Fusion 2: B2.1 – Ecology

National Curriculum Link up
•3.3a, d.

Learning Objectives	Teaching / Learning activities	Teaching suggestions
Pupils should learn: That plants are essential for the existence of life on Earth. How animals and plants depend on each other. How plants obtain their energy for growth.	**Lesson structure** **Starter -Plants in space** Working in groups, get the pupils to discuss why humans may one day take plants into space with them if they have to go on very long missions. Discuss their answers, drawing out the interactions between plants, animals and the environment.(5–10 mins) **Main** Burn some food, such as sugar, over a bench mat and ask where the energy comes from. Show the pupils a carbon dioxide fire extinguisher and ask why a squirt from it would put out the flames. Establish, through questioning, that the energy originally came from the Sun and that oxygen is necessary for the conversion of the stored chemical energy into other forms. Using the activity 'Studying a garden' in the pupil book, and using a writing frame if necessary, fill in all the ways that are shown in which plants and animals are of benefit to each other. Summarise the relationships in a PowerPoint series of slides to include plants providing food and oxygen for animals and animals providing nutrients for plants through their excreta and remains, plus providing them with carbon dioxide as a raw material for photosynthesis. Run an activity to help understand energy. Place four stations around the room labelled glucose, oxygen, water and carbon dioxide, each with cards labelled as such. Give pupils an identity sticker either animal or plant. Plants get a green sticker with the word (chlorophyll) in brackets. Pupils who are plants have to get water and a CO_2 card and then go to you. You stand by a light or a board drawing of the sun. Give them glucose and an O_2 card in exchange for their H_2O and CO_2 cards. Also place a removable 'energy' sticker on the glucose card. Pupils who are animals must get the glucose cards from the plants and remove the energy stickers. They need an oxygen card to do this and must put a CO_2 and water card back on the piles after exchanging. After a suitable interval discuss how the cards are exchanged. **Plenary - Key word spotter** Using PowerPoint fl ash up definitions of some of the key words in this section and ask the pupils to write down on 'Show me' boards which word is being defined. (5–10 mins)	**• Learning styles.** *Visual:* Watching the PowerPoint presentation. *Auditory:* Listening to other pupils' views about whether or not plants should be taken into space. *Kinaesthetic:* Taking part in the understanding energy activity. *Interpersonal:* Taking part in discussions. **• Special needs.** Provide a list of words to choose from in the 'Key word spotter' plenary. Provide ready-prepared labels for the naming of the parts of a plant and a plant cell. **• Extension.** Ask pupils to draw up a food web of the scene depicted in 'Studying a garden'. Pupils could search the Internet for references to the way in which vegetables and fruit are grown in water culture at Achiltibuie, Scotland, and assess whether it would be possible to set up such a system on the Moon. **•Homework.** Pupils could gather together all the information from the lesson about the ways in which plants help animals and vice versa and either write a paragraph about each or summarise in the form of a table.

Learning Outcomes	Additional teachers notes
All pupils should be able to state that animals and plants are interdependent. *Most pupils should be able to* describe the structure of a plant and the functions of its parts. *Some pupils should also be able to* describe examples of the inter-relationships between plants and animals.	**Equipment and materials required** A suitable food is needed, dish, Bunsen burner, safety mat and eye protection. **Safety** Eye protection. Burning sugar is very hot.

Fusion 2: B2.2 – Making Food.

National Curriculum Link up
•3.3a, d.

Learning Objectives
Pupils should learn:
That plants can make their own food by photosynthesis.
That plants need light to make glucose and other carbon containing compounds.
How we can show the presence of starch in the leaves of plants and the need for light.

Teaching / Learning activities
Lesson structure
Starter - Autumn leaves
Show the pupils some photographs of autumn leaves then some bare winter branches. Compare this with some pictures of palms and bananas from the tropics. (5–10 mins)
Main
Testing leaves for starch: Discuss the potential hazards associated with this practical work. Ensure that the pupils do not confuse the instructions and pour the ethanol with the leaf into the hot water. Use a glass rod to stir the ethanol while the leaf is in it and to remove the leaf when blanched. The colour change for a positive result can be demonstrated in advance by getting a pupil to squirt some iodine on to a slice of white bread.
For the experiment 'Is light needed to make starch?', have the de-starched plants ready. Allowing pupils to cut out black paper or aluminium foil shapes can add stimulus to this investigation. Use miniature clothes pegs (available from craft stores) or paperclips to hold the paper or foil templates on to the leaves.
Plenary - Interview with Van Helmont
Organise the pupils, in small groups, to write a script for an interview with Van Helmont where he describes how he carried out his experiment. Groups could either stage the interview as a news item and use 'our science correspondent' or a Newsnight-type interview. (10–15 mins)

Teaching suggestions
• **Special needs.** Use a sequencing sheet to show flow through the stages of the practical.
• **Extension.** Pupils to plan out a mini version of Van Helmont's experiment using cress seeds.
• **Learning styles.**
Visual: Observing the colour changes in the experiments.
Auditory: Listening to the interviews with van Helmont in the plenary.
Kinaesthetic: Carrying out the practical investigations.
Interpersonal: Working in groups to write a script for the interview in the plenary.
• **Homework.**
Pupils could write up accounts of the practical work done in the lesson.

Learning Outcomes
All pupils should be able to state that photosynthesis is the way in which plants make their food.
Most pupils should be able to describe the tests for the presence of starch in leaves and the necessity for light.
Some pupils should also be able to explain why glucose is built up into starch for storage.
How Science Works
Adapt the stylistic conventions of a range of genres for different audiences and purposes in scientific writing (1.1c) (see Van Helmont plenary).

Additional teachers notes
Autumn leaves equipment and materials required
Photographs of leaves or real leaves and bare branches.
Testing leaves for starch equipment and materials required
Geraniums or zonal pelargoniums illuminated, water baths, test tubes, ethanol, white tiles, dilute iodine solution, glass rods, forceps. **Safety.** Need eye protection. Pupils should be told to keep iodine solution off their clothes and hands. Iodine solution: CLEAPSS Hazcard 54B. Careful with hot water and ethanol (no naked flames). Ethanol is highly flammable: CLEAPSS Hazcard 40A.
Is light needed to make starch? equipment and materials required
Plants should be de-starched (keep in dark for at least 48 hours). Black paper, paperclips, materials for the starch test as above. **Safety.** As above.

Fusion 2: B2.3 – Photosynthesis

National Curriculum Link up
•3.3a,d.

Learning Objectives
Pupils should learn:
That chlorophyll is needed for photosynthesis.
That carbon dioxide and water are needed as raw materials for the process of photosynthesis.
That glucose and oxygen are produced.

Teaching / Learning activities
Lesson structure
Starter - What's in a word?
Write up the word 'Photosynthesis' onto the board. Split it into two parts, using different colours to emphasise the 'photo' bit and the 'synthesis' bit. Ask the pupils if any one can think of any words connected to either of the sub-units. Illustrate each of these words and draw out the meaning of 'photosynthesis' as making new things using light. (5–10 mins)
Main
Cut up some grass and place in the bottom of a mortar with a little sharp sand. Add a few millilitres of ethanol (**care:** no naked flames) and grind to a pulp. Filter the mixture into a test tube and show it in a bright light. Chlorophyll has been extracted and can been seen as an intense green colour.
Show the pupils a number of variegated plants and establish that the white parts of the leaves do not contain chlorophyll. Carry out the practical 'Do plants need chlorophyll for photosynthesis.
The activities 'Do plants need carbon dioxide for photosynthesis?' and 'Making oxygen in photosynthesis' are best set up beforehand.
Plenary - Green cloze
Working in pairs, ask the pupils to write out a cloze passage or 'fill in the gaps' for their peer. Peer mark and read out some of the best ones. (10–15 mins)

Teaching suggestions
• **Special needs.** Using large diagrams of the apparatus used and preformed labels, ask pupils to label the apparatus used in the experiments.
• **Extension.** If the 'Why are colours coloured?' starter was used, ask the pupils to think of what colour a plant would be if it developed a perfectly efficient photosynthetic method [black] and to write creatively about an invasion of black plants.
• **Learning styles.**
Visual: Observing the results of the experiments.
Auditory: Listening to instructions about the practical.
Kinaesthetic: Carrying out the practical work.
Intrapersonal: Writing out the 'Green cloze' passage.
• **Homework.**
Using the word equation devised in the plenary, summarise the experiments used to show the reactants, pre-requisites and products of photosynthesis. This could either be a poster, as suggested in the pupil book, or a spider diagram. Complete worksheets given out in the lesson.

Learning Outcomes
All pupils should be able to name the raw materials and the products of photosynthesis.
Most pupils should be able to describe the experiments to show that the raw materials are needed and that the products are glucose and oxygen.
Some pupils should also be able to explain the results of the experiments in detail.
How Science Works
Describe an approach to answer a scientific question using sources of evidence, and where appropriate, making relevant observations or measurements using appropriate apparatus (1.2a).

Additional teachers notes
Demonstration: Extraction of chlorophyll equipment and materials required
Grass/spinach/watercress, ethanol, mortar and pestle, sharp sand, filter funnel, filter paper, test tubes and stand, paint brushes or empty fountain pen ink cartridges.
Do plants need chlorophyll for photosynthesis? equipment and materials required De-starched spider plant, materials for starch test.
Do plants need carbon dioxide for photosynthesis? equipment and materials required
De-starched potted plants, plastic bags, soda lime, materials for starch test.
Making oxygen in photosynthesis equipment and materials required
Elodea, large beaker, funnel, test tube, source of bright light, splint, matches. **Safety.** Iodine solution: CLEAPSS Hazcard 54B. Ethanol is highly flammable, no naked flames: CLEAPSS Hazcard 40A. Eye protection needed. CLEAPSS handbook section 15.5.1. Soda lime is corrosive: CLEAPSS Hazcard 91.

Fusion 2: B2.4 – Leaves and Photosynthesis.

National Curriculum Link up
•3.3a.

Learning Objectives
Pupils should learn:
That the leaves of plants are where photosynthesis occurs.
The ways in which leaves are adapted for photosynthesis.
To plan an investigation into the factors that can affect the rate at which photosynthesis occurs.

Teaching / Learning activities
Lesson structure
Starter - Captain Blackfinger's cruelty to plants club
Tell the pupils that you are Captain Blackfinger and that you have started a 'Cruelty to Plants' club. As your first activity, you are going to pull all the leaves off a plant, one by one, without anaesthetic. Do so (make sure the plant is not toxic). When the leaves are all off, ask the pupils to write down what will happen to this plant now and why. (5–10 mins)
Main
Ask the pupils how the water gets into the leaves. Some pupils will probably answer 'through the leaves', but dispel this suggestion by demonstrating that leaves can be waterproof. Ask a volunteer to hold running off. Show how a scoop can be made from most leaves that will hold water.
Hand out blank un-labelled leaf diagrams or use a projected blank diagram and discuss the different structures of the leaf and allow the pupils to label their diagram.
Microscopic leaf structure: Well before the lesson, paint transparent nail varnish on to the underside of *Tradescantia* leaves, enough for one between two pupils. Get the pupils to peel a section of the varnish off and examine it under a microscope on low magnification at first, and then on higher magnification. Give the pupils a half A4 sheet of plain paper and tell them to draw what they see, complete with magnification.
Plenary – Captain Blackfinger's rules
Pupils could draw up some more rules for 'Captain Blackfinger's cruelty to plants club'. Suggest that such rules could apply to anything concerned with preventing the plant from carrying out photosynthesis. (5-10 min)

Teaching suggestions
• **Special needs.** Give the pupils printed labels to place on large diagrams of leaf structure. This can be done for both the external adaptations and the internal structure of the leaf.
• **Extension.** Ask the pupils to investigate limiting factors, by making a list and then working out what would be the best combination of factors to set up in a glasshouse in order to produce crops all the year round.
• **Learning styles.**
Visual: Observing stomata and leaf structure using microscopes.
Auditory: Listening to discussions and explanations of the different parts of the leaf.
Kinaesthetic: Using microscopes to look at leaf sections.
Intrapersonal: Thinking up some more rules for the 'Captain Blackfinger's cruelty to plants club' for homework.
• **Homework.**
Pupils could finish labelling diagrams and organise them to be stuck into notebooks.

Learning Outcomes
All pupils should be able to state that the leaves are where photosynthesis occurs and to describe their main adaptations.
Most pupils should be able to identify the internal tissues of a leaf and state their functions.
Some pupils should also be able to design an investigation and explain how environmental factors may affect the rate of photosynthesis.
How Science Works
Describe and identify key variables in an investigation and assign appropriate values to these (1.2b).

Additional teachers notes
Captain Blackfinger's cruelty to plants club equipment and materials required
plant.
Microscopic leaf structure equipment and materials required nail varnish, *Tradescantia* leaves and microscopes. **Safety.** Nail varnish might be flammable.

Fusion 2: B2.5 – Food Chains.

National Curriculum Link up
•3.3a, d.

Learning Objectives
Pupils should learn:
What is meant by a food chain.
How organisms are classified in food chains.
Which groups of organisms act as decomposers.

Teaching / Learning activities
Lesson structure
Starter -Food chains 'drag and drop'
Use a digital projected 'drag and drop' exercise with the parts of a simple food chain. Ask a volunteer to assemble the chain and explain their reasoning. As above, sort out any unorthodox and draw out and record currently known vocabulary associated with the topic. (5–10 mins)
Main
Carry out a bookwork exercise, copying the correct key words, with the correct definitions, for producer, consumer, food chain, carnivore, herbivore, omnivore, predators, prey, scavengers, parasites and decomposers.
Organise the pupils into pairs and give each pair an A3 sheet with the names of many organisms on it and a set of coloured highlighter pens. Explain that they have to make food chains by joining the organisms together using arrows, and that they should then make a key showing which colour represents each one of the key words used in the previous exercise. They should highlight the words accordingly, going around them with more than one colour. When finished, they can check out other groups' sheets. As an extension, ask them to add more examples of their own. Also see the activity 'Making food chains' in the pupil book.
Plenary - Unscramble key words
Give the pupils sheet with the key words scrambled up and get them to unscramble them. Alternatively, write out the key words with either the vowels or the consonants missing. As an extension, get them to make up some of their own and try them out on other pupils. (5–10 mins.)

Teaching suggestions
• **Special needs.** Play hangman with the key words. If necessary put in initial letters, or all the vowels.
• **Extension.** Introduce the phrase 'trophic levels'. Pupils should find out what the word 'trophic' means and see how many words they can find which incorporate it. Using the Internet, ask the pupils to draw out as long a food chain as they can find, writing down the URLs (uniform resource locator) of each site as evidence.
• **Learning styles.**
Interpersonal: Working in groups in the activities.
Intrapersonal: Unscrambling the key words.
• **Homework.**
Pupils could write out a set of definitions of the key words which can be used to test their peers' knowledge at the beginning of the next lesson. Ask pupils to work out food chains for the meals they have eaten in one day. It is interesting for them to see how high up the food chain their food is.

Learning Outcomes
All pupils should be able to describe and construct simple food chains, using the correct terminology.
Most pupils should be able to describe the energy flow through a food chain and classify the organisms in the food chain.
Some pupils should also be able to explain the importance of the decomposers.

Additional teachers notes
A PowerPoint presentation of a food chain would be a useful reinforcement at this stage, as would a section of video. Many widely known science video series have sections on food chains.

Fusion 2: B2.6 – Food Webs.

National Curriculum Link up
•3.3a.

Learning Objectives
Pupils should learn:
That food chains link together to make food webs.
That populations can be affected by changes in feeding relationships.
That food webs can be upset by introducing organisms into a different habitat.

Teaching / Learning activities
Lesson structure
Starter - Crossword race
Give the pupils a crossword puzzle of all the key words from the previous lesson. (10–15 mins)
Main
Floor food web activity: Arrange the pupils into groups of four or five. Give them each a pack, containing the laminated words grass', 'corn', 'rabbit', 'sheep', 'cow', 'fox', 'hawk' and 'human'. Also include in each pack some much smaller labels, saying 'producer' (2 of these), 'consumer' (6), 'herbivore' (3), 'carnivore' (1) and 'omnivore' (2). The packs should also contain paper arrows. The objective is to use a pack to construct a floor diagram of a food web, using the paper arrows to show feeding relationships. Tell the pupils to put the producers at the bottom, then the primary consumers in the next layer above, then the secondary consumers. When each group has completed the exercise, take a digital photograph of the completed diagram to print out later as a record. Let the groups examine and assess each other's work. Then, pick out an organism and ask the pupils to discuss how other organisms would be affected if the numbers of this organism (population) increased. Repeat this with the numbers going down (population decreasing).
Give the pupils a written exercise to define a food web and give them a pre-printed food web diagram to complete by filling in the arrows and missing words.
Plenary - Net spotting
Give the pairs of pupils an A3 sheet with the names of lots of organisms on it, but no links. Each pair should spend five minutes drawing in as many links as they can and five minutes circulating the class to look at others, adding in any extra links they have found in a different colour. If time permits, compare sheets and keep as a record. (5–10 mins)

Teaching suggestions
• **Special needs.** Use a simpler food web floor chart or give a printed model of what their floor chart should look like.
• **Extension.** Give the pupils a list of websites and ask them to produce a synopsis of the alien species problems which are currently in high profile internationally. Let the pupils choose one alien species, use the Internet for research and produce a poster about it for display. For example, the impact of the different ladybird species from the continent could be relevant.
• **Learning styles.**
Visual: Observing the food webs.
Auditory: Listening to discussions about changes in population numbers.
Kinaesthetic: Taking part in the Floor food web activity.
Interpersonal: Working in groups and pairs in the activities.
Intrapersonal: Completing the crossword puzzle; completing the food web diagram.
• **Homework.**
Draw out another food web of your own.

Learning Outcomes
All pupils should be able to understand that food chains link together to make food webs.
Most pupils should be able to understand that a change in the size of a population of one species in a food web can affect other species.
Some pupils should also be able to predict the effects of such changes on the other organisms in a food web.

Additional teachers notes
Show the pupils a video clip of a food web if available.
Use PowerPoint to illustrate the effect that introducing an alien species, such as those mentioned in the pupil text, will have on the food web. There are a number of good videos available about this. Try searching the BBC for their news report video 'The case for culling grey squirrels'.

Fusion 2: B2.7 – Food Pyramids and Energy Flows

National Curriculum Link up
•3.3a.

Learning Objectives
Pupils should learn:
What pyramids of numbers are.
How pyramids of numbers can show energy flow through ecosystems.
How bioaccumulation occurs in ecosystems.

Teaching / Learning activities
Lesson structure
Starter -Big fleas have little fleas
Tell the pupils about *Ichneumon* flies, which are wasp-like insects that lay their eggs in the bodies of butterfly and moth larvae (caterpillars). The caterpillar is the host and the *Ichneumon* fly larvae feed parasitically inside the caterpillar. The fly larvae are parasitised by the larvae of another group of wasp-like insects. This second lot of parasites are called 'hyperparasites'. Assuming that each parasite has only one hyperparasite, ask the pupils to suggest what shape the pyramid of numbers would be (5–10 mins)
Main
Collect leaf litter from a 50 × 50 cm area of woodland (or other suitable habitat) and place in a bag for transport to the laboratory. Tip the litter out into a large tray. Get the pupils to catch any animals they can spot, using pooters, pipettes, paintbrushes (emphasising that they need to be careful to separate out the animals and keep them in specimen tubes). Classify the animals into carnivores, herbivores and detritivores, and build a pyramid for the leaf litter. All animals should be returned safely to their original habitat.
Show the pupils a PowerPoint presentation of the concept of pyramids of numbers, building up each layer in turn, using all the terminology (consumers, etc.). The pyramid should relate to a specific habitat or situation. Give them a worksheet to complete as the presentation proceeds, with a table of numbers to fill in and then plot a pyramid to scale on graph paper.
Plenary - When is a pyramid not a pyramid?
Ask the pupils to write this question on one half of a folded piece of A4 and on the other side to draw out, in words and pictures, the answer to this riddle. [In a pyramid of numbers where the bottom layer can be of smaller volume than the ones above.] (5–10 mins)

Teaching suggestions
• **Special needs.** If available, have a magnetic balls model and get a pupil to build a pyramid from it. Stick stickers on the balls to state which layer represents which type of organism. Alternatively, use building bricks and stick-on labels.
• **Extension.** Research the use of dung as fuel and present as a PowerPoint.
• **Learning styles.**
Auditory: Discussing problems with pyramids.
Kinaesthetic: Carrying out the practical activities.
Intrapersonal: Drawing the answer to 'When is a pyramid not a pyramid?' plenary.
• **Homework.**
Pupils could complete pyramids of numbers activities.

Learning Outcomes
All pupils should be able to construct a pyramid of numbers from given data and link it to energy flow.
Most pupils should be able to interpret pyramids of numbers and describe how persistent chemicals accumulate in ecosystems.
Some pupils should also be able to explain why bioaccumulation occurs.

Additional teachers notes
Equipment and materials required
Leaf litter, bag, large tray or sheet of paper, specimen tubes, forceps, pooters, pipettes, paint brush, identification keys.
Safety
Follow local guidelines and risk assessments for outside activities.
CLEAPSS laboratory handbook/CDROM section 17.1.

Fusion 2: B2.8 – Predators and Prey

National Curriculum Link up
•3.3a.

Learning Objectives
Pupils should learn:
How predators are adapted to catch prey.
How plants and prey are adapted to avoid being eaten.
How populations of predators and prey affect each other.

Teaching / Learning activities
Lesson structure
Starter - Predator, prey, both or neither?
Remind the pupils what the words 'predator' and 'prey' mean. Place the words 'predator', 'prey', 'both' and 'neither' on to the board and assign them each a letter: 'a', 'b', 'c', or 'd'. Show the pupils a series of photographs of various animals, including some which are obviously predators, such as lions, hawks; some which are obviously prey species, such as rabbits and deer; some which could be both, such as small birds; and some which are neither, such as plants. Using small individual white boards, get the pupils to write the letter they think best sums up each organism in turn and, on a signal, hold them up. Discuss the class views. (5–10 mins)
Main -
Choose a pair of organisms in a feeding relationship and ask the class what will happen to the number of the prey species if the number of predators increases, and what will happen to the number of prey if the number of the predator species decreases. In addition, if available, use modelling or simulation software, such as the relevant tool in Multimedia science school, and allow the pupils to interact with the system, changing variables and seeing the effect on the numbers of predators and prey.
Carry out the exercise 'Predators and prey' from the pupil book.
Plenary - A harey story
Ask the pupils to compose a piece of prose (or poetry if they prefer!) from a hare's point of view, to encapsulate the family history of a snowshoe hare. Allow the pupils to anthropomorphise and tell dramatic tales of the fluctuating fortunes of the family history, to include suitable references e.g. to lynx numbers, predation, competition, food supply, disease. Read out some examples, or encourage the pupils to do so themselves. This activity could be started as a plenary and continued for homework. (10–15 mins)

Teaching suggestions
• **Special needs.** Provide differentiated worksheets to summarise the information and use templates and clue sheets for recording the adaptations.
• **Extension.** Some predators hunt at night and some during the day. Ask the pupils to research and discuss any differences between the adaptations of those that hunt at night and those that hunt during the daytime.
• **Learning styles.**
Visual: Observing PowerPoint presentations and viewing pictures of animals.
Intrapersonal: Writing a 'harey story' for the plenary.
• **Homework.** Pupils could continue with the plenary 'A harey story'. Ask the pupils to make the poster as described in the 'Predators and prey' activity.

Learning Outcomes
All pupils should be able to describe how predators are adapted to catch prey and how plants and prey avoid being eaten.
Most pupils should be able to describe how predators and prey affect each other.
Some pupils should also be able to explain the fluctuations in predator and prey populations.

Additional teachers notes
Equipment and materials required
Photographs of various animals.

Show a section of video, if available, of the inter-relationship of the populations of the arctic fox and the snowshoe hare.

Fusion 2: B2.9 – Habitats and Adaptations

National Curriculum Link up

•3.3a.

Learning Objectives

Pupils should learn:

That a habitat is the place where organisms live.

That animals and plants are adapted to live in a particular habitat.

Teaching / Learning activities

Lesson structure

Starter - Creature features

On the board, draw out a grid with five columns. Title the columns as follows: 'Name of organism', 'Food', 'Water', 'Shelter', 'Oxygen'. Ask the pupils to suggest the names of different organisms, ensuring that there is a variety of both plants and animals. Taking each suggested organism in turn, discuss where they get these necessities from and what feature they have that enables them to do so. Get the pupils to fill in the table accordingly. (10–15 mins)

Main –

Carry out the activity 'Adaptations for a habitat' as described in the pupil book. The finished results could be displayed around the room.

If the weather is clement and the facilities are available, an alternative activity would be to look at a habitat by carrying out fieldwork. The class teaching environment must be stable and positive to allow this type of work. For further details see B2.11 and B2.12 later.

Another alternative is to use the Internet, providing a series of questions relating to individual websites relating to a variety of habitats. The URLs for these can be hyperlinked from a page of text in a Word document on the school's intranet. Pupils could place their finished documents into a shared area for their peers to review.

Plenary - What we found

If the habitat investigation fieldwork option has been taken in the main lesson, groups can choose leaders to report back to the class on which organisms they found, what their adaptations for survival are and the physical features of the environment which make these a necessity. If the Internet trawl option is taken, pupils can view each other's work and collectively appraise it. (10–15 mins)

Teaching suggestions

• **Special needs.** You could use differentiated worksheets and have simplified practical expectations during the fieldwork.

• **Extension.** As an extension, some individuals may wish to investigate how the environmental conditions in a habitat have dictated the features of the organisms which live there. This could lead to a consideration of evolution and natural selection. An information file (either electronic or paper) and a list of pertinent open-ended questions will be of assistance here.

• **Learning styles.**

Visual: Identifying and linking organisms to habitats.

Auditory: Listening to the discussions and reports from other pupils and groups.

Kinaesthetic: Taking part in the fieldwork or compiling the master sheets.

Interpersonal: Working in groups on the activities.

Intrapersonal: Making a personal contribution to the group activity

• **Functional Skills - ICT Skills** Obtain, insert, size, crop, and position images that are fit for purpose (level 2).

Learning Outcomes

All pupils should be able to explain that different animals and plants live in different habitats.

Most pupils should be able to describe some adaptations of animals and plants to their habitats.

Some pupils should also be able to explain how specific adaptations enable organisms to survive.

Additional teachers notes

Equipment and materials required

It depends on the habitat, e.g. pond nets, dishes and specimen tubes for ponds.

Safety

Follow local guidelines and risk assessments for outside activities. CLEAPSS laboratory handbook/CDROM section 17.1.

Fusion 2: B2.10 – Habitats Changing

National Curriculum Link up
•3.3a.

Learning Objectives
Pupils should learn:
How habitats change daily.
How habitats change with the seasons.
The ways in which animals and plants cope with these changes.

Teaching / Learning activities
Lesson structure
Starter - Clothes for thought
Give the pupils pictures of a large range of different types of clothing, to include pyjamas and slippers, school uniform, casual wear such as jeans, beachwear and sunhats, high visibility jackets, woolly hats and scarves. You may choose to bring in examples. Ask the pupils to state which time of day or year the clothes are for and draw out what the daily and seasonal changes are. (10–15 mins)
Main -
Recap, the reasons for day and night and for the seasons, emphasising that the tilted angle of the Earth's spin is what is responsible for these. Relate it to the relative lengths of day and night time, the number of hours above the horizon, the elevation of the Sun in the sky and changes in the relative concentration of the rays. Ask the pupils, in pairs or small groups, to discuss and list the changes which take place every day and every year.
Show a video clip from the film *Ice Age* if available, where the animals are discussing, then setting off on the great migration. Discuss the reasons for migration and get the pupils, in small groups, to list as many animals as they can which migrate. Check their lists and provide a small motivational prize for the group which gets the most.
Show some video footage of animals hibernating, defining the word. Draw out through questioning what 'hibernation' means, why some animals do it and some examples. Pupils can then complete a concise worksheet summarising migration and hibernation.
Plenary - Mind map key words
Ask the pupils to make a mind map joining together the key words used in the lesson. Ask them to annotate the arrows so that they make complete sentences. (5–10 mins)

Teaching suggestions
• **Special needs.** Give the pupils a mind map of the key words, but give them all the key words in a box at the bottom of the map. Put in all the arrow link phrases for them and, if necessary, put in initial letters and correct numbers of spaces for the number of letters into the text boxes where the key words are to go. The colours of the empty boxes and their correct key words can also be correlated.
• **Extension.** As an extension to the day and night and seasons recap at the start of the lesson, higher-attaining pupils could envisage what dramatically changing the rate of, and angle of, the Earth's spin would have. Get the pupils to come up with some extreme scenarios and describe the consequences of them in terms of the effects of the changes and of how life would be constrained on such a planet.
• **Learning styles.**
Visual: Watching video clips and viewing slides.
Auditory: Listening to exposition on the reasons for the seasons and the tides.
Kinaesthetic: Constructing a mind map of the key words in the plenary.
Intrapersonal: Completing their worksheets on key words and definitions.
• **Homework.**
Ask pupils to choose one bird from a suggested list that migrates to the British Isles and to write a short account of its activities, entitled 'A year in the life of …'. For reference see RSPB or BTO websites and good bird identification guides.

Learning Outcomes
All pupils should be able to describe how habitats can change daily and with the seasons.
Most pupils should be able to describe ways in which animals and plants cope with daily and seasonal changes.
Some pupils should also be able to explain the adaptations of organisms to seasonal changes.

Additional teachers notes
Introduce the word 'nocturnal'. A short video clip or some stills of nocturnal creatures would be helpful. Ask the pupils to write a brief definition, with some examples, in their exercise books.

Fusion 2: B2.11 – Investigating a Habitat (1)

National Curriculum Link up
•3.3a.

Learning Objectives
Pupils should learn:
How to use keys to help identify living organisms.
How to collect animals and plants in a habitat.

Teaching / Learning activities
Lesson structure
Starter - Balls key
Show the pupils a slide with eight types of ball with different characteristics. Give one pupil a question-based key on a sheet of A4 and ask them to step outside the room, while the rest of the class choose a ball for them to identify. When the pupil returns, they must ask the series of questions, to which the class answers either 'Yes' or 'No'. The pupil should soon arrive at the type of ball chosen by the class. (10–15 mins)
Main -
Studying a habitat: Remind the pupils of the definition of a habitat and get them to give some examples. Take identification keys into the field for use there and prepare frameworks for recording the findings. Use graphs, tables, pie charts, and so on to present the findings. Get the pupils to explain how each organism is adapted to the place in which it is found. Further research on the organisms (what they eat, who eats them) could result in building up a food web for the habitat studied.
Plenary - The best bit for me
Discuss the findings of the investigation. Ask pupils if the sampling methods worked, whether they caught the organisms they expected and what were the advantages and disadvantages of the methods used. Encourage the pupils to share with each other what they found out and what they were enthused by or found stimulating. (10–15mins)

Teaching suggestions
• **Special needs.** Picture keys could be used for identification and pupils could be asked to look for specific organisms.
• **Extension.** Pupils could be asked how such an investigation could be made quantitative and could be introduced to the idea of random sampling techniques.
Give the pupils a selection of the plants in the habitat and ask them to devise a key to identify or separate them.
• **Learning styles.**
Visual: Identifying organisms using keys.
Auditory: Discussing the different techniques used.
Kinaesthetic: Carrying out the sampling methods.
Interpersonal: Collaborating in groups during the investigation.
Intrapersonal: Telling others what was the best bit for them.
• **Homework.**
Ask pupils to write a full description of one technique they used in the investigation of the habitat.

Learning Outcomes
All pupils should be able to identify a living organism using a simple key and to describe some ways in which organisms can be collected in a habitat.
Most pupils should be able to use equipment to collect and identify the organisms in a habitat.
Some pupils should also be able to use more complex keys to identify organisms and to select appropriate equipment for sampling specific habitats.
How Science Works
Describe an appropriate approach to answer a scientific question using sources of evidence and where appropriate, making relevant observations or measurements using appropriate apparatus (1.2a).

Additional teachers notes
Equipment and materials required pitfall traps, pooters, beakers of disinfectant and washing water, card or sheets for tree beating, sweep nets, plastic trays, hand lenses, beakers, Petri dishes, digital camera, identification guide books and laminated key cards appropriate to the area studied. Clipboards with writing frames for recording findings.
Safety. Risk assess any outdoor work. See CLEAPSS laboratory handbook/CDROM section 17.1. Caution regarding falling in or pushing in around ponds. Be aware of allergies to plants and of any toxic stinging species in the habitat. Wash hands after handling organisms and before eating. Make sure any cuts are covered by waterproof plasters. If using microscopes, beware of breaking slides.

Fusion 2: B2.12 – Investigating a Habitat (2)

National Curriculum Link up
•3.3a.

Learning Objectives
Pupils should learn:
That there are physical factors affecting the organisms in a habitat.
How to measure some of the physical factors in a habitat.
How to estimate the number of plants in a habitat.

Teaching / Learning activities
Lesson structure
Starter - It could be you!
Ask the pupils to think about the National Lottery. Imagine that the numbers, instead of being on balls, were written in large 1 × 1 m squares on the ground and that the person in charge of the lottery had to throw a series of bean bags to choose the numbers. Ask: 'Would this be fair? How could they cheat? How could you stop them cheating?' Relate this to the distribution of quadrats in a plant survey. (10–15 mins)
Main -
Put some quadrat frames around the room and discuss the need for random samples of plants in a habitat. Discuss methods of random sampling. Show students how to estimate percentage cover, as this is easier to assess than other ecological measures.
Choose a habitat to study and assign co-ordinates for each group of pupils. Collect the data. As a class, carry out the investigation and collect individual results. The physical factors can be measured by assigning one factor to each group of pupils e.g. air temperature, soil temperature, and light intensity. On return to the classroom, collect all the class data and calculate an average. From the average percentage cover per quadrat and the total area, calculate the total cover area.
Plenary - Results summary
Collectively pool results: ask each group of pupils to write a summary sentence. (5–10 mins)

Teaching suggestions
• **Special needs.** Give pupils a picture of the plant being investigated, so that they can help locate them in the quadrats.
• **Extension.** Introduce the pupils to the point frame for sampling vegetation and get them to work out what information it could provide about the nature of the vegetation in a habitat.
• **Learning styles.**
Auditory: Listening to discussions in starters and plenaries.
Kinaesthetic: Carrying out the practical investigation.
Interpersonal: Working in a group to do the sampling.
Intrapersonal: Writing description of random sampling for homework.
• **Homework.**
Each pupil could write a description of how to carry out random sampling, including an explanation of its importance.

Learning Outcomes
All pupils should be able to list the physical factors in a habitat and describe a random sampling technique.
Most pupils should be able to describe how some physical factors are measured.
Some pupils should also be able to explain how physical factors may affect the distribution of organisms.
How Science Works
Describe an appropriate approach to answer a scientific question using sources of evidence, and where appropriate, make relevant observations or measurements using appropriate apparatus (1.2a).

Additional teachers notes
Equipment and materials required
Quadrat frames, string to mark out area, pre-printed recording sheets, digital thermometers, light meter, plastic bag and trowel to collect soil samples, pH meters or universal indicator papers.
Safety
Usual risk assessments and precautions for outside work. See CLEAPSS laboratory handbook/CDROM section 17.1.