London Gifted & Talented

Teachers' Guide

Interdependence

Interdependence is a key idea in science. As students learn about science, they begin to understand that the Earth is not a group of discrete parts but a continuous environment, existing over time as well as place. The idea of interdependence in and between biological and physical environments is fundamental. Interdependence focuses on the adaptation of living organisms to their environment, their modes of feeding and how feeding relationships between living organisms in an environment involve energy transfers that ultimately affect their survival.

This learning pathway is made up of two learning routes and students consider one big question in each route.

Learning Route 1: Adaptation

How is it that living organisms are so well adapted to survive and reproduce in their natural environments?

Learning Route 2: Energy Transfer

How do living organisms in an environment depend on one another to survive and why is energy transfer so important?

The two routes are complementary, and if both are covered, this material contributes to the following aspects of the yearly teaching objectives in the KS3 Framework for teaching science:

Interdependence

- Explain that energy is transferred between organisms in food chains and webs.
- Describe relationships of organisms in a food web and use this to explain: why photosynthesis is important to humans, how pyramids of numbers represent feeding relationships in a habitat.
- Begin to describe a model for the whole environment that recognises how the materials that make up all living organisms are recycled, and that energy from sunlight flows through the system.

Energy

- Use a simple model of energy transfer to explain that the Sun is the ultimate source of energy, the transfer stages in a range of living systems.

Cells

- Explain that cells obtain energy through respiration (this aspect provides a direct link to ideas explored in the Deep Cells website).

Each of the two learning routes is divided into three parts: **Starter**, **Main** and **Plenary** sessions. The time taken to complete each of these is up to you, but suggested guidance times are given later in the notes. Minimum guidance times are suggested in the Overview but we do stress that these are only suggestions.

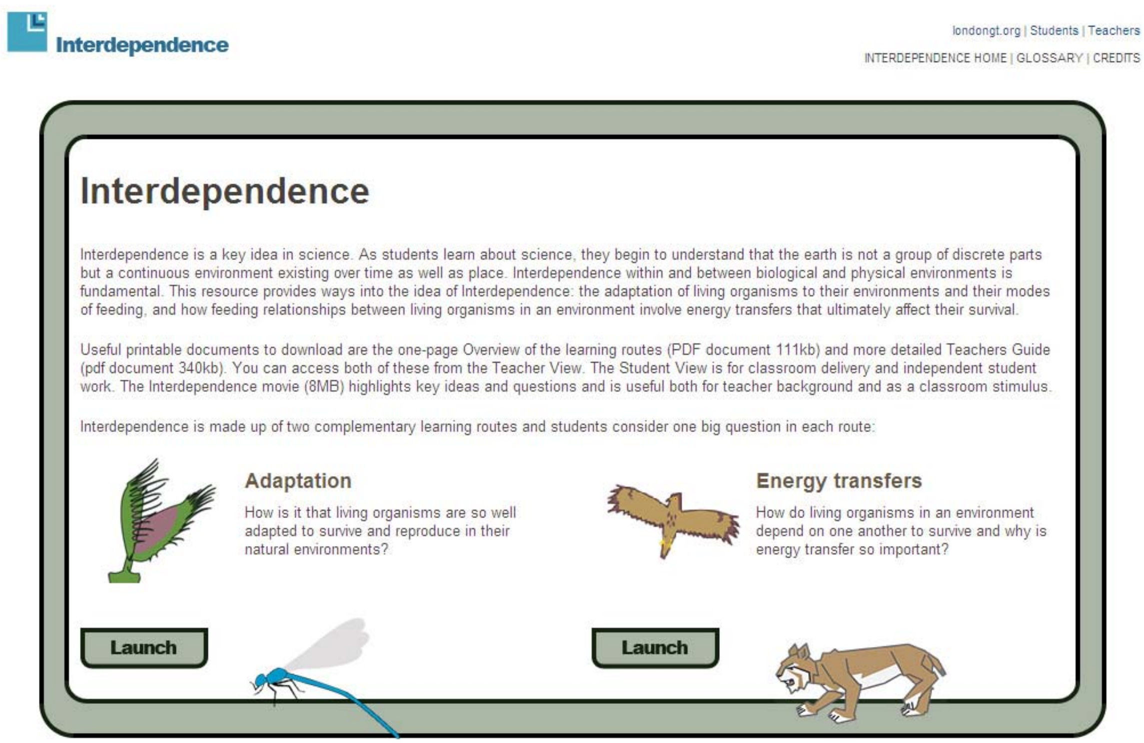
Starter session (teacher-mediated)
Introduces the objectives and learning outcomes and engages students with initial material to stimulate discussion and speculation around the big question for the activity.

Main session (assignment-based, independent working)
Involves the students working independently or in small groups to research, evaluate and present information that supports a point of view or an interpretation of the question.

Plenary session (teacher-mediated)
Brings the students back together to share and discuss what they have learned, and to apply the learning to a different context.

How the site is organized

The Interdependence Home page is the first page you come to; both the Adaptation and Energy Transfer learning routes are reached from here. The Interdependence Home page is linked to from the top right-hand corner of every page.

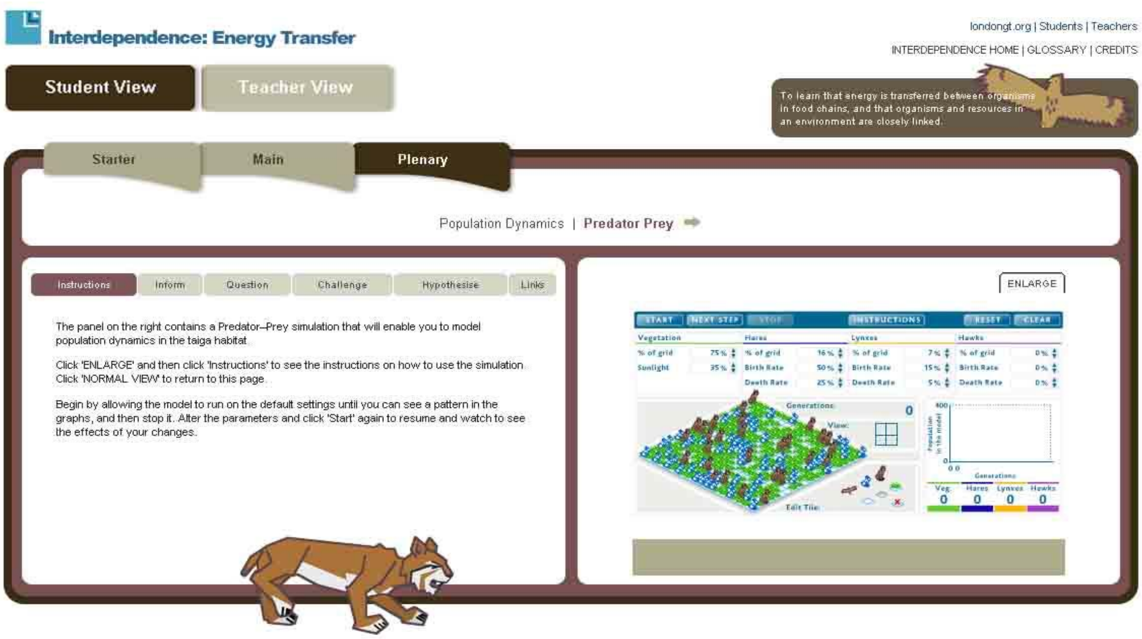


The organisation of the site mirrors the **Starter**, **Main** and **Plenary** teaching structure for both the Adaptation and Energy Transfer learning routes.

The site has two ‘views’: the **Student View** and the **Teacher View**. These can both be accessed from each Starter, Main and Plenary screen.

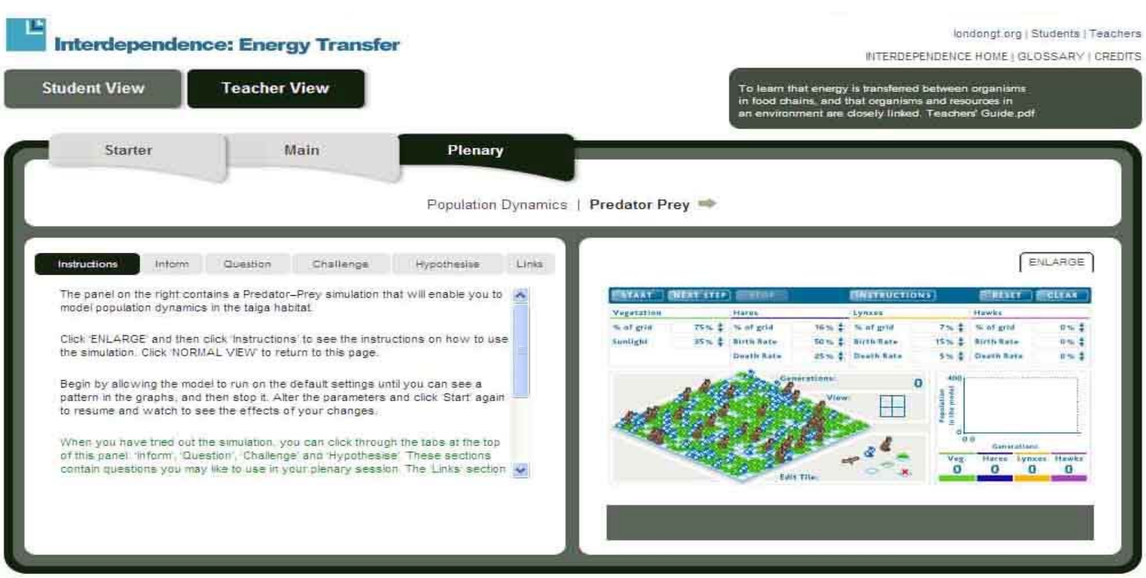
Student View

The Student View is used for classroom delivery and is the only view that students need to see.



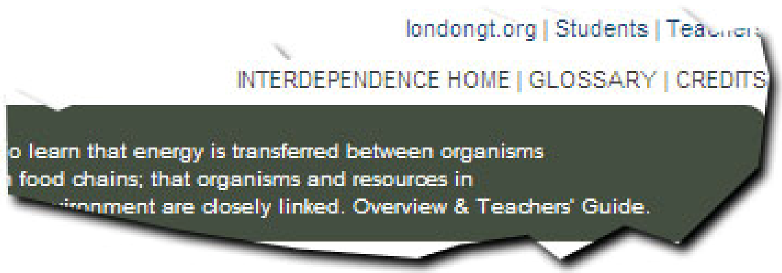
Teacher View

The Teacher View is identical to the Student View but with additional resources for the teacher.

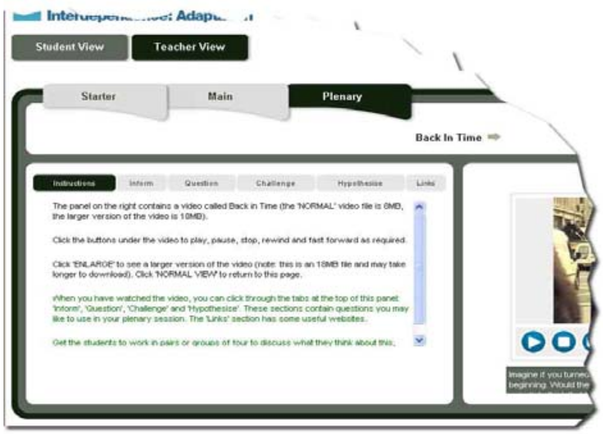


Within the Teacher View, the additional resources for the teacher come in three forms:

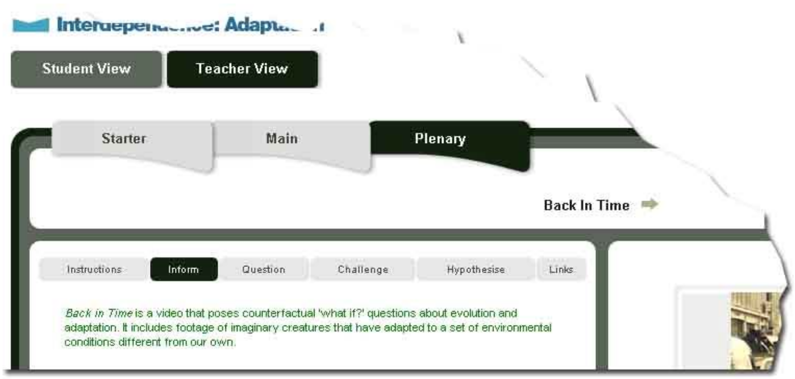
1. The Teachers' Guide (this document) and the one-page Overview document are accessible from every screen. They can be reached from the 'Aims and objectives' box at the top right of the screen.



2. Where relevant, 'Additional teacher's notes' are given in green below the main text. (NB: not every screen in the Teacher View contains 'Additional teacher's notes'.)



3. There are questions to help guide discussions in the teacher-mediated Plenary sessions – these appear in both the Student AND Teacher Views.



How the pages are structured

Students investigate and explore the science through a series of activities with visual images and animations, which are always on the right-hand side of the screen. The visuals range from still images, such as the portrait of Charles Darwin, to interactive games to engage students in topics such as food webs and ecological pyramids. There are also narrated videos to stimulate discussion, such as *Back in Time*, and more complex interactive simulations such as Energy Optimisation and Predator-Prey that enable students to model 'what if?' scenarios.

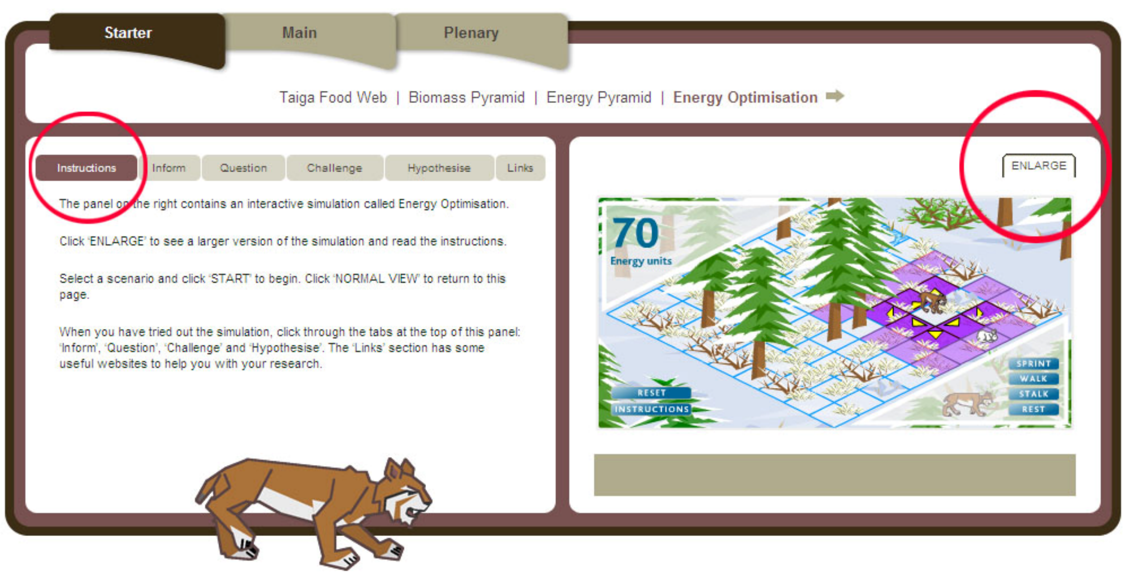
The visuals can be viewed in 'Normal' mode, with the text information on the left, or in 'Enlarge' mode, where the visual fills the screen. 'Enlarge' mode is useful for classroom delivery.

The text box on the left of the screen has up to six buttons.

The 'Instructions' button gives information on how to use the visuals on the right-hand side.

The 'Inform', 'Question', 'Challenge' and 'Hypothesise' buttons take the user to content and resources organised such that, as the student progresses through the activities and questions their knowledge and understanding of the issues increase. The questions become progressively more complex and present higher challenge as the students move from left to right.

The 'Links' button (far right) connects to useful resources on the internet. Web pages will open in the *same* browser window as the Interdependence site, so use the browser 'Back' button to return to Interdependence. If you close the browser window this will also close Interdependence.



How to use the resource in the classroom

The resource is extremely flexible and you will decide how best to use it with your own students. You may wish to use all or some of the material with a separate group of gifted and talented students, or within a whole-class setting, as it contains differentiated extension activities for some students.

You could use this resource on an interactive whiteboard (IWB). This allows the information, videos and animations to be presented in an exciting and engaging way and creates more motivating outcomes. Interactive whiteboards also encourage collective engagement with learning problems at greater depth and demonstrate a more creative approach to learning. They also incorporate a variety of teaching techniques that support a range of preferred learning styles. Effective use of IWBs can also encourage visual, auditory and kinaesthetic learning.

The IWB enables you to demonstrate scientific models on a large scale and to work at an appropriate pace that ensures students are constantly engaged. It also allows you to receive immediate feedback on the activity. The content in Interdependence encourages creative risk-taking in teaching, and learning through the 'what if?' concept – you will find that your more able students are particularly engaged and challenged by this type of learning.

English as an Additional Language (EAL)

This resource can also be an effective learning tool for your EAL students, but you will need to give additional support to them. EAL students need opportunities to develop proficiency in using the complex conventions and language of science in order to progress. This resource will support them in their visualisations of key scientific ideas by using models such as interactive visuals and physical simulations that are clearly explained. It will help these students to develop key scientific ideas, interpret evidence and draw conclusions. It will also encourage them to apply key scientific ideas within a range of scientific enquiries. Where there are visuals with narrative, transcripts are provided (e.g. for the *Back in Time* video in Adaptation and the conservation-based assignment in Energy Transfer).

There is also a Glossary of definitions that will help all students, including EAL students, to improve their scientific literacy.

Both learning routes in Interdependence encourage collaborative working during research tasks. EAL students will benefit from working with other students and will especially gain scientific insight when students share their ideas with the rest of the class during the Plenary session.

Useful links for further information on EAL:
Teaching pupils for whom English is an additional language (DfES The Standards Site)
http://www.standards.dfes.gov.uk/keystage3/respub/sc_eal

Cross-curricular links

The learning objectives of this resource are taken from KS3 Science. There is, however, a distinct cross over with other subjects, notably English and Maths. Some additional objectives covered within this resource include:

English

- how to research and study,
- how to persuade, argue and present constructive points of view in writing.

Maths

- how to identify the necessary information to solve a problem; represent problems and interpret solutions in algebraic, geometric or graphical form,
- how to communicate interpretations and results of a statistical enquiry using selected tables, graphs and diagrams in support,
- how to understand probability.

Overview of Learning Routes

Learning Route 1: Adaptation

Aims and objectives

To learn that adaptations allow organisms to survive and reproduce in their natural environments.

Learning outcomes

To be able to:

- describe some examples of how organisms are adapted to their environment,
- explain why organisms succeed best in their own natural environments,
- explain how the theory of evolution by natural selection provides a model to describe how adaptation takes place.

Starter session (timing: minimum 15 minutes; suggested 30 minutes)

Using a 3-D animation of a Venus flytrap, the teacher poses the question 'How does adaptation enable living organisms to survive and reproduce in their natural environments?' and generates an initial discussion with and between students.

Main session (timing: minimum 50 minutes' research, 50 minutes' preparation)

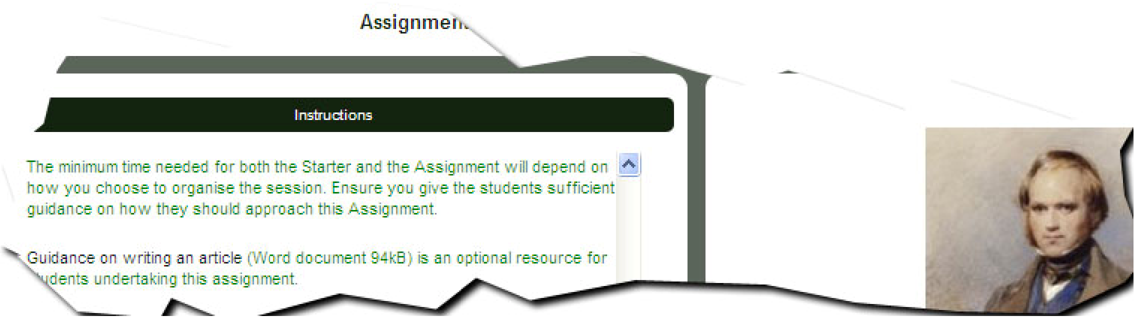
Individuals or groups of students are tasked with researching and writing a science article to convince the general reader that organisms are adapted to their natural environment and that the theory of evolution by natural selection is a model that can explain how this occurs. Material on the site includes: Darwin, the voyage of the Beagle, Galapagos tortoises and finches and Richard Dawkins' 'Weasel' simulation, with information, structured questions and internet links to support their research. Exact timing will depend on how you choose to organise this session – below are three possible examples.

Example 1 (2 hours)
Introduction to assignment and research using the Student View (60 minutes); preparation of the article (60 minutes).

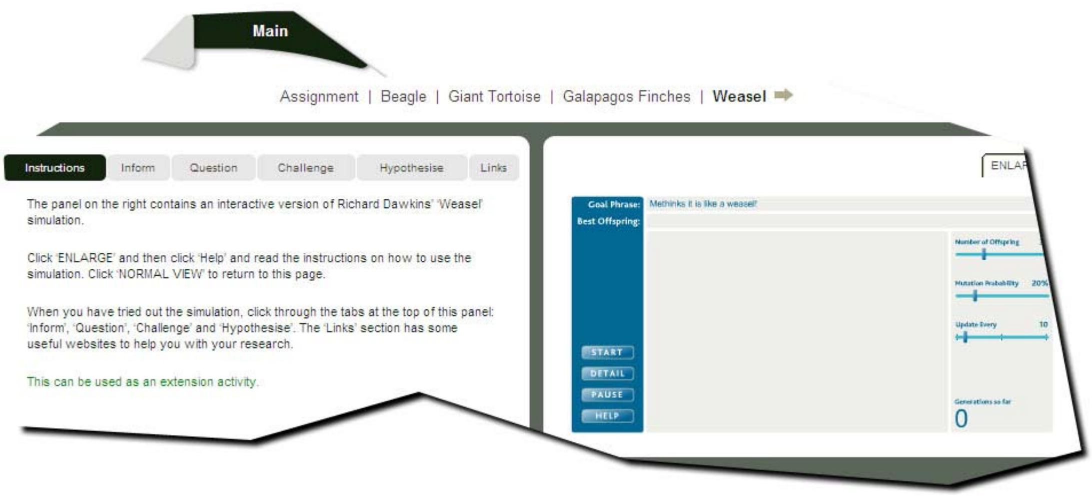
Example 2 (2 hours, 50 minutes)
Introduction to the assignment including extended literacy input (resources available from DfES KS3 Strategy website) about the writing style to be used (50 minutes); research using the Student View (60 minutes); preparation of the article (60 minutes).

Example 3 (3 hours, 15 minutes)
Introduction to the assignment (15 minutes); extended research using the Student View and its additional activities (120 minutes, of which some may be homework); preparation of the article (60 minutes).

You will need to ensure that you have given students sufficient support on how to approach this activity. Included in the Teacher View of Adaptation in the Main session is Guidance on writing an article (PDF), as shown below.



An optional extension activity for this session is ‘Weasel’, a mathematical model devised by Richard Dawkins to demonstrate how the imposing of simple rules can seem to produce order from chaos.



Plenary session (timing: minimum 50 minutes, including presentations; suggested 50 extra minutes if using ‘Weasel’ extension activity.)

The teacher brings the students together to share the outcomes of their research. Following a short movie showing an evolutionary time-travel journey, a quote from Stephen Jay Gould is used to stimulate the students to use what they’ve learnt about adaptation in a new context.

Learning Route 2: Energy Transfer

Aims and objectives

To learn that energy is transferred between organisms in food chains; that organisms and resources in an environment are closely linked.

Learning outcomes

To be able to:

- describe how energy from sunlight is transferred through an environment,
- explain how the abundance and distribution of organisms relate to the resources available within the environment.

Starter session (timing: minimum 50 minutes; suggested 50 extra minutes if you wish to give more time to ecological pyramids)

There are four linked stimulus activities, intended to be teacher-mediated, to encourage discussion and questioning:

- an interactive model of a taiga food web,
- a pyramid of biomass,
- a pyramid of energy,
- Energy Optimisation – a simulation game that models the feeding relationship between the lynx and snowshoe hare in terms of energy efficiency of the predator.

Main session (timing: minimum 50 minutes' research, 50 minutes' presentation)

Individuals or groups of students are given the 'in role' task of presenting a case to manage the conservation of animal populations in a habitat. Materials on the site include an interactive case study, information, structured questions and internet links to support their research.

For suggested extended timings see Adaptation above.

Plenary session (timing: minimum 50 minutes; suggested 50 extra minutes if you wish to give more time to the Predator-Prey simulation)

The teacher brings the students back together to share the outcomes of their research. Using an interactive population graph, s/he guides the students as they use what they have learned to make hypotheses about how changing environmental and biological factors will affect the shape of the graph. These hypotheses can then be tested using Predator-Prey, an interactive 'Game of Life' simulation that models interdependent animal populations. Questions that may be used as stimulus for discussion will be found in 'Additional teacher's notes'.

Technical Requirements

To run the KS3 Interdependence, you will need *as a minimum*:

- Flash Player 8,
- Internet Explorer 6 or Firefox 1.0,
- RAM 128Mb,
- CPU 800MHz,
- Adobe Acrobat Reader,
- Microsoft Word.