

Unit 7D Variation and classification

About the unit

In this unit pupils:

- explore variation within and between species
- consider why classification is important and are introduced to scientific classification of animals
- investigate patterns of variation in living things and ways of representing and explaining the occurrence of variations

In scientific enquiry pupils:

- frame questions to be answered using first-hand or secondary data
- make qualitative observations and record these in a variety of ways
- draw conclusions from observations and explain these using scientific knowledge
- investigate variation between individuals of the same species using an appropriate sample size

Much of this work involves the interpretation and analysis of visual information gathered from a variety of sources. The use of enlarged images and other methods of gathering information may support learning for pupils with visual impairment.

Teachers will be aware of the need for sensitivity to the circumstances of pupils and their families throughout this unit.

This unit is expected to take approximately 7.5 hours.

Where the unit fits in

This unit draws on ideas developed in the key stage 2 programme of study. It builds on unit 5B 'Life cycles' and unit 6A 'Interdependence and adaptation' in the key stage 2 scheme of work, and on unit 7C 'Environment and feeding relationships'.

It provides a foundation for unit 8D 'Ecological relationships' and unit 9A 'Inheritance and selection'.

Expectations

At the end of this unit

in terms of scientific enquiry

most pupils will: use observation to identify questions to investigate about variation between individuals; suggest data to collect to answer the questions; present and analyse the data; identify associations or correlations in their data

some pupils will not have made so much progress and will: make suggestions about data to be collected to answer questions about variation and, with help, present data using ICT and identify patterns or associations

some pupils will have progressed further and will: evaluate graphs and tables of data in relation to sample size and describe how strongly any association or correlation is supported

in terms of life processes and living things

most pupils will: identify similarities and differences in organisms of the same species and begin to attribute these to environmental or inherited factors; explain the importance of classifying living things; identify some of the main taxonomic groups of animals and describe some features of these

some pupils will not have made so much progress and will: identify similarities and differences between organisms of the same species and classify organisms into plants and animals; identify a few taxonomic groups of animals

some pupils will have progressed further and will: recognise that inherited and environmental causes of variation cannot be completely separated; name some organisms which are not readily classified as plant or animal

Prior learning

It is helpful if pupils:

- know how to identify different living things
- can name the parts of living things
- know how to use a key to identify an unknown living thing

Health and safety

Risk assessments are required for any hazardous activity. In this unit pupils:

- handle small invertebrates
- work in an outside environment

Many employers have specific guidance on fieldwork. Model risk assessments used by most employers for normal science activities can be found in the publications listed in the *Teacher's guide*. Teachers need to follow these as indicated in the guidance notes for the activities, and consider what modifications are needed for individual classroom situations.

Language for learning

Through the activities in this unit pupils will be able to understand, use and spell correctly:

- words relating to the structure of organisms, *eg segment, abdomen, shell*
- words with similar but distinct meanings, *eg limb and leg*
- words and phrases relating to classification, *eg vertebrate, invertebrate, mammal, amphibian, reptile, feature, characteristics, taxonomic group*
- the words variation, classification, identification, inherited, environmental
- words relating to scientific enquiry, *eg classify, association, correlation, confidence, spreadsheet, database*

Through the activities pupils could:

- spot connections and links between how information is presented in different forms

Resources

Resources include:

- secondary sources to explore environmental and inherited variations, *eg illustrations of environmental variation, family photographs, other reference literature*
- photographs showing different animals within one species, *eg dogs, cats*
- database and spreadsheet software
- secondary sources containing descriptions of living things, *eg novels, poems, field guides*
- secondary sources to explore the variety of living things, *eg CD-ROMs, photographs, video clips, other reference literature*
- preserved specimens of animals representing major taxonomic groups
- suitable living animals for observation
- prepared sheets of 30 fingerprints
- data sheets on leaf size

Out-of-school learning

Pupils could:

- observe animals found in the garden or home, including pets
- visit a library to find out more about different groups of living things, as well as extinct groups such as the dinosaurs
- visit a museum, zoo, botanical garden or fishery to observe a wider selection of living things
- use the internet to find out more about the variety and classification of living things, *eg www.nhm.ac.uk/*
- watch wildlife programmes
- find out how clothes manufacturers take account of size variations

How do individuals of the same species differ from each other?

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| <ul style="list-style-type: none"> • that individual members of a species may differ in many ways • to use a spreadsheet to store data • to frame questions which can be investigated • to interpret graphs generated by a spreadsheet • to decide how confident they are in the evidence | <ul style="list-style-type: none"> • Show pupils photographs of a variety of animals of a species, <i>eg dogs, cats</i>, and ask them to point out the differences between them. Extend to humans and elicit examples of differences. • Collect the data, <i>eg eye colour, height, arm span, hand span</i>, about individuals, <i>eg members of the class, relatives</i>, on a spreadsheet. Show pupils how to use the spreadsheet to produce graphs of variation for particular features. • Ask them to suggest and to investigate correlations, <i>eg Do taller pupils have wider arm spans?</i> by producing and interpreting graphs and presenting their findings. | <ul style="list-style-type: none"> • suggest ways in which species, <i>eg dogs, humans</i>, differ from each other • enter information into a spreadsheet • use a spreadsheet to draw graphs • frame questions which can be answered using a spreadsheet • interpret graphs generated by a spreadsheet and say how strong they think an association or correlation is, <i>eg most of the taller people have wider arm spans, but it's not always true</i> | <ul style="list-style-type: none"> • Teachers will be aware of the need for sensitivity towards some pupils who may not wish to provide personal information and of the need to help pupils to be sensitive to the differences between them. • Pupils may have investigated associations in key stage 1 or 2. This activity is intended to review that work and take it further, by showing the range of questions that can be investigated using a prepared database and the range of graphs that can be produced and interpreted. • As an alternative, the data could be used to create a branching database which pupils could use, <i>eg a game in which pupils have to guess the identity of a mystery person, given bits of information about them.</i> |
| <ul style="list-style-type: none"> • to frame questions that can be investigated • to choose a sufficiently large sample size • to interpret graphs and draw conclusions from them • to decide how confident they are in the evidence | <ul style="list-style-type: none"> • Extend the idea of variation between individuals to other animals and plants. Ask pupils to observe different individuals of the same species, <i>eg daisies, snails, holly bushes</i>, to identify differences between them and then to frame a question which can be investigated, <i>eg</i> <ul style="list-style-type: none"> – <i>Do pink-tipped daisies have longer stems?</i> – <i>Do snails with longer shells have wider shells?</i> – <i>Do longer holly leaves have more prickles?</i> • Help pupils to decide how to collect data and decide on a suitable sample size. Ask them to produce a report of their investigation, encouraging the use of a spreadsheet for the analysis of data. | <ul style="list-style-type: none"> • suggest a question to be investigated based on their observations and decide what measurements or observations are appropriate • choose a sufficiently large sample to be confident in their conclusions • interpret their graphs and say how strong they think an association or correlation is | <ul style="list-style-type: none"> • If animals are brought into the classroom, ensure that they are treated with care and returned to the habitat from which they came as soon as possible. • There are many questions of this kind that pupils can investigate, <i>eg through fieldwork or studying a collection, such as shells</i>. What is chosen will depend on the school's location, resources and surroundings. <p>⚠ Safety</p> <ul style="list-style-type: none"> – wash hands after handling animals and wipe bench with disinfectant – if off-site visits are made, these must be carried out in accordance with school/LEA guidelines – pupils' plans must be checked for health and safety before practical work begins |


What are the causes of variation?

<ul style="list-style-type: none"> that some characteristics are inherited that although individuals are like their parents they are not identical to them that offspring from the same parent show considerable variation 	<ul style="list-style-type: none"> Provide pupils with information relating to variations between members of different generations of a family. Ask them to identify patterns of similarities which suggest real or fictional inherited features and ask them questions, <i>eg What features are inherited in their own families?</i> Challenge them to consider why some members of the family share common features that may not be shown by other members. Establish that this may be because inherited characteristics were not passed on from parent to offspring or that there are other causes of variation. 	<ul style="list-style-type: none"> identify characteristics, <i>eg eye colour, skin colour</i> that are inherited identify examples of patterns of similarities and differences within several generations of one family suggest reasons why differences and similarities exist within families 	<ul style="list-style-type: none"> Sensitivity to issues relating to parenthood is needed when talking about inheritance. Teachers may prefer to use a fictional family for this work. Information on family characteristics may be presented as photographs of members of the same family. Some pupils may continue to think that boys inherit characteristics from their fathers and girls from their mothers. Mechanisms of inheritance and selective breeding are covered in unit 9A 'Inheritance and selection'.
<ul style="list-style-type: none"> that some variations are inherited how environmental differences can result in variations in a species to interpret secondary data and draw conclusions from it 	<ul style="list-style-type: none"> Show pupils photographs or other secondary sources of information illustrating variation related to environmental causes, <i>eg trees grown in windy and non-windy environments, gentian plants growing above and below the snowline, healthy and undernourished children</i>, and then ask pupils to review their work on variations within a species and to consider the causes and origins of the variations. Ask pupils to think about their own observations of animals and plants and to suggest ways in which the environment might cause variations between individuals. Present pupils with data, <i>eg nettle leaf size in sunny and shaded positions, dog-whelk shell size on sheltered and exposed shores</i>, and ask them to suggest why the variations occurred. 	<ul style="list-style-type: none"> identify some characteristics that are inherited, <i>eg hair colour, eye colour, colour of flower, shape of leaf</i> suggest ways in which environmental difference may result in variation within a species, <i>eg length of leaf, height of plant, weight</i>, explaining how the data supports their conclusions 	<ul style="list-style-type: none"> It is important to establish that some variation, <i>eg height</i>, may be a result of both inherited and environmental factors. As an alternative, pupils could be presented with blackberry leaves from open and shaded habitats and asked to work out leaf areas and suggest why variations occur.

Checking progress

<ul style="list-style-type: none"> to present ideas about causes of variation 	<ul style="list-style-type: none"> Summarise ideas about variation and inheritance by asking pupils to write an account, possibly as a poem, about their own or a fictional family. They could write about the different individuals, describing features which have been inherited, and others which are the result of environmental effects. 	<ul style="list-style-type: none"> describe the inherited and environmental differences in a group of individuals 	<ul style="list-style-type: none"> Teachers will be aware of the need for sensitivity to the circumstances of some pupils. Teachers may prefer to use a fictional family for this work. Responses of different kinds could be used in the next activity where pupils are asked to compare different styles of writing.
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How can we describe living things?

<ul style="list-style-type: none"> to compare different styles of writing about observations to spot connections and links between how information is presented in different forms 	<ul style="list-style-type: none"> Remind pupils that the work they have done so far in this unit has focused on variation within a species and explain that they are now going to think about differences between species. Present pupils with written descriptions of animals or plants taken from a variety of sources, <i>eg field guides, poems, novels</i>, and ask them to suggest what animal is being described. Discuss the different ways of observing and presenting this type of information. 	<ul style="list-style-type: none"> comment on the use of different styles of writing which may be used to describe living things suggest why a particular style is used in a text 	<ul style="list-style-type: none"> In this activity prose or poems could be compared with the more factual scientific descriptions of living things found in identification keys and field guides. CD-ROMs and video clips could be used to observe a variety of animals and plants in motion.
<ul style="list-style-type: none"> how to make sure they are working safely with living organisms to make and record appropriate observations relevant to a particular piece of work to use observations to make comparisons of living things 	<ul style="list-style-type: none"> Explain the safety procedures to be followed when working with living things, including consideration of the welfare of the specimen. Provide a range of living things, <i>eg snail, earthworm, fish, hamster</i>, and secondary sources and ask pupils to make observations to identify differences, <i>eg what the specimen looks like and how it behaves</i>, and to record these in appropriate ways. Ask pupils to work in pairs or small groups to produce a piece of writing about an animal or a pair of different animals. Ask pupils to suggest appropriate observations to make, and features to record, from the range of specimens provided. Encourage, through questioning, suggestions of observations which could be tabulated, <i>eg number of legs, colour, segmented body or not</i>, and provide a suitable table for collation of observations. Make sure pupils are familiar with the terms for parts of animals' bodies. Ask pupils to make observations of a number of specimens and to record these using the table. Discuss problems arising from observations, <i>eg Do different pupils' records for one specimen agree?</i> 	<ul style="list-style-type: none"> handle living organisms in a safe and appropriate manner make suggestions about the characteristics to be observed and recorded make appropriate observations of a range of specimens and record these describe the similarities and differences between two living things use scientific vocabulary to describe the body parts of animals 	<ul style="list-style-type: none"> This activity is intended to help teachers find out about pupils' experiences, and knowledge and understanding of living things. Teachers will need to take this into account in their short-term planning of later activities in this and other units. If animals are brought into the classroom, ensure that they are treated with care and returned to the habitat from which they came as soon as possible. A range of living specimens could include those that may be easily collected from and returned to the local environment, <i>eg snail, slug, woodlouse</i>. These could be supplemented with images, <i>eg photographs, CD-ROMs, internet or videos</i>. The information recorded here is to be used to classify living things in the next activity. Sometimes pupils' observations of the same specimen will be different. This will provide an opportunity for discussion of issues relating to reliability. <p> Safety – wash hands after handling animals and wipe bench with disinfectant</p>

How can we sort things into groups?

<ul style="list-style-type: none"> that although individual members of a species differ in many ways they have features in common to classify fingerprints into groups which have features in common, giving reasons 	<ul style="list-style-type: none"> Ask pupils what they know about fingerprints and how they are used. Establish that they are used to identify individuals because they show great variation, but they can be classified because they have common features. Provide pupils with a sheet on which there are 30 fingerprints from 20 to 30 different individuals. Ask the pupils to observe these closely and to work in groups to devise their own system for classifying them into groups with features in common, giving their reasons. Once this has been done ask them to find differences that might be used to identify individuals. Present them with a single fingerprint and ask them to identify which person from the original set it belonged to. Use the fingerprint example to help pupils understand that although there is variation between individuals, there are sufficient similarities, <i>eg among members of a species</i>, to allow them to be recognised as one group. 	<ul style="list-style-type: none"> suggest ways in which fingerprints differ from each other classify fingerprints into groups which have features in common suggest reasons for the groups which they have made use their classification to identify an unknown individual 	<ul style="list-style-type: none"> Fingerprints can be classified into three general groups: loops, arches and whorls. However, some pupils may identify further distinguishing features and produce five groups: loop, simple arch, whorl (symmetrical), whorl (spiral), whorl (double loop). The original sheet may be enlarged for inspection, or hand lenses may be used for observation. There is an opportunity to invite a representative of the police force to talk to pupils about how fingerprints and other techniques are used to identify individuals.
<ul style="list-style-type: none"> to sort organisms into groups according to common features that there are different ways of classifying living things that newly discovered organisms may fit into an already existing system of classification or extend it 	<ul style="list-style-type: none"> Provide pupils with the data collected in their review of organisms. Ask them to use this data to sort the organisms they studied into sets, with common characteristics, and to give the reason for their groupings. Ask groups to report back on their rationale for grouping and highlight different groupings which emerge from this activity. Help pupils to consider the advantages and disadvantages of different systems, and to comment on this. Present pupils with information on a new organism, <i>eg as a photograph</i>, and ask them to place this into one of their existing groups. Make this challenging by selecting an organism which will cause conflict between two groupings in the classification, and may force pupils to reconsider and reclassify their initial groups. Review the outcomes by asking pupils to produce a display of their classification. 	<ul style="list-style-type: none"> sort living organisms into groups and suggest reasons for the groups chosen evaluate the relative advantages of methods used to classify organisms review their own classification in the light of evidence presented by new observations 	<ul style="list-style-type: none"> Pupils may initially group organisms according to features which are not particularly helpful, <i>eg live in water, live on land, live in air, or have legs, have wings, have neither</i>. Challenge such groupings by guiding pupils to see that some organisms could be in two groups at once, and ask them to reclassify so that this cannot happen. Extension: the data collected could be entered into a tree database programme, which pupils can use to classify specimens.

How do scientists classify living things?

<ul style="list-style-type: none"> that scientific classification is important because it is a worldwide labelling system, and provides a means for systematic study of living things that two groups of living things are green plants and animals that animals can be subdivided into vertebrates and invertebrates that vertebrates include mammals, birds, fish, reptiles, amphibians 	<ul style="list-style-type: none"> Describe using secondary sources, <i>eg photographs, video clips</i>, the early attempts made by scientists to classify living things into groups, and ask pupils to suggest reasons why an agreed system for worldwide use is helpful. Explore knowledge and understanding of the major groupings of living things, <i>eg plants and animals</i>. Explain the hierarchical nature of classification by introducing the notion that large groups, <i>eg animals</i>, can be subdivided into smaller subgroups, <i>eg invertebrates and vertebrates</i>. Introduce the major subgroups of vertebrates and ask pupils to describe the common features within each group. Provide pictures of a range of animals for pupils to classify into these groups, and ask them to present their work as a branching diagram. 	<ul style="list-style-type: none"> explain some of the advantages of the scientific classification system describe some features of animals and plants summarise the features that groups of vertebrates have in common classify animals as invertebrate or vertebrate and as one of the main vertebrate groups 	<ul style="list-style-type: none"> Pupils often have difficulty in being consistent in their classification, <i>eg they may classify a mouse as a mammal, but say it is an invertebrate because it can 'squeeze through bars' and so cannot have a backbone</i>. Limit the information in this activity to the animal groups mentioned. Others are introduced in the next activity. Classification of plants is introduced in unit 8D 'Ecological relationships'. Teachers may wish to introduce the 'five kingdom' model to some pupils.
<ul style="list-style-type: none"> that invertebrates can be further subdivided to search a CD-ROM database for information to transfer written information from one form to another 	<ul style="list-style-type: none"> Illustrate some sets of invertebrates using a range of resources, <i>eg photographs, videos, live animals</i>. Ask different groups of pupils to find information, <i>eg from a CD-ROM database</i>, about the main characteristics of one group, and some examples. Ask them to present their findings in a succinct format to be shared with other groups. Ask pupils to summarise the information from each group of pupils as a table showing some main groups, their characteristics, and examples. 	<ul style="list-style-type: none"> give an example of one invertebrate group which can be subdivided find and present information about one subgroup of invertebrates in an appropriate written format summarise the information about some main groups in a table 	<ul style="list-style-type: none"> Suitable sets of invertebrates include insects, molluscs and arachnids. At this stage it is not necessary for pupils to distinguish between levels of subgroup, <i>eg phylum, class</i>.

Reviewing work

<ul style="list-style-type: none"> to classify animals into the main taxonomic groups 	<ul style="list-style-type: none"> Ask pupils to review their original observations on a group of animal specimens, and to use what they have found out to classify each specimen as vertebrate or invertebrate and as one of the subgroups of vertebrates or invertebrates, <i>eg insect, mollusc, arachnid</i>. 	<ul style="list-style-type: none"> correctly classify animals into their taxonomic groups 	<ul style="list-style-type: none"> When pupils classify animals, it is helpful to provide them with descriptions of the main characteristics of groups.
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