
1961	3.00
1974	4.00
1987	5.00
1999	6.00

1 billion = 1000 million

### Using your graph as a mathematical model

- 1 The doubling time of a population is the time it takes to double. Using the above figures describe what happened to the doubling time of the world human population between 1802 and 1999.
- 2 Which is probably the most unreliable point on the graph? Explain your answer.
- 3 Estimate what the world population was in the year of the Great Fire of London (1666) by *interpolation* (reading off the graph between the points).
- 4 Estimate what the world population will be in 2050 by *extrapolation* — extend the line remembering that it is a curve which keeps getting steeper and steeper and read the number of people from the y-axis.
- 5 Use the internet (try putting ‘world human population’ into a search engine) to find what other people predict the world population will be in 2050. How does it compare with yours?
- 6 How reliable do you think your estimate is? What are the limitations of how you did this activity?

## Activity 1.5: Taking the Mystery Out of Computers

### Suggestions for further work/homework

You could add your data to a spreadsheet program and use it to plot the graph. How could you work out the shape of the line and then use it to predict the population in 2050? You might have found drawing your graph hard work but a computer can handle a lot more data much faster. It can also take into account more factors, eg suppose you are predicting the size of populations of insect pests in the UK. Present conditions may change, eg the temperature may increase due to global warming or the population of a predator may also increase so more of the pests get eaten. The computer model could take a number of such factors into account and thus produce a better prediction than a simple graph like yours. But the prediction is still only as good as the program and data.

‘Food webs: Pond’ and ‘Food webs: Australian woodland’ are examples of computer models which model populations and take into account a range of factors. Why might computer models be useful to make the best predictions we can about populations of humans, wild animals and plants — even if they are not perfect?

## Activity 1.5: Taking the Mystery Out of Computers

### Notes for teachers and technicians

#### Aim

Introduce the concept of computer modelling to predict population growth.

#### Skills, knowledge and understanding

Students may be assessed on:

- 1 Graph drawing.
- 2 Concluding and evaluating skills.

#### Previous skills, knowledge and understanding required

- 1 Basic ICT skills.
- 2 The ability to plot line graphs.

#### Materials required

- 1 Graph paper.
- 2 Pencil.

#### Health and safety issues

None.

#### Delivery strategies

Introduce the topic as a way to predict population growth, using computers.

#### Links with Key Stage 3 (KS3)

This activity builds on the following skills, knowledge and understanding from KS3:

- the ways in which living things and the environment can be protected, and the importance of sustainable development
- basic ICT skills.

#### Resources

[www.cquest.utoronto.ca](http://www.cquest.utoronto.ca)

## **Demonstration 1.6: Natural Selection Simulation**

### **What you will learn from this demonstration**

In this demonstration you will find out how selection pressures lead to populations becoming extinct and how selection pressures can change the appearance of populations.

### **What you will know after you see this demonstration**

- 1 Mutations can occur at random in any population.
- 2 Populations need to adapt to changing environmental conditions.
- 3 Mutations could result in unfavourable characteristics which would result in the death or extinction of a population.
- 4 Mutations could result in favourable characteristics which would enable a population to survive and breed to pass on their favourable characteristics.
- 5 You will know actual examples of natural selection.

### **What you do**

You will be provided with a selection of red and green worms to place in the soil of a remote island. After a flock of hungry birds visit the island you will find out how many of each colour remain to breed.

### **Questions**

- 1 Draw a table to show how many red and green worms in total were caught by the birds.
- 2 How many green worms were left on the island to breed?
- 3 How many red worms were left on the island to breed?
- 4 Which was the more successful colour?
- 5 Predict how many red and green worms would be on the island after five, 10 and 100 generations.

### **Suggestions for further work/homework**

Choose an animal that has become extinct. What were the selection pressures that caused its extinction?

Choose an animal that has become highly evolved or specialised. What were the selection pressures that lead to its evolution?

# Demonstration 1.6: Natural Selection Simulation

## Notes for teachers and technicians

### Aim

In this demonstration students will find out how selection pressures lead to extinction and changes in populations.

### Skills, knowledge and understanding

This demonstration will enable students to gain the following skills, and/or knowledge and understanding:

- 1 Populations need to adapt to changing environmental conditions.
- 2 Mutations could result in unfavourable characteristics which would result in the death or extinction of a population.
- 3 Mutations could result in favourable characteristics which would enable a population to survive and breed to pass on their favourable characteristics.
- 4 Students will know actual examples of natural selection.

### Previous skills, knowledge and understanding required

- 1 Some organisms are adapted to survive daily and seasonal changes in their habitats.
- 2 Random mutations occur which could cause favourable or unfavourable characteristics.

### Equipment and chemicals required

- 1 100 cocktail sticks pre-soaked in red food dye.
- 2 100 cocktail sticks pre-soaked in green food dye.
- 3 16 metre rules.
- 4 Stop-clock.

### Health and safety issues

Once the worms have been collected students with appropriate footwear should trample inside the four metre square island to flatten any remaining protruding cocktail sticks.

### Delivery strategies

To set the scene explain to the students that many years ago there existed a species of red worm on a remote island. A chance mutation occurred which resulted in a population of green worms. The red and green worms now exist on the island in equal abundance.

The cocktail sticks should be handed out evenly among the students prior to going outside. Insist that they are not cocktail sticks, but living worms and should be treated accordingly. Once outside on open grassland set out the 16 metre rules in a four metre square to represent a small island. Organise the students evenly around the island and place their worms into the soil at random so their heads are still poking out of the ground. Students should reach into the island rather than go into the middle in case they stand on previously planted worms.

When all the worms have been planted the students move around to the opposite side of the island so they do not know where the worms are. Tell them they are now hungry birds flown over from another island in search of food. Allow time for flapping of wings and hungry squawks before giving 30 seconds to collect as many worms of any colour as possible.

## Demonstration 1.6: Natural Selection Simulation

Back in the classroom count the total numbers of green and red worms collected. How many of each colour remain on the island to breed? What then, would happen to populations of each colour after one, five and 10 generations? This simulation may lead onto similar actual cases of natural selection, such as industrial melanism and the peppered moth.

### Links with Key Stage 3 (KS3)

This demonstration builds on the following skills, knowledge and understanding from KS3:

- SC25 c how some organisms are adapted to survive daily and seasonal changes in their habitats
- 9A Inheritance and selection.

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