



DARWIN
INSPIRED
LEARNING

Enquire with
Darwin

KS2

Module 3: Struggle for Life

Lesson plan

Survival is a constantly shifting struggle

Darwin saw the struggle for existence as ruthless, universal and ceaselessly shifting. We need to recognise this complexity and use the special ways Darwin found to detect and demonstrate what is happening.

He wanted to understand how natural selection worked to drive evolution through the life cycles of every organism. Changes take place from day to night, from season to season, through the stages of each life cycle. Various forces intrude at different times for each organism. If we observe individual species of birds or insects, we may not realise the complex struggle for existence that surrounds us. Weeds are the plants with which children are familiar, even in urban environments – dandelion seeds are blown away, cleavers stick to jackets. Darwin's weed plot experiment makes the ordinary seem extraordinary by bringing alive the everyday dramas of our pavements, walls and back gardens. A patch of common plants becomes a miniature jungle where the struggle to survive is paramount, and competition rife.

Quotation

'With plants there is a vast destruction of seeds, but, from some observations which I have made, I believe that it is the seedlings which suffer most from germinating in ground already thickly stocked with other plants. Seedlings, also, are destroyed in vast numbers by various enemies.'

Charles Darwin, *On the Origin of Species*, 1859.



Above: Close up of ice crystals on leaves.

Below: Weeds in a lawn.

Lesson outcomes

- Exploring how Darwin worked and using his ways of scientific enquiry.
- Working locally with living organisms in their habitats.
- Asking questions that can be answered by observing and recording evidence.
- Working independently and in groups to show the evidence collected.

Curriculum links

- To make links between life processes of familiar animals and plants and the environments in which they are found.
- Different plants and animals are found in different habitats.
- Food chains and food webs.
- Living things and their habitats need protection.

Key words

Weeds, competition, life cycle, food chain, food web, tap root, seed, seedling, soil, predator, experiment, evidence.

Resources

Hand lenses, clipboards, Field Studies Council (FSC) fold-out identification guide to playing-field plants; Darwin notebooks, stiff-card mini-quadrats (See Notes for teachers page 12), pencils, coloured crayons and digital cameras.



A blue butterfly on marjoram; both are chalk grassland species.

Lesson sequence

Pre-visit lesson

Starter activity

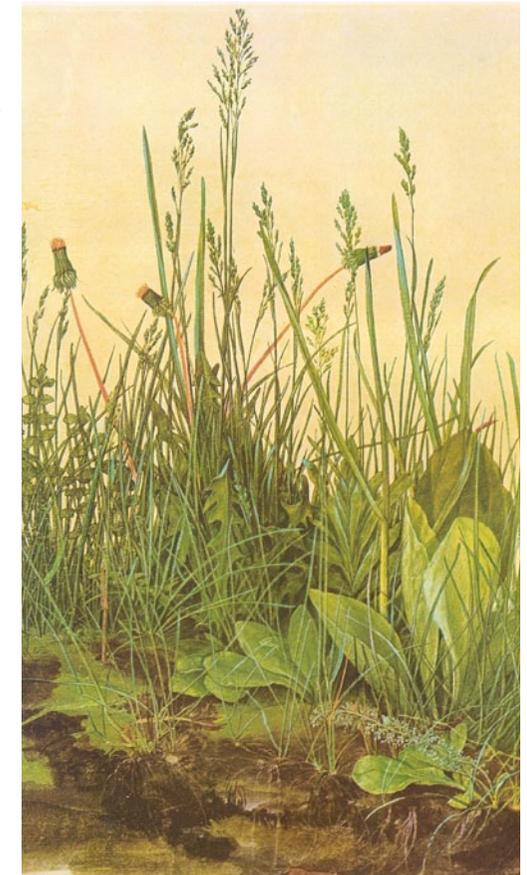
Use the whiteboard display showing Darwin's quotation (PowerPoint slide 3). Drawing on Darwin's words, prompt thinking by the whole class about a plant's life as a seedling. What challenges do other plants force on you? Who are your 'enemies'? Create a mind-map on the whiteboard and save for reference.

Main activities

The Great Turf

Show slide 2 of Albrecht Dürer's 1503 watercolour painting *The Great Turf* (Das große Rasenstück). Encourage pupils to come to the whiteboard and spend time observing the painting closely.

Remind pupils that Darwin wrote down his ideas and questions in a specific notebook so that he could return to it with further evidence at a later date. In their Darwin notebooks, pupils sketch and describe one plant they recognise in the picture and name it if possible. Where have they seen this plant before?



The Great Turf by Albrecht Dürer.

Pre-visit lesson

Introduce Charles Darwin; a scientist interested in how plants and animals compete with each other to survive. In January 1857 he started a weed plot experiment (see slides 4 and 5). He began by clearing a patch of poor soil of the weeds he could see and put up a small fence to protect it from 'large animals'. Then he waited and watched for seedlings to appear. The first appeared in March.

Working in pairs, pupils Think like Darwin (Resource materials page 15) and record their ideas as they discuss the reasons why Darwin:

- went to the weed garden experiment every day.
- marked each seedling with a wire.

Plenary

Collect the Think like Darwin work. Pick a selection and ask pairs to share their ideas with the class. Encourage pupils to build their arguments and use evidence. Ask the rest of the class if they agree with these ideas and give evidence for any arguments they oppose. Explain that Darwin worked in a similar way; he exchanged ideas, by letter with many people around the world with an interest in natural history, until he could develop his arguments for his big ideas on competition and the struggle for life.

As preparation for outdoor lessons/visit, remind pupils that Darwin spent many hours observing the natural world. Ask them to look at their notes and Think like Darwin work to find one question they would like to answer on their visit. The Think like Darwin work can be displayed in the classroom for reference in the post-visit lesson.



Above: Darwin's weed plot experiment at Down House.

Below: Daisies in a lawn.

Extension activities

- This lesson can be extended by challenging Darwin's conclusion in *On the Origin of Species* that 'the strong growth of young plants produced from such seeds, as peas and beans, when sown in the midst of long grass, it may be suspected that the chief use of the nutriment in the seed is to favour the growth of the seedlings, whilst struggling with other plants growing vigorously all around'. Pupils can design an experiment to test the conclusion. What resources are needed? What data would they need and how would they record it? They could try the experiment with broad bean or pea seeds sown in October.
- Darwin continued to do experiments around his garden exploring the idea of competition between plants. Show slide 6 which is a quotation from a letter he wrote in 1857 to Joseph Hooker, Director of Kew Gardens, discussing one of his experiments, and then slide 7 and consider which 'forces' are at play here.
- For those who find reading or focusing on a written task a challenge, the Darwin weed experiment (slide 9) can be used to prompt science talk, either peer to peer or between a learning support assistant and pupil. Thoughts can be added to the margins around the picture on a whiteboard as further support to 'think like Darwin'.



Broad bean seedling emerging.

Visit

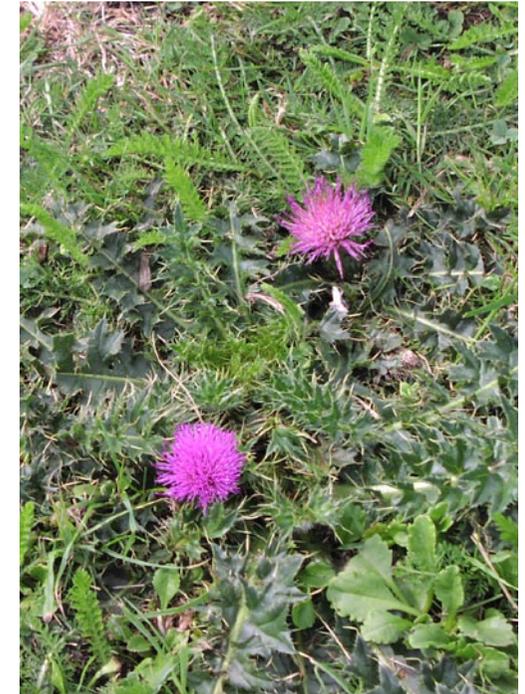
Visit a local park, garden or nature reserve at any time of year but the greatest diversity of organisms is most likely between April and July.

Each pupil needs a stiff-card mini-quadrat (see Notes for teachers page 12), the My square of turf (Resource materials page 16), a clipboard to rest it on, a hand lens, pencil and coloured crayons.

Working within a set area of a quadrat helps scientists to study a comparable area in a range of habitats where different plant types are found. Darwin was one of the first scientists to use such a tool when he fenced off a quadrat for his weed experiment. Pupils will be using a miniature, portable version to help them focus on the different plants they see on the visit.

Pupils work independently and draw what they see in their square. They make notes and record their questions around the square.

- Check they are using their hand lenses correctly.
- Encourage them to think about why a plant might have a certain leaf shape or type of seed.
- Does the shape of its leaves help the plant to survive trampling?
- Do they prevent light reaching the leaves of other plants?
- Are wind-borne seeds successful in arriving at a suitable site to germinate, grow and produce new seed?
- What evidence of competition between plants can they see?
- Are there any signs of leaves being eaten?
- Do the plants show any means of defending themselves from attack?



Thistle in a lawn.

Post-visit lesson

Main activity

Working in groups, pupils display and share their drawings and questions. Support them, with Question stem cards (Resource materials page 17), to choose one question they would like to put to the rest of the class.

Record each group's 'big question' on the whiteboard.

Working as a whole class, ask pupils to contribute ideas about how Darwin might answer such questions.

Plenary

Encourage pupils to draw on their experiences in the earlier lesson and from the evidence they found working outdoors. Using the literacy link on slide 6, they write a letter to Joseph Hooker, as Darwin might have, about what they saw in their 'quadrat' of turf. They tell him how they plan to answer the questions they still have, by designing an experiment. Describe this experiment and if it is one that needs attention every day, they say how they can make sure that data is recorded daily.

Assessment of progression

Take in the letters to Hooker. Determine progression in terms of KS2 criteria but also use the Darwin Inspired Learning development criteria (see KS2 Introduction).



Cranesbill seed.

Notes for teachers

Pre-visit lesson

As preparations for these activities, pupils should have a basic understanding of a plant life cycle and the impact of herbivores on plants.

Main activities

Albrecht Dürer's watercolour painting *The Great Turf*, painted in 1503, contains many recognisable plants. The three plants the pupils will be most familiar with are probably daisy, dandelion and greater plantain. If children are struggling to choose a plant and think about where they have seen one locally, you might like to highlight these plants to encourage engagement. *The Great Turf* activity could also be used as a cross-curricular link to literacy work.

Darwin wanted to know what life was like for a seedling plant. He carried out his weed plot experiment at Down House from January to August 1857 whilst investigating the struggle for existence relevant to his theory of evolution by natural selection which appeared in *On the Origin of Species* (1859). Darwin isolated a group of plants at the seedling stage, free from the pressure of crowding by other plants but still subject to the cumulative effects of other destructive forces. He identified or guessed these forces, for example, insects, slugs, worms, rain and drought, and noted them. Then he observed how many plants were destroyed and looked at each destructive force equally.



Above: Darwin's weed plot experiment recreated at Down House.

Below: Banded snail.

Pre-visit lesson

- Darwin cleared a patch of poor soil of all perennial weeds in January (we think he meant both above and below ground). He erected a barrier to protect it from 'large animals'. Then he watched for seedlings to emerge.
- Seedlings began to appear in early March. He visited the plot daily and marked each seedling with a wire. He noted activities by slugs, worms and insects, and weather conditions, for example, heavy rain or drought that might explain loss or survival of seedlings.
- Every day Darwin counted the wires without a seedling because those seedlings he had marked had been destroyed. On 31st March, 10th April, 20th April, 8th May, 1st June, 1st July and 1st August, he recorded the total number of seedlings that emerged and the total destroyed, and removed all wires.
- 357 seedlings emerged but only 17% survived until August.

The number of seedlings that emerged was almost certainly influenced by the site (previously a shrubbery, then strawberry patch) and Darwin's breaking up the soil (bringing previously deeply buried weed seeds to the surface, increasing their likelihood of germination). Survival rates vary for different plants, and may relate in part to whether they are annual/perennial, shallow/deep-rooted, their life cycles and associated pests.



Above: Plantain in a lawn.

Below: Poppies at a field's edge.

Pre-visit lesson

Common Weed Characteristics

Physical characteristic

Deep, brittle tap root quick to regenerate from broken parts

Several seed distribution or reproduction strategies such as fast germination and/ or long dormancy/ dry and wet dispersal mechanism

Structural flexibility

Fast life cycle

Example weeds

Dandelion; Bindweed

Groundsel,
Poppy (see page 9)

Greater Plaintain (see page 9),
Cleavers

Thale Cress



Pre-visit lesson

Extension

One potential practical experiment that Darwin did not use is a wild oat seed - a virulent weed well adapted to competition in wheat fields. The experiment uses simple equipment and demonstrates a variety of physical adaptations to compete in a crowded field. Details of the experiment and information on obtaining the seeds can be retrieved from <http://www.saps.org.uk/secondary/beyond-the-classroom/294-wild-oats-on-the-move> (please dispose of the seed used very carefully because wild oat is a virulent weed).

Darwin's experiments are perfectly possible to design, and encourage planning and long-term recording of data. Pupils could try the experiment to challenge Darwin's conclusion regarding size of seed and their competitiveness by sowing broad bean seeds and a smaller seeded pea in October. Grow a control container of seeds planted at the same time. If there is space in the school grounds, try repeating Darwin's weed plot experiment, and document daily using digital cameras. Images used as a series of dissolving slides demonstrate change over time and the impact of competition among the plants. The data collected can be used in maths lessons.

Discuss those things which influence what grows in this small space, including soil fertility, light, shade, rainfall, temperature, insects, animals and even the seeds which have been in the soil for many years.



Above: Wild oats.

Below: Pea seedlings.

Visit

Risk Assessment needed. If this activity is done in a local park, additional adult support may be needed.

If you have green spaces in your school grounds, this activity can take place in school, but a dog-free area in a local park or garden will be fine. It is advisable to make a preliminary visit prior to the lesson.

Provide each pupil with a mini-quadrat made from a 20cm-sided square of stiff card with a 15cm-sided square cut out of the centre. Laminate for robustness. Pupils then use My square of turf (Resource materials page 16) to record what they see in the square. A clipboard to rest the sheet on, a pencil and colour crayons and a hand lens will be helpful. Digital photographs of each area will be useful.

Post-visit lesson

Some pupils may need Question stem cards (Resource materials page 17) to help them think about their 'big questions'. Display all the completed My square of turf work.

Plenary

The letter to Hooker should be from 'Charles Darwin' but word processed, and the writer can choose a special font as part of the activity.



Weeds in a lawn

**Website links, videos,
Interactives, references**

Dandelion seed video

<http://www.arkive.org/common-dandelion/taraxacum-officinale-agg/video-09.html>

Acorn video

<http://www.arkive.org/sessile-oak/quercus-petraea/video-00.html>

Wild oat experiments

<http://www.saps.org.uk/secondary/beyond-the-classroom/294-wild-oats-on-the-move>

Field Studies Council

<http://www.field-studies-council.org/publications/pubsinfo.aspx?Code=OP97>

Plants that struggle to grow in the UK

<http://www.arkive.org/rough-marsh-mallow/althaea-hirsuta/#text=ALL>
<http://www.arkive.org/military-orchid/orchis-militaris/>

Darwin's letter to Hooker

<http://www.darwinproject.ac.uk/entry-2067>

Resource materials

Look closely at the plants you can see in Albrecht Dürer's *The Great Turf*.

Do you recognise any of the plants?

Choose one plant to draw

- What shape are the leaves?
Does it have flowers?
- Have you seen this plant near school or home? If you have, what kind of place did you see it in?
- Are there other plants growing nearby?
- Imagine what life is like for this plant, living in *The Great Turf*.

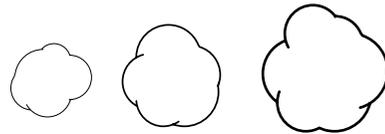
Observations

Resource materials

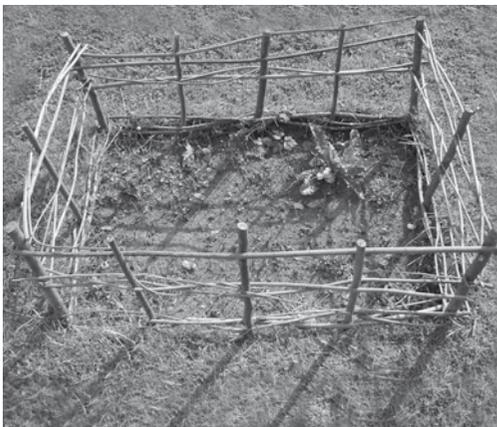
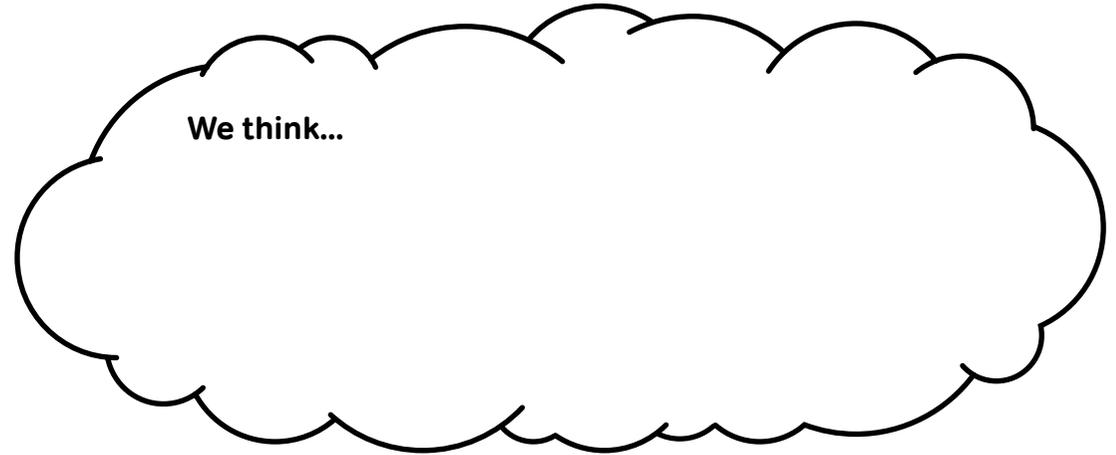
Thinking like Darwin



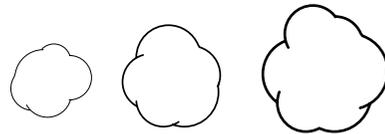
1. Went to the weed garden experiment every day.



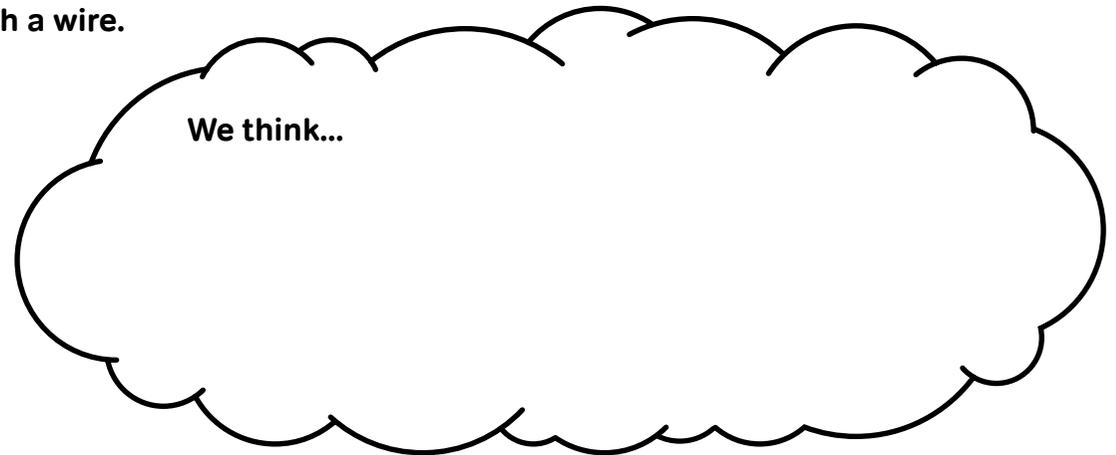
We think...



2. Marked each seedling with a wire.

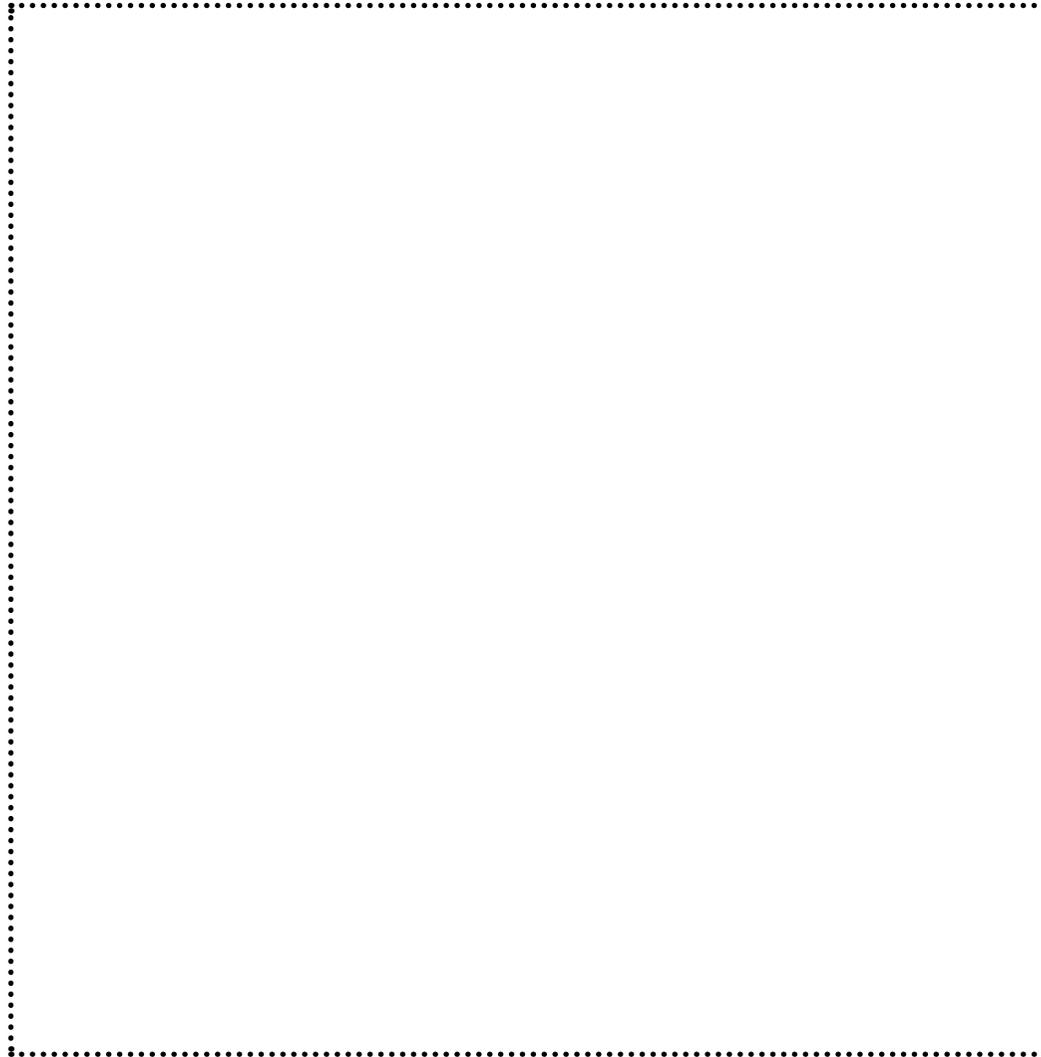


We think...



Resource materials

My square of turf



Resource materials

Question stem cards

Why is

When will

Where does

What is

How does

Could this

What if

Can it

Should we

Acknowledgements

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