



DARWIN  
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Darwin

KS2

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# Module 1: Life Cycles

## Lesson plan

### Overlapping life cycles

Observing plants in his garden closely, Darwin realised that animal and plant life cycles must coincide. He theorised that overlapping life cycles must also be central to the struggle for survival in the natural world.

Darwin grew many different varieties of cabbage and found that large white butterflies laid their eggs on them. The emerging caterpillars were then attacked by the ichneumon fly which deposited its eggs in their living bodies. He reasoned that here natural selection had produced a structure in an animal that was detrimental to another species. Because they destroyed caterpillar numbers, this parasite also reduced the number of adult butterflies surviving to produce eggs in the following year.

### Quotation

*'I use the term Struggle for Existence in a large ... sense, including dependence of one being on another, and including (which is more important) not only the life of the individual, but success in leaving progeny.'*

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



Above: Spring cabbage.

Below: Bee on cabbage flower.

## Lesson outcomes

- Making the connection between gardening, where selection of seed can change the characteristics of crops, and the processes of natural selection.
- Recognising that a garden can be a laboratory in which to discover the interdependence of plants and animals.
- Presenting illustrations of interdependent life cycles to explain the processes central to the struggle for survival.

## Curriculum links

- To recognise that modern science has its roots in societies and cultures which are different from our own.
- To draw on a range of valid approaches to scientific practice.
- To look at domestic and environmental contexts that are familiar to explain scientific concepts.
- Food chains and food webs.
- Living things and the environment need protection.

## Key words

**Gardening, interdependence, life cycle, parasite, evolution, natural selection.**

## Resources

Packets of cabbage seed, Darwin notebooks, pencils, digital camera.



Above: Cabbage flowers (yellow) and seed pods.

Below: Vegetable garden.

## Lesson sequence

### Pre-visit lesson

#### Starter activity

PowerPoint slides 2-8 show Darwin's interest in the development of cabbage crops. The video (slide 9) [www.youtube.com/watch?v=l2SApdV210k](http://www.youtube.com/watch?v=l2SApdV210k) (4 minutes) shows how insects attack cabbage plants in a garden.

#### Main activity

In groups of three, pupils work together to research and illustrate each of the following:

- the life cycle of the large white butterfly (from the video)
- the life cycle of the ichneumon fly (from the video)
- the life cycle of a spring sown cabbage (slide 11 and cabbage seed packets)

#### Plenary

Each group presents its illustrations. Display these illustrations. Discuss the kind of questions pupils have, about different varieties of cabbage and/or large white butterflies as a pest species. Pupils make a note of these questions in their Darwin notebooks to take with them on their visit.



Cabbages (left) and celeriac (right) in the kitchen garden at Down House.

## Extension activities

### Differentiation

- Use the seed packet template, on slide 12 to show how a seed company might redesign its cabbage-seed packaging to help gardeners reduce damage to their crops by large white butterflies.
- Use the data on Sorting cards 1 (page 15.) Groups discuss which of these methods would be most appropriate for:
  - either a small garden with a single row of spring cabbage;
  - or a large garden with raised beds: one contains spring cabbage and another has sprouts;
  - or an allotment plot where 5 different varieties of cabbage are grown in three areas.
- Collect caterpillars from cabbages and put them in a butterfly cage. Feed them, let them pupate and count the number of pupae. Predict what will happen next. Count the number of butterflies that emerge and decide whether the prediction was correct.
- Pupils use the internet to find reasons why a large white butterfly might choose to lay eggs on cabbages instead of on wild plants in the cabbage family. (See also slide 10 for Darwin's thoughts.)
- Research might also show how many cabbages a large supermarket sells in a week and this information will be useful in the post-visit lesson.



Above: Caterpillar eggs (left) and young caterpillars (right) of large white butterfly.

Below: Mature large white caterpillars.

## Visit

Visit a local allotment, community garden, Botanic garden, or National Trust vegetable garden. Divide the class into groups; each group considers the factors that will influence the growth of members of the cabbage family: the soil, local climate, light levels. Having a gardener available to talk about sowing and planting times, pests, diseases, harvesting and obtaining seed, would be helpful on this visit. An organic gardener might have different views from one who uses pesticides.

Groups make notes and use digital cameras to photograph as many different varieties of cabbages as they can find. They record the number of cabbages they find; the number of these that have caterpillars on them; the number of these with holes in the leaves. They can question the gardening expert about caterpillar damage, how to prevent it and the wildlife friendliness of the methods suggested.



## Post-visit lesson

### Main activity

Everyone draws a graph of the number of undamaged cabbages, number of cabbages with caterpillars on them and number of cabbages with holes in the leaves. Groups upload their photographs and create a 4-slide presentation which includes one of their graphs and at least 2 different cabbage varieties. The class discusses the different cabbage plants they observed, the main causes of damage to the plants and damage prevention method being used.

### Plenary

A sorting activity to decide which is the most wildlife friendly method of reducing damage to cabbages.



## Assessment of progression

Pupils consider the letter regarding funding for organic school gardens and local community land-share allotments. They discuss it in pairs and as a class. Individuals write a letter which teachers collect and award certificates in the following lesson.

Above: Holes made by caterpillars in cabbage leaves.

Below: Cabbages protected from damage by mesh.

# Notes for teachers

## Pre-visit lesson

Darwin was struck by the changes that gardeners and nurseries could make to domesticated species of plants. Gardeners bred plants to increase the size of the part of the plant that was good to eat.

### Starter activity

The starter video gives a good indication of the large white butterfly life cycle and [www.arkive.org/ichneumon-wasp/ophion-luteus/#text=Biology](http://www.arkive.org/ichneumon-wasp/ophion-luteus/#text=Biology) indicates when the ichneumon fly is likely to be laying eggs.

You may need to show the video more than once so that everyone notes all stages of the life cycle. This written version may be helpful:

Adults of the large white butterfly (*Pieris brassicae*) start to appear from their pupae in May. They lay their skittle-shaped yellow eggs in small clusters on the underside of cabbage leaves. They may lay two generations of eggs during the summer and are active until October.

When the eggs hatch, the young green and yellow caterpillars feed together, first under the leaves but, as they get larger, they can be seen all over the leaves.

Once fully grown, caterpillars move away to pupate on a fence, wall or other vertical sheltered place where they attach themselves with a silky pad at the tail and silky threads around the middle. The pupa (chrysalis) is generally cream coloured with black spots.

Shriveled caterpillars and empty cocoons may be found where an ichneumon fly (*Apanteles glomeratus*) has been at work. The female fly detects the pupating caterpillars and lays a batch of eggs inside each one. The grubs feed inside the caterpillar, carefully avoiding the vital organs that keep it alive, until they are almost fully grown. They finish off their food supply and emerge to pupate around the empty skin.



Savoy Cabbage

## Pre-visit lesson

### Starter activity (continued)

The survivors are the new generation of large white butterflies which start to emerge from their cocoons in May and join huge numbers of migrants that arrive from Europe in July. They feed on nectar-rich plants like buddleia, marjoram and lavender but scout for cabbage plants on which they lay their eggs in August and September.

Unlike many other butterfly species, the large white butterfly is thriving.

Their numbers are reduced by parasites but increase with an influx of European large whites in summer. Without this influx, the species could disappear from the UK.

### Main activity

Seed packets show part of a cabbage life cycle but some do not show a calendar; pupils may need help with making a time line. Point out that the packet life cycle ends when humans harvest cabbages. Talk about what happens next; they flower and seed. Cabbage, kale, sprouts, cauliflower and similar garden species in the cabbage family will flower from April and produce seed by July. BBC and RHS websites may also be helpful for research (see websites).

### Plenary

The Question starters (page 13 and slide 13) may assist question development. Remind pupils to write their questions in their Darwin notebook and take these on the visit.



Large white butterfly on marjoram.

## Pre-visit lesson

### Extension

The seed packet template (on slide 12 and page 14) can be made to any size to assist differentiation.

Cut out and laminate a set of Sorting cards for each group.

Collect large white butterfly caterpillars (yellow and black) from cabbages and put them in a gauze butterfly cage. Feed them on cabbage leaves of any sort.

Research should show that large white butterflies have almost abandoned interest in wild cabbage family weeds like charlock and lay their eggs on the more succulent garden cabbages grown in blocks and rows. The caterpillar of the large white is very destructive, reducing the leaves to skeletons.

Find out how to get information from supermarkets about the fresh vegetables they sell and all the cabbage varieties they stock. Whether commercial growers may use pesticides is another line of research.



Cavolo nero cabbage

## Visit

A risk assessment will be necessary before the visit and a preliminary visit is advisable. Cabbages are more likely to be abundant from late summer to early spring.

Finding a garden to visit: Community gardens: the Federation of City Farms & Gardens [www.farmgarden.org.uk/](http://www.farmgarden.org.uk/).  
Royal Horticultural Society gardens and links to local community gardens [www.rhs.org.uk/Gardening/Community-gardening](http://www.rhs.org.uk/Gardening/Community-gardening); BBC map of sites [www.bbc.co.uk/gardening/today\\_in\\_your\\_garden/community\\_projects.shtml](http://www.bbc.co.uk/gardening/today_in_your_garden/community_projects.shtml).

Allotments are the responsibility of borough and parish councils. More information about local allotments would be available from council offices.

National Society of Allotment & Leisure Gardeners [www.nsalg.org.uk/](http://www.nsalg.org.uk/) and Groundwork may provide useful local contacts [www.groundwork.org.uk/](http://www.groundwork.org.uk/).

Botanic Gardens Conservation International (BGCI) has a list of botanic gardens in the UK [www.bgci.org/garden\\_search.php](http://www.bgci.org/garden_search.php). Many will have a vegetable garden.

For the National Trust gardens to visit, the best place to start looking is [www.nationaltrust.org.uk/main/w-chl/w-learning\\_discovery/w-schools.htm](http://www.nationaltrust.org.uk/main/w-chl/w-learning_discovery/w-schools.htm)

A preliminary visit may assist teachers to find a gardener at the site who is knowledgeable about cabbages, how they are grown and the pests and diseases that attack them. The cabbages available will depend on the time of year, so check with the garden which cabbages pupils will see growing well. June to February is probably the best time.

Pupils make notes in their Darwin notebook. Give everyone the opportunity to take photographs of the varieties of cabbage, netting, companion planting, butterflies, caterpillars and other insects.

Visiting the garden more than once makes the activity a more powerful learning tool.



Above: An allotment.

Below: Caterpillar damage and droppings.

## Post-visit lesson

Look at the graphs and decide what they say about pest damage to cabbages. Discuss whether other pests could be to blame at the time of year the class visited the garden.

Ask pupils what they discovered about growing and protecting cabbage plants. How does this affect their views on growing food for themselves? Some pupils might like to find out how many cabbages a large supermarket sells in a week.

### Plenary

Darwin was a keen beetle collector but '*...in childhood, it had been damped by the moral scruples of a sister, as to the propriety of catching and killing insects for the mere sake of possessing them.*' Thomas Huxley, 1888. [Obituary notice: Charles Robert Darwin.] Proceedings of the Royal Society of London 44 (269): i-xxv. Darwin himself had to decide whether he should collect and kill beetles and what was the most moral/ethical action.

Use the Sorting cards again to encourage pupils to decide which would be the most and least wildlife friendly way to protect cabbage plants from butterfly/caterpillar attack. Using Sorting cards 1 and 2, ask groups to place each statement card in order with the most and least wildlife friendly cards at either end. Discuss the reasons pupils place their cards in the order they have chosen. Darwin was killing insects as a hobby; does killing insects on a food crop make a difference to pupils' reasoning? How would pupils treat ichneumon flies and pupae if they found them?



Above: Pinned tropical beetle specimen (x2 life size).

Below: Young cabbage plants.

## Assessment of progression

Use the letter (page 16 and slide 16) as a stimulus to discuss organic gardening and pupils' attitudes to producing their own food. Organise pupils into pairs; they might take roles to stimulate ideas (page 17 and slide 17.) Give 5-10 minutes for the pairs to take a position for or against the ideas of funding organic gardens in school grounds and local community land-share allotments, bearing in mind their own ideas or role. Ask them to justify their arguments with evidence.

The main arguments might include: Food security (for example, during an oil crisis); overcoming food poverty (fresh food is expensive); health (exercise, growing and eating vegetables). Emphasis on community, old, young, many cultures working together; reducing food miles (imported food has a carbon footprint); wildlife and gardening and sustainability; eating food in season which need less energy input; many different vegetables in a small area, not just one crop.

While this discussion is underway, listen to the groups to establish who is arguing for and against the funding proposal. Re-organise the pairs so that each person is now paired with someone who has taken an opposing position. Give them between 5 and 10 minutes to present their arguments to each other, and to construct counter-arguments.

In a plenary discussion, ask whether anyone changed their minds and, if they did, why they did. Alternatively ask for a vote either for or against the funding proposal, then pick on some individuals to share their reasoning with the class.

Pupils write a letter with at least one reason for their decision. Take in the letters to assess progression and hand out the certificate (page 18 and slide 18) in the next lesson.



Above: Allotment showing cabbages covered by mesh.

Below: Close up of mesh over cabbage.

**Website links, videos  
Interactives, references**

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**Large white butterfly life cycle**

[www.youtube.com/watch?v=l2SApdV210k](http://www.youtube.com/watch?v=l2SApdV210k)

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**Ichneumon fly life cycle**

<http://www.arkive.org/ichneumon-wasp/ophion-luteus/#text%3DBiology>  
[www.arkive.org/ichneumon-wasp/ophion-luteus/#text=Biology](http://www.arkive.org/ichneumon-wasp/ophion-luteus/#text=Biology)

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**Growing cabbages**

[http://www.bbc.co.uk/gardening/basics/techniques/growfruitandveg\\_growingbrassicas1.shtml](http://www.bbc.co.uk/gardening/basics/techniques/growfruitandveg_growingbrassicas1.shtml)  
[www.rhs.org.uk/Gardening/Grow-Your-Own/Veg-A-to-Z/Cabbage](http://www.rhs.org.uk/Gardening/Grow-Your-Own/Veg-A-to-Z/Cabbage)

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**Organisations that promote growing local food include**

[www.localfoodgrants.org/](http://www.localfoodgrants.org/)  
<http://www.fruitfullschools.org/>  
[www.commonground.org.uk/](http://www.commonground.org.uk/)  
and <http://www.farmgarden.org.uk/news/631-community-orchards>

# Resource materials

## Question starters

What is

When will

Why do

How do

What if

Can it

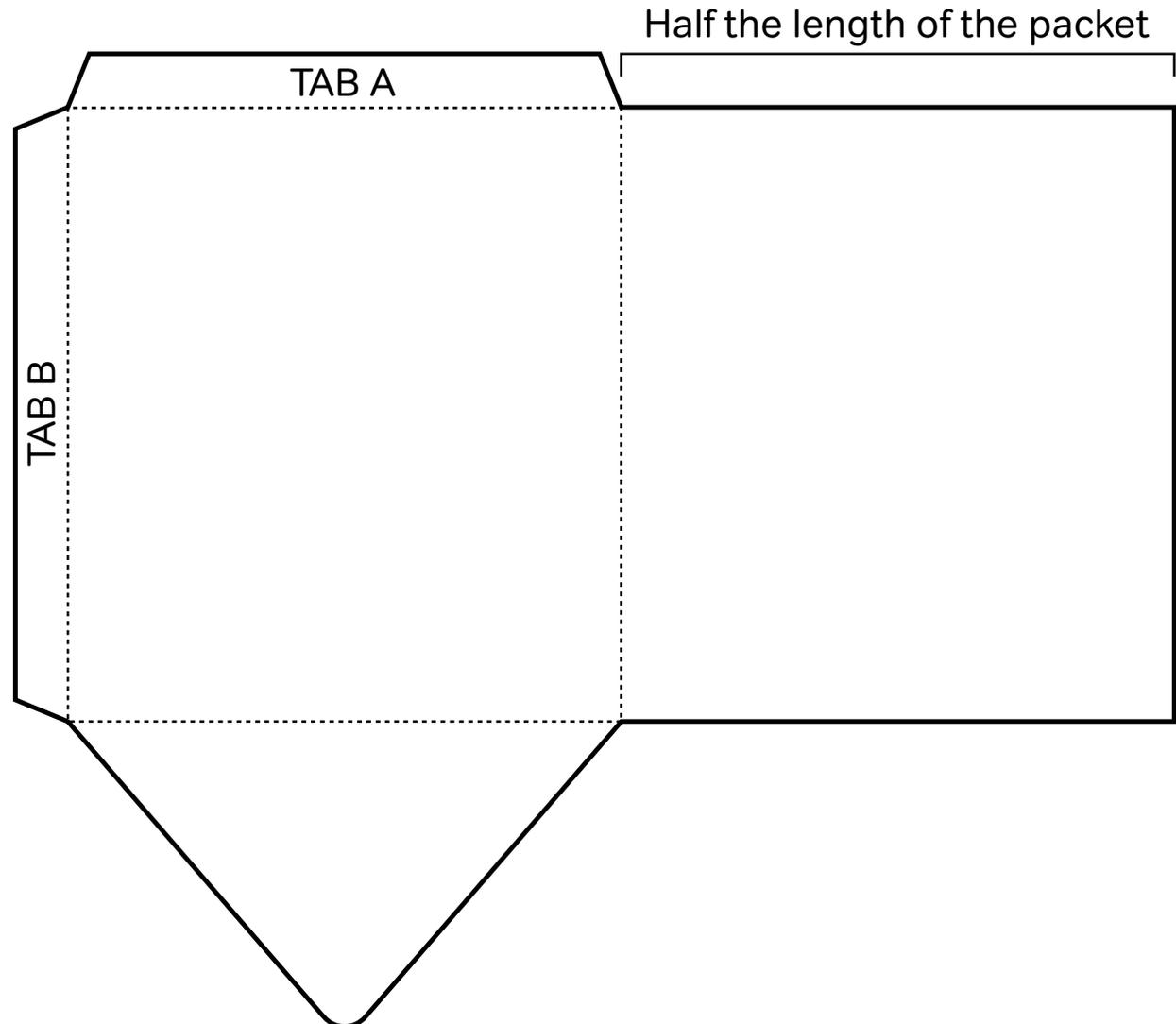
How do

Where will

## Resource materials

### Seed packet

Fold over along the lines.  
Glue tabs A and B in place to  
make the envelope and leave  
the long triangle open. This can  
be folded into the envelope.



## Resource materials

### Extension: Sorting cards 1

**Gardeners use these methods to limit the damage to their cabbages by large white butterfly caterpillars.**

Cover the cabbage plants with a small-mesh, butterfly-proof netting.

Soap and garlic water sprayed on cabbage leaves masks its smell and keeps the butterfly away so no eggs are laid.

Companion planting - rows of celeriac or French marigold planted between cabbage rows to mask their smell.

Squash caterpillar eggs on cabbage plants - they are on the underside of the leaf.

Spray plants with the chemical pyrethrum. It kills the caterpillar as it crawls over the sprayed leaves.

Take caterpillars off the leaves. Squash them because birds will not eat them (birds avoid yellow and black insects that taste nasty).

### Post-visit plenary: Sorting cards 2

**Set out Sorting cards 1, and put them in order with most wildlife friendly at one end and least wildlife friendly at the other.**

**most wildlife friendly**

**least wildlife friendly**

**The International Agency for Public Funding  
Jacquetta House  
Haymarket  
London**

**Dear Young Scientist,**

I am pleased to invite you to take a part in a new project. We are asking pupils to let us know if our agency should fund organic school gardens and local community land-share allotments.

Some people believe that gardening is pointless when it is so easy to buy food in supermarkets and we can get vegetables and fruit all year round in supermarkets. Others think that organic gardening in a community is helpful because it offers good quality, cheap food that is grown without using chemicals and encourages gardeners to take exercise. We need you to tell us whether we should give money to these kinds of projects.

Your job as a class is to give us your arguments for or against the funding for organic school gardens, community land-share allotments. There is no right or wrong answer for this project. It is important however, that you give us reasons and evidence to support the claims you make.

When you have finished this work successfully, you will receive a certificate and you will become an honorary member of the International Agency for Public Funding.

I hope that you will enjoy your task. I look forward to reading your reports.

Yours sincerely,

**Dr Caitlin Jones**  
Director

## Resource materials

### Role play

Families living in flats with no garden	Families that believe organic food is better for them but can't afford it	Unemployed people who find fresh food too expensive	Families that want to have healthy exercise together
Families that want to grow more interesting vegetables than they can buy locally	People concerned about their carbon footprint	People concerned about wildlife and sustainability locally	Parents concerned about the nutritional value of food
People who want to learn a skill that might get them a job	People who want to learn how to prepare, store and preserve food they grow	Parents concerned about pesticides on food	People worried about where supermarkets get their food

Certificate

I am pleased to admit the Young Scientist:

.....

as an

**Honorary member of**  
**The International Agency for Public Funding**

Signed:

*Dr Caitlín Jones*

.....

**Dr Caitlin Jones**  
Director



## Acknowledgements

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This resource has been produced by The Charles Darwin Trust

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Series editor Dr Susan Johnson

Author Dr Susan Johnson

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Design SPY Studio

Photographs taken at Down House are with thanks to English Heritage which owns and opens the House to the public.

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Thank you to our current funders who are supporting Darwin Inspired learning and have made *Enquire with Darwin* possible: the Evolution Education Trust, the Foyle Foundation, the Garfield Weston Foundation, the JJ Charitable Trust and the Mark Leonard Trust, The Mercers' Company, and a number of individual donors.

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