

Unit 8D Ecological relationships

About the unit

In this unit pupils:

- study a habitat in detail and learn how:
 - organisms can be identified and sizes of populations compared
 - feeding relationships can be modelled quantitatively
 - living things within a community influence each other and are affected by the environment

In scientific enquiry pupils:

- model consequences of environmental changes within a habitat
- learn how to sample in biological investigations
- collect, present and interpret data and use this to make predictions
- undertake fieldwork to collect information about organisms within a habitat

The activities in this unit are intended to be combined into a full day of fieldwork. This could focus on habitats studied in unit 7C ‘Environment and feeding relationships’, but it would be preferable to use a contrasting habitat. Many urban environments provide ample opportunities for the work in this unit. Alternative classroom-based activities are suggested within the unit.

This unit is expected to take approximately 9 hours.

Where the unit fits in

This unit builds on unit 7C ‘Environment and feeding relationships’ and unit 7D ‘Variation and classification’.

It draws on unit 8C ‘Microbes and disease’ and relates to unit 9C ‘Plants and photosynthesis’ and unit 9G ‘Environmental chemistry’. It provides a foundation for unit 9D ‘Plants for food’.

It also provides a foundation for work in key stage 4 on energy transfer through an ecosystem and its relationship to food production.

This unit provides links with unit 3 ‘Processing text and images’ and unit 7 ‘Measuring physical data’ in the ICT scheme of work, with opportunities for presentations on, and measurements in, the environment.

Unit 7 ‘Rivers – a fieldwork approach’ in the geography scheme of work also covers fieldwork.

Expectations

At the end of this unit

in terms of scientific enquiry

most pupils will: suggest what data should be collected to investigate a habitat and choose appropriate apparatus and techniques to make measurements and observations; use a sampling technique to collect data to compare populations in habitats; use ICT to collect, store and present information in a variety of ways

some pupils will not have made so much progress and will: collect data to investigate a question about a habitat using appropriate apparatus and techniques; use ICT to collect, store and present information

some pupils will have progressed further and will: plan how to collect reliable data, taking into account the fact that variables cannot readily be controlled

in terms of life processes and living things

most pupils will: classify some plant specimens into the main taxonomic groups of plants; identify and name organisms found in a particular habitat and describe how they are adapted to the environmental conditions, explaining how the adaptations help survival; relate the abundance and distribution of organisms to the resources available within a habitat and begin to represent this using pyramids of numbers

some pupils will not have made so much progress and will: name some organisms found in a habitat and describe how they are adapted to environmental conditions; recognise that the abundance and distribution of organisms is different in different habitats

some pupils will have progressed further and will: explain how pyramids of numbers represent feeding relationships in a habitat

Prior learning

It is helpful if pupils:

- know that different living things live in different habitats
- can describe ways in which animals and plants are adapted to survive in a habitat
- can represent feeding relationships by food chains and food webs
- know that organisms can be classified into animals and plants and about the main taxonomic groups of animals

Health and safety

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

- carry out fieldwork outside the school
- handle a variety of living things

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 and phrases relating to the environment, *eg community, habitat, pyramid of numbers*
- words with similar but distinct meanings, *eg predator, carnivore, habitat, environment, ecosystem*
- words and phrases relating to the classification of plants, *eg taxonomic group, mosses, ferns, conifers*
- words and phrases relating to an investigation of a habitat, *eg environmental conditions, quadrat sampling, transect, population sizes, reliable data*

Through the activities pupils could:

- describe and evaluate how the work was undertaken and what led to the conclusions
- group sentences into paragraphs that are clearly focused and well developed

Resources

Resources include:

- secondary sources to explore animal and plant communities living in different habitats, *eg reference books, CD-ROM, access to internet*
- specimens of a variety of plants, *eg mosses, liverworts, ferns, conifer branches, pelargonium, grasses in flower*
- secondary data providing information on food webs, population sizes, etc, in a range of environments
- keys and field guides for use in fieldwork
- datalogging equipment and software
- prepared spreadsheet template for recording data from fieldwork
- apparatus for collecting specimens during fieldwork
- quadrats and other sampling apparatus
- video camera and/or digital camera and associated software
- simulation software for investigating predator-prey interactions

Out-of-school learning

Pupils could:

- visit a range of habitats, *eg nature reserves, bird sanctuaries, national parks*
- visit libraries or museums to find out more about the animal and plant communities living in different habitats, and their adaptations, and about issues related to the environment
- watch wildlife videos and television programmes about a range of very different habitats
- take part in environmental awareness or improvement projects
- use internet sites, *eg www.ase.org.uk/envlnk.html* that offer opportunities to find out about ecological relationships, biodiversity and environmental issues
- read newspaper articles, magazine articles and books about habitats, including those that are under threat or where protection schemes have resulted in species re-establishing themselves
- read fiction with an emphasis on the natural environment, *eg Watership Down*

How can animals be classified?

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| <ul style="list-style-type: none"> that organisms only survive in a habitat where they have all the essentials for life and reproduction | <ul style="list-style-type: none"> Review what pupils recall from previous work on living things in the environment by providing stimulus pictures of different habitats and asking pupils to suggest what types of animal and plant live there. Ask pupils to suggest reasons why the animals and plants differ, focusing on environmental factors. Use the opportunity to encourage pupils to think about how organisms get all the things they need to survive in these habitats. | <ul style="list-style-type: none"> suggest how organisms living in different habitats obtain the essentials for life and reproduction identify organisms likely to be found in a habitat | <ul style="list-style-type: none"> The first two activities are intended to find out what pupils know and understand about living things in habitats. Teachers will need to bear this in mind in later work. |
| <ul style="list-style-type: none"> that animals can be divided into vertebrates and invertebrates and that these groups can be further subdivided | <ul style="list-style-type: none"> Remind pupils of the work they did in year 7 on classification and using, <i>eg photographs, ICT resources</i>, as stimulus material, establish that it is helpful to classify organisms into plants and animals and that animals can be subdivided into vertebrates and invertebrates. | <ul style="list-style-type: none"> describe differences between vertebrates and invertebrates name some groups of invertebrate and give examples of these | <ul style="list-style-type: none"> The number of vertebrate and invertebrate groups introduced is likely to depend on the habitats to be investigated in the next part of the unit. At this stage it is not necessary for pupils to distinguish between levels of subgroup, <i>eg phylum, class</i>. In unit 7D 'Variation and classification' pupils consider the classification of animals. |


How can green plants be classified?

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| <ul style="list-style-type: none"> that green plants can be subdivided into those with vascular tissues (xylem and phloem) and complex leaves with a waterproof cuticle, and those without | <ul style="list-style-type: none"> Show a selection of common living plants, <i>eg mosses, liverworts, ferns, conifer branches, pelargonium and grass in flower</i>. Ask pupils to suggest where, and in what environmental conditions, each might be found. Show how plants are subdivided into two groups: plants without waterproofing layers, <i>eg mosses, which are confined to damp environments</i>, and plants with waterproof cuticles, which inhabit a wider range of habitats. Ask the pupils about other features shown by the plants. Use their suggestions to form the basis of classification, <i>eg ferns, cone-producing plants and flowering plants</i>. | <ul style="list-style-type: none"> recognise that plants are subdivided into groups based on characteristics such as vascular tissue and seed- or spore-bearing reproduction explain why mosses are found in places that are damp | <ul style="list-style-type: none"> The purpose of the classification work is to help pupils to make sense of what they find during the major fieldwork activity in this unit. For many pupils, teachers will wish to simplify the terms used to describe plant characteristics. Some pupils may wish to explore the subdivision of flowering plants into monocotyledonous and dicotyledonous plants. Conifers are contained within gymnosperms, but not all gymnosperms bear cones. Extension: pupils could classify a range of living, preserved and photographic plant material using the main taxonomic features. |
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Pupils should learn:

How do plants, animals and environmental conditions interact in a habitat?

a) How can we collect data to answer questions about a habitat?

<ul style="list-style-type: none"> • how to frame questions that can be investigated • to use scientific knowledge and understanding to raise questions about habitats • to decide what data might be collected and how to present data • how to use ICT to measure and record environmental factors 	<ul style="list-style-type: none"> • Organise fieldwork in a suitable location, <i>eg woodland, pond, stream, school grounds, wall, paving stones, park, sand dunes, rocky shore</i>, and discuss with pupils the questions they will try to answer during the work, <i>eg</i> <ul style="list-style-type: none"> – <i>What lives there?</i> – <i>Why do communities differ in different habitats?</i> – <i>How can we measure sizes of populations of living things?</i> • Ask pupils for ideas about data they will need to collect to answer the questions, how they will go about it and what they will do with the data collected when they return to school. • Remind pupils of how to use dataloggers to collect remote data when outside, <i>eg temperature variations, dissolved oxygen, light intensity and humidity</i>, and how to produce graphs from the data collected. Discuss the formats to be used for presenting results in the fieldwork activity. 	<ul style="list-style-type: none"> • decide on questions to be investigated • suggest data to be collected 	<ul style="list-style-type: none"> • It is helpful if the locality chosen allows two contrasting habitats to be studied. • Pupils are likely to have used environmental sensors and computers to collect and display environmental data in unit 7C 'Environment and feeding relationships'. <p> Safety – all off-site visits must be carried out in accordance with employer's guidelines. Pupils' plans must be checked for health and safety before practical work begins</p>
<ul style="list-style-type: none"> • about the importance of sampling in biological studies • about the use of quadrats as a sampling technique for investigating populations • to sample using quadrats 	<ul style="list-style-type: none"> • Ask pupils to suggest how they might go about finding out the size of a population of a plant or animal living in a habitat. Help them to realise the limitations of simply counting in some situations, <i>eg where the animals are difficult to find, or where they occur in large numbers</i>. Explain the principles behind sampling as a means of collecting this type of data in biological studies. Describe different methods of sampling populations including the use of quadrats. • Provide groups with trays of sand, in which small steel tacks have been buried. Show them how to use small wire square quadrats to sample areas of the tray, using a magnet to remove the tacks within a quadrat. Ask them to estimate how many tacks are hidden, by taking ten quadrat samples, and to explain why taking ten samples gives more reliable data than taking one. 	<ul style="list-style-type: none"> • explain why it is sometimes necessary to use sampling methods to get information in biological studies • use data from quadrat sampling to give information about population size • explain why one sample might provide misleading results 	<ul style="list-style-type: none"> • Detailed mathematical treatments are not required in this key stage. • This activity illustrates how a sample can be taken. It is not a substitute for sampling within a natural habitat.

b) What lives there?

<ul style="list-style-type: none"> to observe and record the organisms which comprise the living community in a habitat to work safely with living things to show sensitivity to living things in their environment 	<ul style="list-style-type: none"> Agree with pupils what data they are going to collect and show them ways of finding and observing living things in the habitat being studied. Make sure they understand issues relating to safe working and care for living organisms. Show pupils ways of collecting specimens of animals, <i>eg using pooters</i>. Provide pupils with resources, including keys, field guides to help them find, collect, and identify typical animals and plants that they may come across. If possible, help pupils to use a digital camera to make a record of the habitat and organisms found. 	<ul style="list-style-type: none"> observe and record the organisms which comprise the living community in a habitat work safely with living things and show sensitivity to them make records in an appropriate way, <i>eg using a digital camera</i> 	<ul style="list-style-type: none"> A prepared spreadsheet template on a portable computer can help with the collection of data in the field. If small invertebrates are removed from their habitat, ensure they are treated with care and returned as soon as possible. Avoid disturbing the habitat. Plants should not be removed unnecessarily. Stones or logs should be replaced if they are turned over. Pupils could be reminded that most micro-organisms within a habitat will not be found in this kind of activity. <p> Safety – wash hands after handling animals. Pooter mouthpieces should be disinfected each time they are used. Wipe benches with disinfectant</p>
<ul style="list-style-type: none"> that different habitats support different living things to describe and evaluate how the work was undertaken and what led to the conclusions 	<ul style="list-style-type: none"> If possible, ask different groups of pupils to make and collect data about the communities in two different habitats within the same locality, and share findings as a report in the classroom. Ask pupils to produce a report of their findings, describing what they did, comparing the communities and saying what led to their conclusions. 	<ul style="list-style-type: none"> describe how the communities in two habitats differ describe, <i>eg in an OHT/Powerpoint presentation</i>, how they carried out their work and explain how they came to their conclusions 	<ul style="list-style-type: none"> Information on a second habitat could be provided from secondary sources and studied in the classroom. As a classroom-based alternative, ask pupils to search sources of secondary data about the animals and plants found in two different habitats, <i>eg pond and stream; two soil communities; different stages of sand dune; woodland shrub layer and leaf litter; rocky and sandy shores</i>.

Pupils should learn:

c) Why do the communities differ in different habitats?

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| <ul style="list-style-type: none"> • to use ICT to measure, record and describe environmental factors • that different habitats have different environmental features | <ul style="list-style-type: none"> • Agree with pupils what data they are going to collect about the environmental factors of the habitat, <i>eg temperature variations, light intensity, dissolved oxygen</i>. Provide them with the appropriate apparatus, including dataloggers. Ask pupils to make a record of environmental conditions. | <ul style="list-style-type: none"> • collect data, <i>eg temperature variation, light intensity within a habitat</i>, using ICT • use data collected to compare different habitats | <ul style="list-style-type: none"> • It may be helpful to decide beforehand on the format for recording environmental conditions. If a spreadsheet is used, pupils could investigate the data and produce graphs. • Many CD-ROMs and internet sites are good sources of information on environmental conditions and on the organisms associated with different habitats. |
| <ul style="list-style-type: none"> • to group sentences into paragraphs that are clearly focused and well developed | <ul style="list-style-type: none"> • Ask pupils to write a report, including graphs of the data, about ways in which the two environments are different and encourage them to make associations between some of these conditions, <i>eg in ponds, warm conditions and abundant plant growth can result in low oxygen levels fast-flowing water in streams leads to cooler conditions</i>. | <ul style="list-style-type: none"> • produce a report comparing two environments, incorporating appropriate data and other information | <ul style="list-style-type: none"> • The term 'habitat' refers to a place; 'environment' refers to the surroundings. In this activity, pupils are comparing the environmental features of two habitats and are therefore comparing two environments. Pupil records of comparisons of environments could be combined into one piece of work. |
| <ul style="list-style-type: none"> • that organisms show adaptations to environmental conditions • that both plants and animals are adapted to ensure the survival of the species | <ul style="list-style-type: none"> • Ask pupils to make suggestions about how the conditions in each habitat influence the communities of organisms living there, <i>eg by asking why there is more of this here than over there</i>, and ways in which animals and plants are adapted for the problems of living within those environmental conditions, <i>eg pond communities contain rooted plants on the fringe and floating plants in the middle of the pond, and an abundance of free-swimming animals, while fast-running streams may have plants with long, flexible stems, and animals adapted to holding on to a stony substrate</i>. • Help pupils to present their work as a wall display, including images of animals and plants showing relevant adaptations. | <ul style="list-style-type: none"> • describe organisms which show adaptations for particular habitats, and explain how these help the organisms to survive • explain that both plants and animals are adapted to ensure the survival of the species | <ul style="list-style-type: none"> • As a classroom-based alternative, ask pupils to search secondary sources of information, or use real data about the environmental conditions of the two habitats being compared, <i>eg</i> <ul style="list-style-type: none"> – <i>temperature at different depths, flow rate, light intensity, availability of dissolved oxygen for two aquatic habitats</i> – <i>temperature, moisture, organic content, mineral content, pH for two soils</i> – <i>air temperature, humidity, light intensity, wind, for two terrestrial habitats</i> |

Pupils should learn:

d) How big are the populations in the habitat?

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| <ul style="list-style-type: none"> • how to use quadrat sampling techniques to collect information about populations of organisms • how to record data in appropriate ways | <ul style="list-style-type: none"> • Remind pupils about quadrat sampling and help them to collect quantitative data about number and distribution of organisms, <i>eg count and find out about distribution of weeds on a school field, limpets on a rocky shore or earthworms in the soil; estimate percentage cover of different plant types in different habitats or in different areas of a habitat, such as along a transect.</i> Arrange for pupils to collect comparative information from two habitats, or different parts of a habitat for which environmental data has also been collected. | <ul style="list-style-type: none"> • collect information about the number and distribution of organisms in a quadrat sample • use sample data to estimate a population • record data in appropriate ways | |
| <ul style="list-style-type: none"> • that abundance of organisms in habitats is affected by environmental factors such as availability of light, water and nutrients • that distribution of organisms in an environment is affected by environmental factors • that the size of a population depends on resources | <ul style="list-style-type: none"> • Ask pupils to represent the data graphically, to make comparisons of the data and to suggest reasons for the distribution of organisms. Encourage them to consider the range of resources needed by animals, <i>eg nesting sites, mates</i>, and how environmental differences affect numbers and distribution of organisms. They should also be able to suggest ways in which organisms may influence each other, <i>eg a large tree shading the area below it, preventing other plants from growing; availability of food influencing animals' distribution.</i> • Help pupils to bring together all the work resulting from their field trip as a classroom display. | <ul style="list-style-type: none"> • suggest how environmental factors, <i>eg availability of light, water and nutrients</i>, affect numbers of organisms • describe how the distribution of organisms depends on environmental factors • explain how the size of a population depends on resources | <ul style="list-style-type: none"> • Data collected in the field may need to be supplemented by data from secondary sources. • If possible, compare results with those from a previous year. Building up long-term data can help to make sense of some of the variables noted. |

How do living things in a community depend on each other?

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| <ul style="list-style-type: none"> • that all feeding relationships within a habitat are interconnected • that food webs are made up of a number of food chains • to make predictions about the effect of different environmental factors on plant and animal populations • to use ICT to model population changes • that plants benefit from waste products and the decay of other organisms | <ul style="list-style-type: none"> • Review pupils' understanding about feeding relationships by providing them with examples of food webs to analyse. Ensure that they can identify the food chains within a food web, and that they understand the terms 'producer' and 'consumer' and the flow of materials through the food chain. • Challenge pupils to predict the effects of making changes to the numbers of one type of organism. Encourage pupils to go beyond simple relationships by considering knock-on effects of a single change, <i>eg as the number of rabbits decreases, more grass will grow, providing more food for other grass-eating animals, whose numbers may increase as a result.</i> • Ask pupils to consider a range of examples of such changes in communities and their consequences. Extend the work by asking pupils to use a computer program to model changes, <i>eg the effect of changing initial population sizes of predators and prey.</i> Ask pupils to look for patterns in graphs produced from the data, to use these to make predictions about what will happen next and to test their predictions by allowing the simulation to run on. • Challenge pupils to explain how plants benefit from the other organisms in the community. | <ul style="list-style-type: none"> • identify the food chains which make up a food web • use the terms 'producer', 'consumer' and other terms related to feeding • describe how a food web shows the feeding relationships within an environment • predict how changing the size of one population will affect the numbers of other species • present data from simulations as graphs and make predictions from patterns in these • describe ways in which plants depend on other organisms | <ul style="list-style-type: none"> • Pupils will have constructed food webs in unit 7C 'Environment and feeding relationships'. • Data from the fieldwork could be drawn on for the rest of this unit. It will need to be supplemented by secondary data. • A visit from an ecologist or environmental scientist to tell pupils about how he/she gathers evidence would enhance this unit. Pupils could be asked to use their own experience to prepare questions. • Changes in populations of micro-organisms over a relatively short time period can provide helpful illustrations of the relationship between populations and resources. |
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Learning objectives

Pupils should learn:

- to identify patterns in data
- that a pyramid of numbers describes the numbers of food plants, herbivores and carnivores in a habitat
- that there is a flow of energy from the producer to the final organisms in the food chain

Possible teaching activities

- Provide pupils with data on the numbers of animals and plants in a community and what they feed on. Ask them to count up numbers of producers, herbivores and carnivores, and to look for patterns in the results and to repeat for a different set of data. Ask pupils whether the pattern in the two sets of data is the same. Show them how to represent the data as a pyramid of numbers and explain the usefulness of this model in considering the interdependence of living things.
- Show pupils examples of inverted pyramids of numbers, *eg involving an oak tree*, and ask them to explain how these are different.

Learning outcomes

Pupils:

- draw pyramids of numbers from data provided
- explain how a pyramid of numbers describes the number of producers, herbivores and carnivores in a habitat
- describe how there is a flow of energy from the producer to the final organisms in the food chain

Points to note

- Pupils will have considered energy transfer in unit 7I 'Energy resources'.
- The term 'trophic level' is not required at this stage.
- Data on numbers of animals in the community studied in the field should be used for this activity, if available. This can then be built on using secondary data.

Reviewing work

- to apply their knowledge of populations within a habitat to an environmental issue including protection of living things
- Present pupils with a case study, *eg plans to cut down a number of trees in a school's grounds*. Provide relevant information, such as food webs for the community, population sizes, etc. Ask pupils to report how this action might affect the living things in the area including ideas they might have about protecting their local environment.
- produce a report in which consequences of the change are related to specific organisms within a particular habitat and how they might be protected