






Objectives

- B9.1** Describe the different levels of organisation from individual organisms, populations, communities, to the whole ecosystem.
- B9.3** Describe the importance of interdependence in a community.
- B9.6** Explain how to determine the number of organisms in a given area using raw data from field-work techniques, including quadrats.

Maths requirements

- 1c** Use ratios, fractions and percentages.
- 2c** Construct and interpret frequency tables and diagrams, bar charts and histograms.
- 2d** Understand the principles of sampling as applied to scientific data.

Learning outcomes

-  **SB9.1** State what is meant by the ecological terms community, population and habitat.
-  **SB9.1** Give examples of an ecosystem, a community, a population and a habitat.
-  **SB9.1** Describe the organisation of the components of an ecosystem (including populations, communities, habitats and abiotic factors).
-  **SB9.3** Describe how the interdependence of organisms in an ecosystem allows their survival.
-  **SB9.6** Explain how to estimate population size, including the use of quadrats.

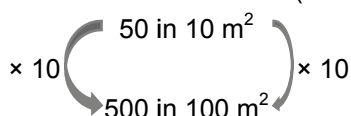
Before starting, consider using rapid-fire quick questions to check and secure basic knowledge and understanding from recent lessons (examples are given in the Quick Quiz below). The quiz can be done as a whole class and should take no more than a couple of minutes.

You can also ask students to complete the Progression questions at the top of the Progression Check sheet and to score their confidence levels. This gives students their own baseline with which to measure their own learning during the lesson.

The **ALDS** presentation *SB9a Ecosystems objectives* contains the Objectives, Learning outcomes and Progression questions and allows confidence levels to be monitored. The Quick Quiz is available as the **ALDS** presentation *SB9a Quick Quiz*.

Quick Quiz

- Which term describes organisms, such as plants or algae, that make their own food? (producers)
- Why can plants and algae make their own food? (cells contain chlorophyll/carry out photosynthesis)
- Which term describes organisms that get their food by eating other organisms? (consumers)
- Which term describes animals that eat plants or algae? (herbivores/primary consumers)
- Which term describes animals that kill and eat other animals? (predators/carnivores/secondary consumers)
- Name a type of diagram that shows the feeding relationships between organisms. (food chain/food web)
- Which scientific term means all the organisms and the environment they interact with? (ecosystem)
- Which scientific term means all individuals of the same species living in a particular area? (population)
- Which piece of equipment could be used to investigate the number of plants in an area? (quadrat)
- Fifty daisy plants have been found in a 10 m^2 sample of a 100 m^2 lawn. Estimate the total population of daisies in the lawn. ($50 \times 100 / 10 = 500$)



Starters

1. Building a food web

Ask students to name organisms that might be seen locally and write these on the board. You may need to prompt for plants such as grass or trees, or organisms that are not usually visible (such as those in the soil or in water). If needed, add familiar organisms such as blackbird, earthworm, rabbit, fox.

Students should work in pairs to arrange the organisms into a food web. Take examples of food chains in their webs, and expect students to justify their links.

2. Ecosystem concept map

Write the word ecosystem on the board. Ask students to work in pairs or small groups to construct a concept map on scrap paper around the word. They should discuss suitable words and agree how best to link them. (If needed, suggest some suitable words, such as: food chain, food web, population, producer, consumer, environment, light, water.) When pairs have at least six linked words, they should compare their map with a neighbouring group's map and justify what they've added. Students should keep their concept maps for adding to at the end of the lesson.

Equipment

scrap paper

Exploring

1. Estimating population size

Worksheet SB9a.1 provides work on estimating population size. Students may have carried out this kind of investigation in Key Stage 3, in which case this will provide revision. If not, consider carrying out the methods that students come up with in question 1 as fieldwork, if there is time and the opportunity.

To complete the sampling question on the sheet, students will need a method of randomly generating whole numbers from 0 to 9. This can be done, for example, using a 10-sided die (recording 0 every time a 10 is rolled) or a random number app. Discuss with students how they should use each pair of numbers to place the quadrat, for example, the first number should be read on the horizontal scale, and the second number on the vertical scale. To help answer question 4 about random sampling, ask students which squares on the field grid they would choose to sample and why. Discuss the impact of choosing 'interesting' areas for sampling, or areas that might be easier to get to.

If students are well experienced with the counting method used in the worksheet, ask students how the method could be adapted for species where it is difficult to identify separate individuals (e.g. grass plants) or for comparing the importance of different species in an area (as some plants have much larger leaves than others). In this case, the percentage cover of a quadrat by the species is measured. Examples of the use of this method can be found on the Internet.

Support: Students may need help working out how to use pairs of random numbers to identify the correct squares to sample. They may also need support when carrying out the calculation in question 5c.

Stretch: The Extra challenge question at the bottom of the sheet will help students evaluate their results. For part b, if students are unsure how to test the statement, hint at the answer by asking them how much variation in estimates they would expect if they calculated from only one square/sample each time.

Safety

If fieldwork is carried out, carry out a full risk assessment of the area where sampling will take place and make sure students are fully aware of safety issues and how to tackle them.

Course resources

AAP: Worksheet SB9a.1

Equipment

method for generating random whole numbers between 0 and 9, e.g. 10-sided die or a random number app, calculator

Optional for fieldwork: quadrat, plant identification guide, ruler

2. Ecosystem research

Students should work in pairs or small groups to carry out research on a specific ecosystem. Either provide examples of ecosystems on the board for students to select from or check that students have chosen something reasonable before they start. Suitable examples include: a coral reef, a rainforest, a desert, African savannah, polar ocean. Students should identify organisms in the ecosystem and then show how they are grouped into populations and communities. From these they should create a food web to identify feeding relationships. Results could be displayed on a poster or in a presentation.

Skills Sheets RC3 and RC4 could support this task.

Support: Give students a familiar ecosystem (e.g. UK farmland or garden) and the names of a selection of organisms in it to get started.

Stretch: Students should choose an ecosystem with a challenging 'storyline', such as coral reefs that are dying or rainforest that is being replaced with palm oil plantations. Students can then focus on the impact of ecosystem-level destruction and the importance of interdependence.

Course resources

AAP: Optional: Skills Sheets RC3 and RC4

Equipment

access to the Internet

Explaining**1. Student Book SB9a Ecosystems**

Work through the Student Book pages, answering the questions up to the checkpoint.

Students should be familiar with food webs and categories of feeding from Key Stage 3. These can be simply revised using examples from the food web in diagram D.

Students may need practice in defining the terms ecosystem, habitat, community and population, because these are often used incorrectly in non-scientific text.

The Core Practical statement in the GCSE specification includes the use of quadrats to measure abundance, and the use of quadrats along transects to measure the effect of the environment on distribution. Exploring 1 provides practice on estimating abundance. The belt transect work is covered on *SB9c Abiotic factors and communities* in the Student Book.

The **ALDS** presentation *SB9a Ecological terms* covers ecological definitions in a visual way.

Support: Work with students to answer the questions.

Stretch: Students could write dictionary definitions for each bold word on the Student Book pages for the topic.

Course resources

ALDS: Presentation *SB9a Ecological terms*

SB: *SB9a Ecosystems*

2. What might happen if ...?

Display a food web on the board. Suitable examples can be found on the Internet. If possible, use an example where a change to the community has been made or is being considered, for example introducing a non-indigenous species or reintroducing a species (such as wolves in the Scottish Highlands or beavers in Devon).

Use the food web to ask questions of the form 'What might/will happen if ...' to identify how changes will impact on other populations in the community. For example, what might happen to the population size of deer if wolves

are reintroduced to the area? Encourage students to explain their answers and to take each answer a step further by considering what effect the change to the population size of deer (or equivalent) will have on a different population. Use the answers to get across the idea of interdependence in an ecosystem and its importance in a food web. Note that this prepares for some of the work on biotic factors in topic *SB9d Biotic factors and communities* and the impact of non-indigenous species in *SB9g Biodiversity and humans*.

Support: Only ask questions that consider species that directly affect each other (e.g. a predator and one species of prey).

Stretch: Students could think up their own questions using the food web and test each other. Take examples from around the class to find really challenging examples of interactions.

Equipment

food web from the Internet, such as where a non-indigenous species has been introduced to the community or there is suggestion of reintroducing a species

Checkpoint

Ask students to complete the Assessment and Feedback sections of the Progression Check sheet for this topic. Or revisit the Progression questions on *SB9a Ecosystems* in the Student Book and assess whether students feel more confident about answering them. Less confident students should use the 'Strengthen' activity. Students who demonstrate good understanding should move on to the 'Extend' activity.

Strengthen

Ask students to work in pairs or small groups to answer question S1 in the Student Book and/or the questions on Worksheet SB9a.2. Question 1 on the worksheet provides scaffolding for answering question S1. The remaining questions on the worksheet cover other objectives for this topic. Students should compare their completed answers with another pair or group, to check for any errors.

As an alternative or extension, students could add to the concept maps that they produced in Starter 2, using what they have learned in the lesson. They should compare their additions with other students to make sure they have included all the key points.

Course resources

AAP: Worksheet SB9a.2

SB: *SB9a Ecosystems*

Equipment

calculator

Extend

Ask students to work in pairs to discuss question E1 in the Student Book. If needed, hint at what the diagram does not include, or suggest other species that are not included, such as pond skaters, midge larvae or water lilies. They will need to consider how other species might fit in the food web, and how they are affected by pond snails, either directly or indirectly. They should compare their answer with another pair, to identify any similarities and differences in their explanations.

Course resources

SB: *SB9a Ecosystems*

Reflect

Ask students to answer the exam-style question at the end of *SB9a Ecosystems* in the Student Book. Encourage students to think about what each mark is for before constructing an answer. You could point out that the question requires a description, not an explanation, so no reason is needed in the answer.

Homework

Homework 1

Worksheet SB9a.3 is suitable for homework and contains straightforward questions about this topic. Question 3 is a calculation, which some students might find challenging.

Support: Check that students understand the questions before completing the sheet.

Course resources

AAP: Worksheet SB9a.3

Equipment

calculator

Homework 2

Worksheet SB9a.4 is suitable for homework and contains more challenging questions about this topic.

Stretch: Students complete the Extra challenge question at the end of the sheet.

Course resources

AAP: Worksheet SB9a.4

Equipment

calculator