Pupil's Book C

Chapter 1

Inheritance and selection

Rationale

This chapter begins with an overview of the work carried out in *Pupil's Book A* – testing pupils' prior knowledge of the causes of variation and asking for examples of the different types of variation. The chapter first looks at similarities and differences in humans and how sex cells with reduced numbers of chromosomes are produced. The chapter then goes on to consider some specific cases of selective breeding in plants and animals: the sheepdog, Hereford cattle, seedless grapes, and an interesting example of the use of selective breeding to reintroduce a previously extinct variety of animal, the Quagga.

Building on previous learning

This unit builds on the work covered in Chapters 1, 4 and 10 of *Pupil's Book A*. It builds on the pupils' knowledge of the processes of inheritance and selection, and uses their knowledge and understanding of variation to illustrate the process of selective breeding and to explain how variations can arise from environmental differences.

Future learning

This lays the foundation work for variation, inheritance and evolution at Key Stage 4 (Sc2.4 a, b, c, d, e, f, g, h, i, j).

Match to

National Curriculum references

2.4 Variation, classification and inheritance

a) about environmental and inherited causes of variation within a species

c) that selective breeding can lead to new varieties.

Scheme of Work section

9A: Inheritance and selection

Framework *Yearly teaching objectives*

Explain that the nucleus in a cell contains genes that control all characteristics of the organism; use this to explain:

- fertilisation, where genes from one parent join with genes from the other to produce a new set of genes;
- how selective breeding, either by nature or by humans, can increase the chance of certain genes passing from parent to offspring.

Suggestions

Thinking skills opportunities

This work gives pupils the opportunity to consider evidence, to form opinions on the ethical work of science (e.g. conservation, clones etc.) and to gain a deeper understanding of the genetic basis of life.

Key vocabulary

artificial inheritance; artificial insemination; asexual reproduction; chromosomes; clone; conjoined twins; DNA; embryo; extinction; fraternal twins; genes; hormones; identical twins; inheritance; fertilisation; meiosis; ovule; pollen grain; selective breeding; sexual reproduction; species; trait; variation (continuous and discontinuous); variety

Answers

Answers to questions in Starter Activity and Finishing Off!

On the family photo, the non-family members are (back row, left to right): man in blue shirt, second man in white shirt, lady in purple dress, lady in flowery shirt, lady in red dress on the end; (front row, left to right) lady in flowery jacket and man with moustache.

Starter Activity

1 Continuous variation – height, length of hair, height of a tree, size of a tomato
Discontinuous variation – hair colour, eye colour, flower colour, foot size

2 Inherited – hair colour, mouth shape, hand size, nose shape, eye colour, foot size
Environmental – ability to draw, being good at maths, ability to sing
Both – weight, height, skin colour

Finishing Off!

1 The following are examples of sexual reproduction: c), d), e).

2 Breeding cattle to improve the quality and quantity of meat is an example of selective breeding.

3 Another name for selective breeding is artificial selection.

4 In sexual reproduction genetic material is inherited from both parents, as a sperm comes from one parent and an egg from the other.

5 Natural hair colour and the shape of the nose are both examples of inherited characteristics.

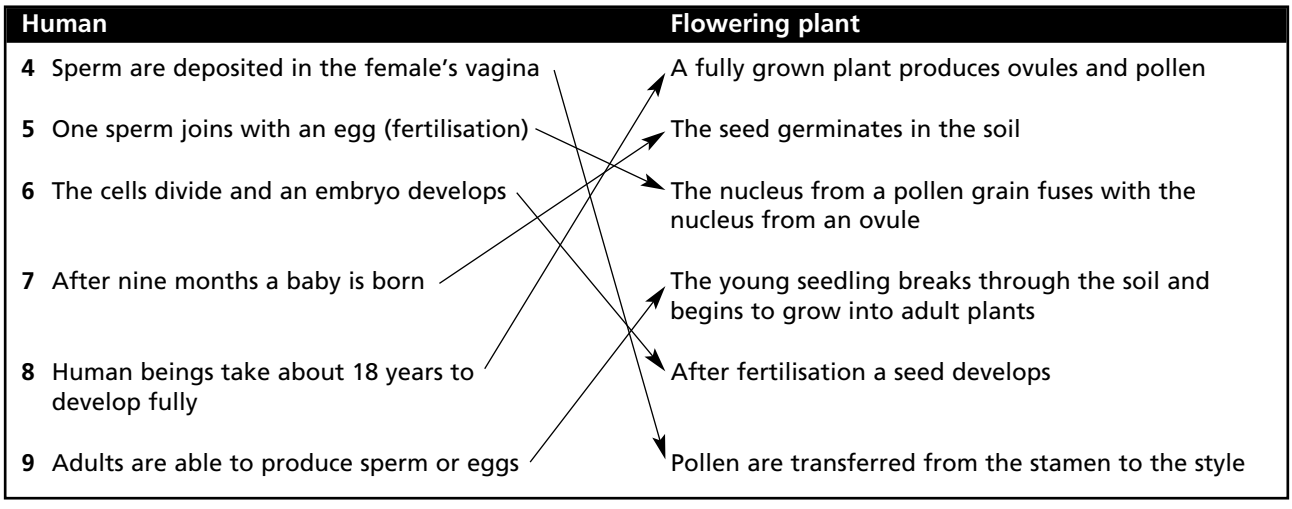
6 The others, weight and skin colour after bathing, are examples of environmental characteristics.

7 A clone is a genetically identical copy of an individual plant or animal.

8 Asexual reproduction will result in offspring that are identical to the parent.

9 This is a true statement, as the offspring will be genetically identical to the parent and will, therefore, be a clone.

10 This is also true, as the two individuals are genetically identical, they are clones of each other.



Answers to End-of-unit test

1 a) Characteristics that show a range of values (e.g. height or weight) are examples of continuous variation.
b) In discontinuous variation, the characteristic is either one thing or another, e.g. eye colour, hair colour etc.

2 Natural hair colour, eye colour and attached lobes are all examples of inherited variation (the others are examples of environmental variation).

3 Adult weight, ability to draw and ability at maths may be different in identical twin sisters.

4–9 See table above.

10 a) The sex cells found in plants are the pollen and ovule.
b) The sex cells found in animals are the sperm and egg.

11 During the cell's division, the pairs of chromosomes split so that one chromosome from each pair ends up in a sex cell. This halves the number of chromosomes. It is necessary as during fertilisation the nucleus of two sex cells join. If the original number of chromosomes were found in each sex cell, the numbers of chromosomes would double on fertilisation.

12 It will have six pairs of chromosomes.

13 Each sperm and egg cell will have six chromosomes.

14 Conjoined twins occur when the embryo cells do not split completely to form identical twins. If a small part of the split embryo remains in contact, the identical twins will be conjoined.

15 Fraternal twins are non-identical and may also be of a different sex to each other though they are born at the same time. Identical twins have exactly the same genetic make up and are also born at the same time.

16 Children are similar to their natural parents because they inherit some characteristics from both. They are not identical because their genetic make up is not identical to either parent.

17 Farmers mean that the sheepdog has several characteristics that make him a good working dog, e.g. a good 'eye', the ability to herd, to crouch, agility etc.

18 A clone is a genetically identical copy of an individual plant or animal.

19 To produce seedless plants, the plants must be forced to fruit early, before pollination takes place and seeds develop. To do this, the plants are sprayed with hormones that promote fruiting.

20 They are essentially the same thing. In both cases the characteristics of the plant or animal are selected and cross breeding takes place in order to produce offspring that have combinations of the desired characteristics.

Chapter 1 Target sheet

Tick off the list as you work through Chapter 1 when you are happy that you understand the following:

YTOs	Target	Tick
✓	I can say what continuous variation is and give some examples.	
✓	I can say what discontinuous variation is and give some examples.	
✓	I can describe some similarities and some differences between parents and their offspring.	
✓	I can identify some inherited characteristics in plants and animals.	
✓	I can identify some environmental characteristics in plants and animals.	
✓	I can draw some diagrams to show how sex cells are produced.	
✓	I can identify some traits or characteristics that breeders might want to pass on.	
✓	I can explain why the breeders might want these traits.	
✓	I can describe pollination and I know what selective pollination is.	
✓	I can describe how sexual reproduction produces new plants identical to the parent plant.	
	I know what a clone is.	
	I have thought about some of the problems cloning can bring about, if we were to clone animals or even human beings.	

Chapter 1 End-of-unit test

1 Explain what is meant by
a) continuous variation
b) discontinuous variation *(level 5, 1 mark)*

2 Which of the following are examples of inherited variation?

★ natural hair colour ★ ability to draw
★ eye colour ★ attached ear lobes
★ adult weight ★ being good at maths *(level 5, 1 mark)*

3 Briefly explain which of the examples in Question 2 will be the same in identical twin sisters and which may be different. *(level 5, 1 mark)*

Link the statements in the columns to show the similarities between the life cycle of humans and flowering plants. The first one has been completed for you. *(level 5, 1 mark)*

Human	Flowering plant
4 Sperm are deposited in the female's vagina	A fully grown plant produces ovules and pollen
5 One sperm joins with an egg and the two nuclei join together (fertilisation)	The seed germinates in the soil
6 The cells divide and an embryo develops	The nucleus from a pollen grain fuses with the nucleus from an ovule
7 After nine months a baby is born	The young seedling breaks through the soil and begins to grow into adult plants
8 Human beings take about 18 years to develop fully	After fertilisation a seed develops
9 Adults are able to produce sperm or eggs	Pollen are transferred from the stamen to the style

10 What are the two types of sex cells found in
a) plants
b) animals *(level 5, 1 mark)*

11 When a sperm cell and an egg cell are produced, why is the number of chromosomes half the number found in an ordinary cell? *(level 6, 1 mark)*

12 If an animal has 12 chromosomes, how many pairs of chromosomes does it have? *(level 5, 1 mark)*

13 How many chromosomes are present in each sperm and egg cell of the animal in Question 12? *(level 6, 1 mark)*

14 Siamese twins are more correctly known as conjoined twins. Briefly explain how conjoined twins occur. *(level 6, 1 mark)*

15 What is the difference between fraternal and identical twins? *(level 6, 1 mark)*

16 Briefly explain why children are similar but not identical to their natural parents. *(level 6, 1 mark)*

17 What do farmers mean when they say that a sheep dog has several good traits? Give two examples of good traits. *(level 6, 2 marks)*

18 What is a clone? *(level 6, 1 mark)*

19 In order to produce seedless fruits, what must a grower do to the plant? *(level 7, 1 mark)*

20 Do the terms artificial selection and selective breeding mean the same thing? Explain your answer. *(level 7, 1 mark)*

1.1 Why are we all similar, but not identical?

Rationale

Learning outcomes

Most pupils will be able to:
- make and record appropriate measurements
- present their data in tables and produce appropriate graphs with or without the aid of software
- draw simple conclusions about variation within varieties and between varieties.

The faster pupils will be able to:
- produce statements that interpret the evidence they have gathered
- explain how the evidence they obtain supports those statements/conclusions e.g. that variation between species is greater than variation within species
- relate this work to other contexts.

Those who progress less quickly will be able to:
- make appropriate measurements
- present the data in a simple way.

Possible teaching strategies

The lesson should include a recap of the work carried out in year 7 on reproduction and variation. The teacher could then ask pupils to say what they know about the terms, genes and chromosomes. Pupils should then be given an opportunity to write down simple definitions of these terms. The photo of pairs of chromosomes in *Pupil's Book C* can be used to illustrate what chromosomes look like and pupils could be asked to count the numbers and pairs of chromosomes present. The teacher will need to explain carefully how and why there is a reduction in the numbers of chromosomes for the sex cells. Pupils may then be asked about the occurrence of the different types of twins: identical, fraternal and conjoined. The pupils may then work in groups on the activity measuring variation in vegetables. Home-grown vegetables display the greatest variation as supermarkets have strick quality assurance for their produce and much of the variation is lost. This may also be used as a focus for the teaching of this lesson

Framework *Lesson plan*

2 hours/lessons
It is important that staff are sensitive to issues surrounding twins (e.g. when there has been the death of a twin) and to the fact that pupils may be adopted or separated twins.

Suggested starters
- Use the Starter Activity for the unit on page 1 of *Pupil's Book C* to gain knowledge of what the pupils already know and understand about variation.
- Try a quick quiz for definitions of the following terms:
  - genes
  - chromosomes
  - variation
    - discontinuous variation
    - continuous variation

Main activities
- Activity 1.1a How much variation:? Pupils have to consider variation in fruits and vegetables.
- Activity 1.1b Left-handedness: Conduct a survey of the class to find out left and right dominance (foot and hand) and if there is a correlation between parental 'handedness' and the handedness of offspring (NB be careful here tackling issues that might affect adopted children). Gather data on number of left-handed pupils, right-handed pupils and any that are ambidextrous. Then ask for information on the number of left-handed family members. Pupils may present this data in an appropriate form. This could be an additional homework activity if desired.

Suggested finisher
Finisher A Genetic Connections: Pupils have to make connections between a series of words. A 'connection' is a mini version of a mind map or concept map, it uses specific words and the job of the pupils is to place these words in sequences that are meaningful. It is possible to have many different sequences for each set of words.

Homework
Pupils can complete Activity 1.1b.

Suggested starters
- Use the Stop and Think activity on page 2 of *Pupil's Book C* to revise the origins of egg and sperm cells and their structure as related to function.
- Starter A Amazing twin facts quiz: Use this as a quick quiz on twins. This quiz is based on information first used in *Teacher's Resource A*, Spread 7.2 and could be a traffic light activity.

Main activity
Pupils should read through the information on pages 2 and 3 of *Pupil's Book C* and complete the questions on page 3.

Suggested finisher
Pupils should complete the remember box on page 3 of *Pupil's Book C*.

Homework
Homework 1.1 How much variation?: A series of questions about inheritance and twins.

Suggestions

Literacy

There is an opportunity for pupils to read sections of *Pupil's Book C* on twins.

Numeracy

Pupils will need to calculate the reduction in the numbers of chromosomes and work with basic numbers.

ICT

Pupils may collect data and input this onto a spreadsheet and produce graphs and charts of their results.
This is also a good activity to encourage pupils to carry out some Internet research, as there is often a lot of information in the newspapers and scientific journals about conjoined (Siamese) twins.

Sc1 Ideas and evidence

The following National Curriculum statements are applicable to this spread.

1.2 Investigative skills: planning

d) consider key factors that need to be taken into account when collecting evidence, and how evidence may be collected in contexts (for example, fieldwork, surveys) in which the variables cannot readily be controlled

g) make observations and measurements, including the use of ICT for datalogging (for example, variables changing over time) to an appropriate degree of precision

h) make sufficient relevant observations and measurements to reduce error and obtain reliable evidence

i) use a wide range of methods, including diagrams, tables, charts, graphs and ICT, to represent and communicate qualitative and quantitative data.

Key skills

Application of number, ICT

Cover friendly rating

3 star (activity – some specialist knowledge is required to explain meiosis and reduction division in sex cells)

Cross curricular links

PSHE, History

Answers

1 a) Egg cell and sperm cell
b) Pollen cell and ovule

2 The chromosomes are found in the nucleus of the cell.

3 A gene is a section of DNA. (*Note*: there is no need for a definition that includes the notion of bases as this is KS4 material.)

4 Children inherit genes from both their natural mother and their natural father and so they will display some characteristics of both, but will not be identical.

5 Identical twins are more similar than brother and sister because they are genetically identical and will therefore have exactly the same features.

6 No, they must be genetically identical which means that they must both be of the same sex.

7 The offspring are most likely to be similar, but not identical, as the implanted embryos have grown past the stage when they would split and produce identical twins. (*Note*: this question is only likely to be answered in this detail by high-ability students. Use your professional judgement to assess the quality of other answers.)

Match to

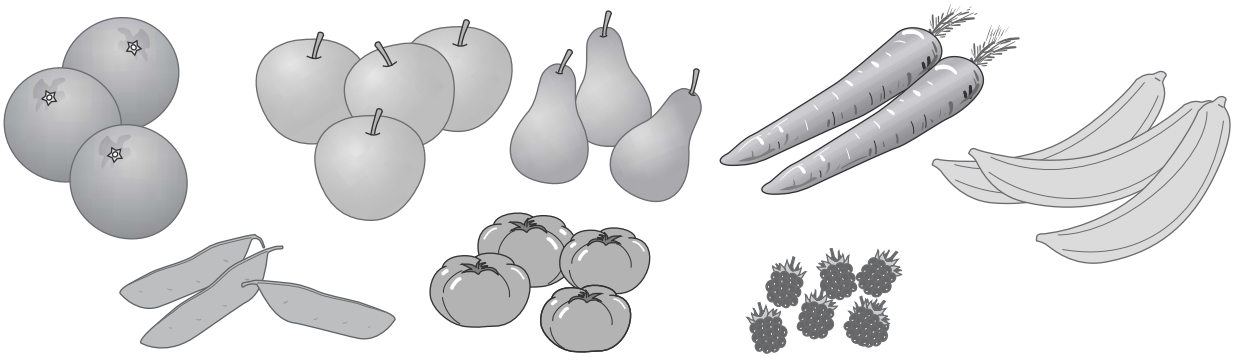
National Curriculum reference

2.4 a

1.1a How much variation?

In this activity you are going to see how much variation there is between different vegetables of the same type.

Before you start to measure the variation, you are going to have to decide on what things you are going to measure and how you are going to record and present the results. You will be given some examples of fruit and vegetables. Think about the following questions and plan an investigation into variation.



Copy these headings into your book, write your answers under each heading.

What variations or characteristics are you going to measure or describe?

Make a list of the characteristics under this heading

How will you record your results?

Under this heading sheet design a table and make a note of the headings for rows and/or columns here. Don't forget to include units for your measurements.

How will you present your results?

Under this heading make a list of the different ways in which your results could be presented.

What could you use to make it easier to record and present your results?

Write down any equipment or computer software that you could use to help you carry out this investigation.

1.1b Left-handedness

Read the following article on left and right-handedness and then answer the questions at the foot of the page.

NEW YORK TIMES ON LEFT-HANDEDNESS, ITS CAUSES AND COSTS

In medieval times, right-handed warriors had a distinct advantage in sword fights. They held their shield with their left hand – over their heart – and thus lived to fight another day, and to reproduce, even after they had been stabbed. Thomas Carlyle, the 19th century writer, suggested that this is why so many more people are right-handed today. The lefties never lived to have offspring.

Could it be true? The question of what causes people to be right-handed or left-handed is nearly as much of a mystery today as it was when Carlyle wrote about it in 1871.

A geneticist who has been working for years with mutant mice has developed a novel theory that he believes will explain why 9 out of 10 people are right-handed, why left-handed parents are more likely to have left-handed children, and why identical twins often have different handedness.

Dr Amar J S Klar thinks that most people have a specific gene that makes them right-handed. But, according to his theory, about 20% of people lack the right-handed gene, and those people without the gene have a 50:50 possibility of being right-handed or left-handed. The gene has yet to be identified.

Dr Stanley Coren, a psychologist, disagrees. He has been working for years to show that left-handedness has nothing to do with genetics and more to do with stress on an unborn baby. Dr Coren is convinced that humans are naturally right-handed and that left-handedness is due to what he calls 'birth stress', by which he means factors like an unnatural placement that causes damage to the foetus in the womb. Many scientists think that both genetics and development are involved.

Dr Klar's studies of handedness grew out of studies of mutant mice. In most mice, the heart is on the left side. But there is a mutant strain of mice that have hearts on the right. When the mutants mate, half the offspring have hearts on the left and half on the right. Last year geneticists identified a gene that is present in normal mice, but totally missing in these mutants. 'If it can work in mice,' Dr Klar asked, 'why can't it work for handedness in people?'

The theory may also explain why about 20% of identical twins with exactly the same genetic makeup have different handedness. Dr Klar's explanation is that these twins lack the right-handed gene, and each one has an equal chance of being right-handed or left-handed.

Questions

1 How many people in your class are left-handed?
2 How many of these have at least one parent who is left-handed?
3 Where in the cell is Dr Klar going to find the left-handed gene if it exists?
4 If you tested 60 sets of identical twins, how many would you expect to be left-handed?
5 If two left-handed twins were to marry what is the chance that they would have a left-handed child?
6 What other factors could decide whether or not a person is left or right-handed?
7 What evidence does Dr Klar have that there may be a left-handed gene?

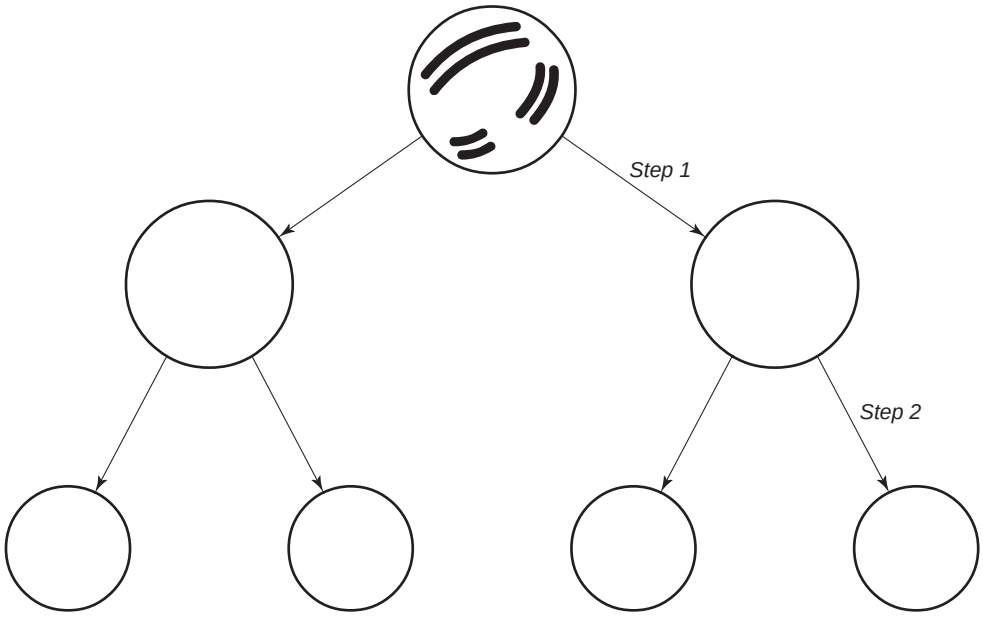
1.1 How much variation?

Questions

1 Give three examples of characteristics that can be passed from a parent to its natural child.

2 Give three examples of characteristics that cannot be passed from a parent to its natural child.

3 Complete the following diagrams to show how sex cells are produced. Draw in the numbers of chromosomes present at each stage.



4 What is the difference between fraternal twins and identical twins?

5 How are identical twins produced?

6 Eng and Chang are the first well-known example of conjoined twins. What is a conjoined twin and how did they develop from a fertilised egg as conjoined twins?

1.2 Sheepdogs

Rationale

Learning outcomes

Most pupils will be able to:
- identify characteristics in a plant or animal which are desirable in particular circumstances
- outline how these characteristics are passed on
- suggest some issues that need to be considered in relation to selective breeding.

The faster pupils will be able to describe how selective breeding can result in offspring with particular characteristics.

Those who progress less quickly will be able to identify some characteristics of a plant or animal which are desirable in particular circumstances.

Framework *Lesson plan*

1 hour/lesson

Suggested starters
- Use a free writing exercise with the pupils. They are not used to doing these in science. Give them a set time, one minute, and they must write everything they know about working animals. Use the list on page 5 of *Pupil's Book C* as a stimulus.
- Get the pupils to work in groups of three or four to discuss their descriptions/free writing and compare their ideas.

Main activity

Activity 1.2 Breeding for a purpose: Activity 1.2 is an exercise in grouping. The class can be split into small working teams and asked to group the items on the Activity Sheet in different ways. This can be a differentiated task. If the class or members of the class are more able, then a higher degree of sophistication in the grouping is required, with specified reasons given for the groups chosen. For less able classes or individuals, simple grouping on obvious characteristics is all that is required. Teachers may wish to add plants or animals to the list given and so increase the possible groupings.

The second part of the exercise requires pupils to think about overlapping or intersecting characteristics and uses some knowledge and understanding of sets from the Maths curriculum. You may wish to check with the Maths department that this theory has been covered, or find out how the Maths department teaches this aspect of the subject before you deliver the lesson.

Suggested finishers
- Pupils should report their findings back to the other teams, giving their reasons for the way they have grouped the plants and animals. This can be turned into a classroom debate about the reasons given and their validity.
- Pupils should complete the remember box on page 5 of *Pupil's Book C*.

Homework

Homework 1.2 Breeding for a purpose: A series of questions on inheritance and breeding.

Suggestions

Literacy

Pupils will read the information provided and have an opportunity to use descriptive prose to discuss issues surrounding selective breeding.

ICT

Pupils may use the Internet to carry out research on selective breeding.

Sc1 Ideas and evidence

Identifying useful sources of information; selection of information relevant to the task or question.

Key skills

Communication, ICT and Improving own learning

Cover friendly rating

3 stars (activity)

Cross curricular links

Maths

Answers

1 a) Sheepdogs need a lot of exercise as they are bred for their speed and agility.
b) They need a balanced diet but one that provides plenty of energy-giving foods.
c) Sheepdogs naturally have herding instincts, therefore they need to be well trained so that they can be kept under control.

2 A trait is a characteristic or set of characteristics displayed by an animal.

3 a) Speed and agility.
b) Ability to produce high quality and high quantities of milk.

4 This is an example of artificial selection. Dogs with the traits that farmers needed were crossbred until they arrived at the sheepdog.

Match to

National Curriculum reference

2.4c

1.2 Breeding for a purpose

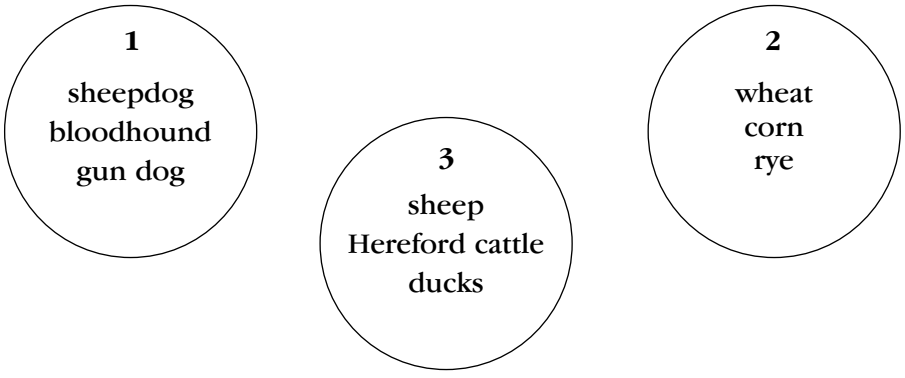
Look at the list of plants and animals below. What are the characteristics or traits that make them useful to us? Some of them are used for food; others are used for carrying out a job. In what way are they bred to be useful?

So try this

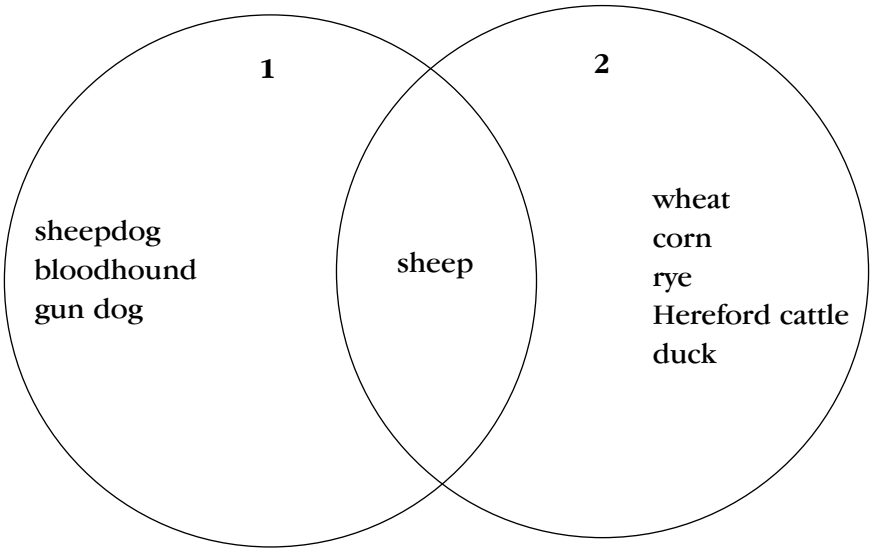
Working in small teams, see how many different groups you can make from the following plants and animals. How many ways can you make the groups overlap? For each group you make, write down the reasons for your group – how you decided what plant or animal to put into each group. Think about the work you have done in Maths on sets.

corn, wheat, rose, sheep, duck, goose, tomato, cabbage, rye, racehorse, cart horse, pit pony, alsation, labrador, sheepdog, St Bernard dog, apple, seedless grape, hemp, fast-growing conifer tree, strawberry, farmed trout, farmed salmon, wild trout, wild salmon

An example of how you might show your groups is given below. The first shows three separate groups. In group 1 are working animals, in group 2 are plants that we eat, and in group 3 are animals that we eat.



In the example below, there are only two groups. In group 1 there are animals used by us to do a job or provide us with something useful, for example wool. In group 2 there are plants and animal used for food. Sheep occur in both groups because they can provide wool and they may be used for food.



1.2 Breeding for a purpose

Questions

1 Which of the following characteristics are inherited from our natural parents and which are caused by environmental conditions? Put your answer into a table.

eye colour, weight as an adult, blood group, fixed or detached ear lobes, natural hair colour

2 Which of the following variables could affect the size of the leaves on a tree?

soil pH, wind, amount of soil, available water, light level, closeness of other trees

3 Write an explanation of what the following words or terms mean in biology:

a) gene b) chromosome c) variation d) inherited e) trait

4 Complete the following paragraph by choosing the correct word from each pair given.

We inherit lots of things from our natural parents. These CHARACTERISTICS/GENES are controlled by our CHARACTERISTICS/GENES. There are two types of variation, INHERITED/CHROMOSOME variation and BEHAVIOUR/ENVIRONMENTAL variation. The first is controlled by the DNA/CYTOPLASM found in our cells and the second is about how and where we were brought up. Plants inherit DISEASES/CHARACTERISTICS through their GENES/ROOTS, just like animals do. Unlike animals, plants can be affected much more by INHERITED VARIATION/ENVIRONMENTAL VARIATION than animals. There are four important environmental factors that can affect plants – TEMPERATURE/ICE, the amount of sunlight, the amount of SOIL/WATER available and how good the soil is.

5 Complete the table below to describe what characteristic you think a farmer is most likely to select when selectively breeding plants and animals. The first one has been done for you.

Organism	Characteristic
Hereford cattle	Lean beef
Jersey cow	
Wheat	
Guide dog for blind people	
Seedless grape	

Choose the correct answer from A, B or C for each of the statements below. But don't just put down the letter in your homework. Copy out the correct answer so that you will remember it.

6 A Genes are made of DNA and contain chromosomes.
B Genes are made from DNA and do not contain chromosomes.
C Chromosomes are made from DNA and contain genes.

7 A Identical twins are produced from a single egg fertilised by two sperm.
B Identical twins are produced from two eggs fertilised by a single sperm.
C Identical twins are produced from a single egg fertilised by a single sperm.

8 A In selective breeding, the plants or animals select others from the same species to breed with each other.
B In selective breeding, humans select plants or animals from the same species to breed with each other.
C In selective breeding, humans select plant or animals with specific characteristics to breed with each other.

1.3 Farmer's beef

Rationale

Learning outcomes

Most pupils will be able to:
- identify some characteristics that are influenced by environmental factors and others that are passed on through inheritance. They will consequently know that variations can arise from either environmental or inherited factors.
- describe desirable characteristics and features bred into plants and animals.

The faster pupils will be able to:
- explain which characteristics are inherited and which are due to environmental factors and know that some can be due to both
- explain what desirable characteristics and features are bred into plants and animals.

Those who progress less quickly will be able to:
- name a limited number of features that are due to environmental variation and a limited number of features due to inheritable traits
- explain in a basic way which characteristics are desirable in a limited range of plants and animals and are therefore deliberately bred by farmers.

Framework *Lesson plan*

2 hours/lessons

Suggested starters
- Poke your tongue out! Ask the pupils to poke their tongues out and see which of them can roll their tongue and which cannot.
- Ask the pupils to look at their partner and see who has a fixed ear lobe and who has not.
- The data should be recorded

Main activity
- Activity 1.3 Inherited or not: This could be introduced to test whether or not we can scientifically tell whether a characteristic is inherited or not. The sheet shows two pieces of evidence: one that argues that tongue rolling in humans is inherited, the other that it is not. The pupils could look at the evidence and try to make up their own minds, with reasons! They should then complete the questions on the activity sheet.
- Ask the pupils to feedback their answers to the whole class.
- This activity may be extended to include a class/year survey of pupils to gather evidence to see whether the hypotheses presented are correct or not. This may be a good piece of work for the more able pupils in the class to undertake as a homework/self study piece of work.

Suggested finisher
- Ask each pupil to list three things that they have learnt in the lesson today.
- Get the pupils to swap their 'learning outcomes' and to explain to their partner anything that does not appear on both lists.
- If time allows get a selection of 'learning outcomes' from the pupils and put them up on the board.

Homework
Homework 1.3 Inherited or not?: Pupils have to design an investigation to determine whether a trait is inherited or not.

Suggested starter
- Ask pupils to think of their favourite food and then to swap their ideas of the attributes of this food with their partner. Pupils should describe to their partner what foods they like, for example meat with no fat, juicy pears and large strawberries. They can only describe unprocessed foods.
- Ask the pupils to describe how supermarkets market food to make it attractive to customers, what 'tricks' might the supermarket use to sell food, for example smells, or laying out only the best and most colourful fresh foods.

Main activity
Pupils should read through the information on pages 6 and 7 of *Pupil's Book C* and complete questions 1 to 6.

Suggested Finisher
Pupils should complete the remember box on page 7 of *Pupil's Book C*.

Homework
None.

Suggestions

Literacy

Pupils will read and comprehend information in the *Pupil's Books* and worksheets. They may also construct a questionnaire for other pupils to complete about tongue rolling.

Numeracy

Pupils may tabulate their results and produce percentage results of tongue rollers vs non rollers.

ICT

Pupils may investigate tongue rolling as an inherited condition via the Internet and may process the results of their survey using spreadsheets and word processors.

Sc1 Ideas and evidence

The pupils will use planning skills to construct an investigation of tongue rolling, make observations and measurements, present data, consider the evidence and draw conclusions (the latter may also be done using the evidence presented in the text and the Activity Sheet).

Key skills

Communication, application of number, ICT, working with others, improving own learning and problem solving

Cover friendly rating

3 star (the interpretation of the investigation (if carried out) would need some expertise in science)

Cross curricular links

History, Geography

Answers

1 Check that pupils have put sensible characteristics in their table, e.g. large, juicy red fruit for strawberry, and lean meat for pig.
2 Beef tallow is a kind of fat used to make wax and as an ingredient in other foods.
3 People are are more inclined to eat a low-fat diet.
4 The grass provides the cow with energy and basic nutrients that are then turned into proteins leading to beef production.
5 Embryos from one cow are removed and transplanted into another cow that may not have been fertilised.
6 The milk is watered down so it goes further.

Match to

National Curriculum reference

2.4a, c

1.3 Inherited or not?

You inherit many things from your natural parents. You might have been asked whether or not you could roll your tongue. Is this something you might have inherited from your parents? Some scientists say yes and some say no. Not all scientists agree about this and many other things in science.

Look at the evidence about tongue rolling below and then decide whether or not it is inherited. You can collect your own evidence about this and this could help you and your classmates to decide. You decide who has the best, most persuasive evidence.

The evidence for, presented by Dr Rolly Muscle

About 70% of European people can roll their tongue. That is they can curl the edges of their tongue up to make what is almost a tube. Why do people do this? Here are two possible explanations. The languages we use in Europe mean that we have had to develop this ability to help us form words so that we can communicate. Also, as infants we would normally breast-feed. This means that the tongue needs to be able to wrap around the nipple in order to extract the milk from our mothers. People who cannot roll their tongue do not feed as well as those who can. The reason that they survive is because mothers make sure that they feed for longer than those babies who can roll the tongue or they use bottles. In my tests, I found that the vast majority of youngsters who could roll their tongue had at least one natural parent who could do the same. That tells me that this characteristic can be inherited and that it is a gene which, if present, means that the person will always be able to roll the tongue. The fact is that you can either roll your tongue or you cannot. There is no halfway measure where you can roll it a little bit. There are a few more facts I would like you to know. In Spain about 67% of the women can roll their tongues while just 64% of the men can. I also found that in the North of England, very few people could roll their tongues. I also found out that which way you clasp your hands together (that is which thumb ends up on top) is related to whether or not you are left or right handed.

The evidence against, presented by Dr Donna Belevit

Over a number of years I have been trying to prove that tongue rolling is either inherited or that it is not. I think that the evidence I have will show that it is not inherited. For my experiment, I came up with a hypothesis, or testable idea, that identical twins should both be able to roll their tongues if it is an inherited characteristic. I tested 33 sets of twins and found that in 18 pairs both of the twins could roll their tongue and in seven pairs both of the twins could not. I also found that in eight pairs of twins, one of the pair could roll their tongue while the other could not. This tells me that it cannot be inherited. I also found that some people could actually learn to roll their tongue. After all it is a muscle, and just as we can exercise other muscles and control individual muscles, so we can also, with practise, control the tongue!

To help you make up your mind, think about the answers to the following questions. Write a statement telling the doctors whether or not you think tongue rolling is inherited and giving an explanation.

Questions

1. What is Dr Belevit's hypothesis (testable idea)?
2. Why does he think that people roll their tongues?
3. Briefly explain why you either agree or disagree with his ideas?
4. What single piece of evidence does Dr Muscle have which could lead him to think that tongue rolling is inherited?
5. In Dr Belevit's experiment, what percentage of the twins supported the idea that tongue rolling was inherited?
6. What percentage of the twins did not support the idea that tongue rolling was inherited?
7. Do you think that she tested enough people?
8. What other characteristics could the two scientists test to see if they are inherited or not inherited?
9. Conduct a survey of your classmates to see how many can or cannot roll their tongue. Explain how this does or does not help you make up your mind?

1.3 Inherited or not?

You are going to design an investigation that can be carried out by Dr Muscle and Dr Belevit to find out if a characteristic or trait is inherited or not. When you plan your investigation, make sure you have covered all of the points below.

Think about the work that you did in class on inherited characteristics. Choose one of the things you discussed or think about another characteristic which may or may not be inherited.

So try this

1 Think of a title for your investigation. You could start it with 'An investigation to find out if . . .'

2 Write down what you are trying to find out. Make sure that this is written in the form of a statement e.g. 'I am trying to find out . . .'

3 Now turn your statement into one or more questions.

4 Write down any evidence you have that supports your statement. This could be something you have read in a science textbook, something that you have seen in the newspapers or something you discussed in class.

5 Now decide how you are going to carry out your investigation. You need to decide:

a) What you are going to do.

b) How you are going to do it.

c) What measurements you are going to make.

d) How you are going to record your measurements.

e) How you are going to present your results.

f) What calculations you might need to make (e.g. percentages, averages etc.).

6 You must also decide how many measurements you are going to make and how you will make it a fair test.

1.4 How do you grow a seedless grape?

Rationale

Learning outcomes

Most pupils will be able to:
- understand that hormones are involved in the production of fruits on plants
- describe pollination in terms of male and female cells.

The faster pupils will be able to:
- describe the process of pollination and the development of pollen tubes
- discuss the role of pollen and ovules in terms of male and female sex cells
- explain that hormones are chemicals that are used to promote the growth of various parts of the plant such as fruiting bodies and roots.

Those who progress less quickly will be able to describe the process of pollination and state that hormones are involved in the process of fruit production in plants.

Framework *Lesson plan*

1 hour/lesson

Suggested starters
- Brainstorm which fruits are seedless and how they may possibly be grown.
- Create a list of seedless fruits on the board.

Main activity
- Activity 1.4 Looking at pollen grains growing: This activity appears in the Year 7 SoW unit, however the theory of pollen tubes is in the Year 9 book, hence the investigation appears here.
  The Activity may be carried out, but please be aware that the success rate of pollen tube production is relatively low. It would be wise to have available either commercially prepared slides or pre-prepared slides produced by the department.
  The Activity requires a break in order to let the tubes develop. At this point you may wish to carry on with work from the textbook, such as the work on bananas or the questions and cloze procedure.
- Read through the information on pages 8 and 9 of *Pupil's Book C* and complete questions 1 to 6 while the slides are left to promote the pollen tube growth.

Suggested finishers
- Use the Stop and Think activity on page 8 of *Pupil's Book C* to recap how pollen is spread.
- Pupils should complete the remember box on page 9 of *Pupil's Book C*.

Homework
Homework 1.4 Plant quiz: A quick quiz about plants.

Suggestions

Literacy

Pupils will read the information on the pollination and production of fruits and seedless fruits.

Numeracy

Basic number work to count grains. This could be extended to produce percentages.

ICT

Pupils could investigate the production of fruits using the hormone method on the Internet (higher ability pupils).

Sc1 Ideas and evidence

Pupils will use a range of equipment appropriately and make observations and measurements. They may then present their findings in an appropriate manner.

Key skills

Working with others, improving own learning and performance

Answers

1 Accept any correct cartoon strip.
2 The ovules normally develop into seeds.
3 Rooting powder is a type of hormone.
4 Plantain contains starch in the fruit.
5 The plantain needs to be cooked to break down the starch into sugars.
6 The stems of the banana plant do not contain wood fibres and so are more like stems of flowering plants than trees that have a lot of woody tissue.

Technician's notes

Equipment	Quantity/group
Pollen media*	1
10 cm^3 plastic syringe filled with soft white paraffin (Vaseline)	1
Dropping pipette (plastic, disposable)	1
Lens tissues	2–3
Microscope†	1
Microscope slides and coverslip‡	2–3
Mounted needle	1
Paint brush (fine bristle brush not paste type)	1
Pollen¶	1–2 anthers

Experimental notes

* 40 cm^3 should be sufficient for each group. To make 40 cm^3 of media, mix the following in a 100 cm^3 beaker: 2 g domestic sugar, 1.4 g thick flower honey, 2–3 small crystals of Boric acid, a thin smear of marmite to cover 1 cm^3 of beaker surface, 40 cm^3 distilled water.

† Set up the microscopes so the students do not have to alter the objective lens. If the glucose solution comes into contact with the high power objective lens, clean it with a cotton bud soaked in water and dry immediately with a lint free cloth. If the stage becomes contaminated, follow the same procedure, taking care not to get water on to the condenser. Set up the microscopes so that the iris (if fitted) is closed (to the left) and the mirror is set to give the best light and the ×10 (or ×8) objective lens is in the viewing position.

‡ Put microscope slides and coverslips into a covered shallow plastic pot/used Petri dish on a piece of paper towel. Provide a large beaker of water for used slides and coverslips.

¶ Wear gloves when handling the pollen from lily flowers as it stains and is difficult to remove. Cut off the anthers and put into a covered shallow plastic pot or used Petri dish.

1.4 Looking at pollen grains growing

In this activity, you are going to observe pollen grains growing.

Equipment list

- ★ a clean glass slide
- ★ a cover slip
- ★ a paintbrush
- ★ some lily pollen
- ★ some pollen growth media
- ★ a microscope
- ★ a 10 cm^3 plastic syringe filled with soft white paraffin

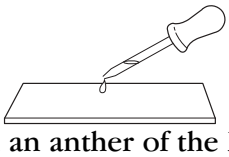
Safety first

Take care with glass slides, they break easily and can produce very sharp edges. Report any breakages to your teacher immediately!

So try this

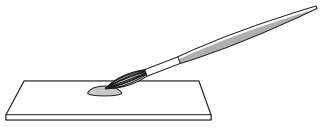
Step 1 Take a glass slide and make sure that it is clean. Carefully wipe the slide taking care not to break it!

Step 2 Put one drop of the pollen growth media on the slide.

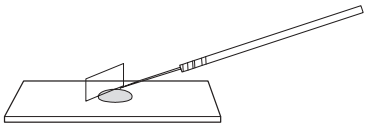


Step 3 VERY GENTLY brush an anther of the lily flower with the paintbrush to pick up some pollen.

Step 4 Gently dip the paintbrush into the liquid on the slide.



Step 5 Using the syringe, squeeze a circle of paraffin around the edge of the coverslip. Then, carefully lower the coverslip onto the slide using a mounted needle.



Step 6 Put the slide onto the microscope stage and use the lowest power lens (the shortest one) to find a few pollen grains. Make a drawing of what you see.

Step 7 Leave the slide in a warm place for 20 minutes then look at the grains again. Choose one grain that shows a pollen tube growing and draw this grain. Count 20 grains and make a note of how many have started to grow a pollen tube.

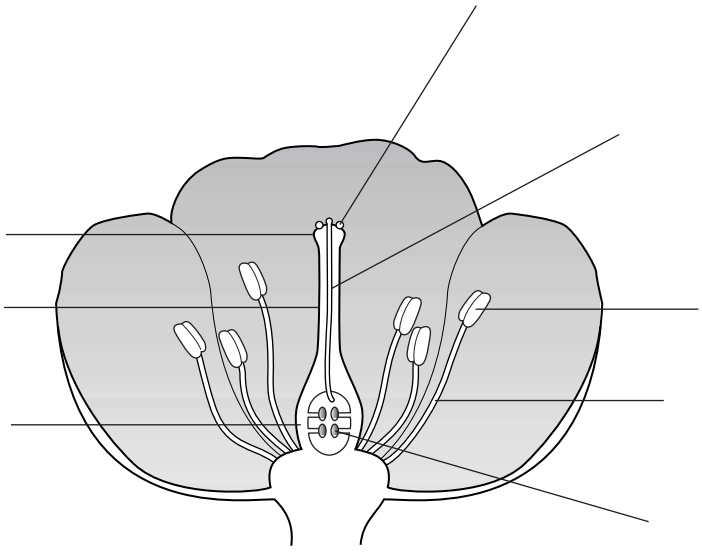
While you wait for the grains to grow, answer the following questions:

1. Why are the pollen grains put in a sugar solution and not into water?
2. Where in the flower might pollen grains get sugar from?
3. On what part of the flower do pollen grains normally grow pollen tubes?
4. What is inside the pollen grain?
5. What are the different ways in which pollen might be carried from one flower to another?

1.4 Plant quiz

Questions

1 Which common fruits that you can buy in a supermarket come as seedless fruits?
2 What other types of fruits and vegetables that you buy have seeds?
3 Plantains look like bananas. What is the main difference between a plantain and a banana?
4 Why does the plantain have to be cooked before it is eaten?
5 What effect do you think heating the starch in the plantain will have?
6 What does the starch in plantain break down into? (*Hint*: Think back to work you did on food and digestion!)
7 What type of chemical is used to produce seedless fruits and to promote the growth of roots in plant cuttings?
8 Label the diagram of how ovules in plants are fertilised by pollen.



9 Plant breeders often need to be sure that the flowers that are pollinated are only pollinated by one type of pollen. Suggest how plant breeders might set about pollinating their flowers and be sure that only the one type of pollen is used.

1.5 Bringing the quagga back to life

Rationale

Learning outcomes

Most pupils will:
- learn that for animals and plants to be the same species, they must be able to breed to produce fertile young
- learn that animals and plants become extinct for natural reasons. Sometimes the reasons include being overhunted by humans.

The faster pupils will:
- learn that there are methods such as cloning that could recreate extinct species. One problem encountered by this is that DNA degrades with time.

Those who progress less quickly will:
- learn the meaning of extinction
- be able to explain that species become extinct because they cannot adapt to changes in their environment.

Possible teaching strategies

This activity is designed to ensure that pupils are aware of what skills are needed for co-operative group work. They will look at *Pupil's Book C* and read about the work that scientists are trying to do to bring back the quagga by selective breeding. This will lead on to discussions about extinction of species and work that is being done to protect endangered species.
Activity 1.5 acts as an agreement form for the pupils to note who is doing what. Rather than give all pupils a free choice in what they are going to research, it would be best to select the topic for each group. This will allow differentiation by task and ensure that appropriate tasks are undertaken. Set a date for the completion of the research and allow sufficient time for each group to present their findings to their peers. This is an ideal lesson to undertake in a dedicated ICT suite with access to the Internet. Ensure that pupils are adequately supervised while online and that steps have been taken to filter out unsuitable sites. Ascertain from the pupils who may have access to the Internet at home and ensure that appropriate topics and site URLs are provided.

Suggested topic list
Note that this is not an exhaustive list and you may wish to add your own topics or, if appropriate, let the pupils choose their own topic. You may also wish to alter the wording to suit your class.
- The destruction of the Amazon rainforest
- The extinction of the dodo
- The discovery of the coelacanth – a living fossil
- The disappearance of the dinosaurs
- Rare insectivorous plants in the UK
- Extinction in our geological past

Framework *Lesson plan*

2 hours/lessons

Suggested starter
Brainstorm with the pupils the range of plants and animals that are extinct (they will come up with some of the more obvious like dinosaurs and the dodo, or perhaps the Tasmanian tiger, but be prepared for a wide range of responses).

Main activities
- Pupils should read through pages 10 and 11 of the *Pupil's Book* on bringing the quagga back into existence.
- Activity 1.5 Extinction: Use this as an aid for pupils to decide who is researching what. This exercise could take place over two lessons and form the basis of a homework activity, using school ICT and internet connections would be useful for this activity.

Suggested finisher
Pupils should continue their research for Activity 1.5.

Homework
Pupils should revise for the end-of-unit test.

Suggested starter
Recap the learning objectives from the whole of the unit using the Target sheet. Pupils should stick the completed Target sheet into their books as a record of what they have learnt. The recap of the learning targets for this activity may take up to 20 minutes of the lesson.

Main Activity
Pupils should complete a test for this unit. A new, short key ideas test can be found on the CD-ROM. In addition test material can be found in the *Hodder Science Assessment Pack*. This includes for each unit, a SATs-style test, a very simple low-level-test for slower learners, extension questions to add to tests for faster learners, and Ideas & Evidence questions to add to tests.

Suggested finisher
If time allows go through the end-of-unit test answers (pupils could mark each other's paper).

Homework
None

Suggestions

Literacy

There is ample opportunity for pupils to read various types of documents and articles and to take that information and display it in another format or to produce comprehension work on the articles researched.

Numeracy

Pupils may use mathematics skills to display information (e.g. charts and graphs) or basic numeracy skills relating to timelines (e.g. extinction in geologic history).

Sc1 Ideas and evidence

Pupils could carry out research to find out what contemporary scientists are doing to preserve endangered species, for example in zoos and wildlife parks. London Zoo might be a good place to look for information.

ICT

Pupils will use a variety of ICT opportunities to research and present their findings. They could be encouraged to

use PowerPoint to make their presentation, if available, and scan in suitable images or copy images from copyright-free Internet sites to add interest.

Key skills

ICT, Communication and Improving own learning

Cover friendly rating

4 star (this activity can be taken by a cover teacher, though science staff must ensure adequate resources are available)

Cross curricular links

Geography, History

Answers

1 A variety is a plant or an animal that is of the same species, but that has visible differences, e.g. a dachshund and a doberman.

2 Zoos were built primarily to provide a place of entertainment for Victorian people. They displayed exotic and dangerous animals with little thought to their comfort or quality of life.

3 We know that two plants and/or animals are from the same species when they can breed and the resulting offspring can also breed.

4 The DNA is present in the nucleus of the muscle cells of the quagga flesh.

5 DNA is a fragile chemical and can break down. In order to clone an animal, a complete record of the DNA is needed. In extinct animals that died out hundreds, thousands or even millions of years ago, the DNA would be broken down.

Match to

National Curriculum reference

This work is not directly related to KS3 but will lay a solid foundation for KS4 work on extinction though some of the concepts looked at, e.g. the concept of species and ecological relationships, are KS3 topics

1.5 Extinction

For this activity you are going to think about the different endangered species on the Earth. You may use CD-ROMs, encyclopaedias and the Internet to find out about the history of life on Earth and which plants and animals are in danger from extinction.

To do this activity you will need to work as part of a group. Your teacher may give each group a topic to research. You are then going to present your findings to the other groups. You may start this activity in class and then finish it off for homework.

Here are some of the things you might need:

★ Graph paper
★ Some continuous-sheet computer printer paper
★ Marker pens
★ Access to a CD-ROM encyclopedia (either at school or at home)
★ Access to a printed encyclopaedia (either at school or at home)
★ Access to the Internet (either at school or at home)

Before you begin you need to decide who is going to do what in the group.

Someone will need to be responsible for finding information about the topic you are going to study. Write the name of the topic here.

_____

Decide who this is (it could be more than one person) and write their name(s) here.

_____

Decide who is going to collect pictures or illustrations to show the rest of the class and write their name(s) here.

_____

Decide on who is going to talk to the other groups during the presentation and write their name(s) here.

_____

Decide on what you are going to use for your research and write the titles down here.

_____

_____

_____

_____

Write down when the presentation is going to take place (your teacher can give you the date).