

# beagle

## Guide for Teachers



**Biodiversity Education and Awareness  
to Grow a Living Environment**





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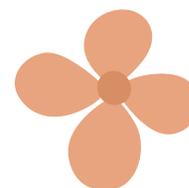
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Education and Culture DG

### Lifelong Learning Programme

This document has been produced with the financial assistance of the European Union. The contents of this document are the sole responsibility of the project partners and can under no circumstances be regarded as reflecting the position of the European Union.



We are inviting you, together with over 300 schools across Europe, to take part in our big investigation on the phenology of six common tree species. The results will help us to learn about how trees differ across Europe and to learn how we are living with our environment.

Project BEAGLE can support several curricular areas including science, geography, biology and citizenship. It will help students to:

- Explore ecosystems first hand.
- Understand human impacts on the environment and biodiversity.
- Take action to improve the natural environment.
- Learn from real scientists.
- Find out about similar experiments all over Europe.

### Why study trees?

Trees are a vital part of our life support system and play a major role in maintaining the balance of the environment. Trees are 'living islands' for many species which makes them ideal objects for biodiversity monitoring projects. Trees provide a number of ecosystem services such as the conversion of carbon dioxide into oxygen and minimising soil erosion. Without these services the lives we lead today would not be possible. Moreover, trees can tell stories about history, the present and the future.

Following the phenological phases of trees and examining their patterns across Europe enables us to see how these differ both spatially and, with the assistance of historical records, temporally. Trees act as indicators of how the environment is changing. They are exemplars of sustainability and with such widespread presence across Europe, they also provide us with ideas of how we can live sustainably.

## 1. What is the link between a dog, a tree and you?

Apart from the obvious, trees tell us a huge amount about our relationship with the environment. A dog, a tree and you can help your students to:

- Engage in real science.
- Promote out of the classroom learning.
- Connect local investigations to global issues.
- Explore topical issues such as climate change.
- Share your experiences with schools in six countries across Europe.

The dog is a ship called BEAGLE that took Charles Darwin on one of the greatest trips of discovery ever. The trees are six common species found across Europe. The 'you' is your school taking part in an exciting pan-European science project called Biodiversity Education and Awareness to Grow a Living Environment – the BEAGLE project.



## The Aims of the Project:

This is an exciting and novel EU funded project which is gathering data collected by school students from across Europe. The project has been designed to be relevant and applicable to students across Europe and also to be of scientific use. The project will:

- Enhance teachers' knowledge and understanding of biodiversity and sustainable development.
- Build the capacity of teachers to be able to create and deliver effective and relevant out of classroom learning experiences for young people.
- Improve teachers' and young people's awareness and understanding that European and global scale solutions are required for successful sustainable development.
- Develop out of classroom learning frameworks and opportunities for biodiversity that improves student's motivation for learning about sustainability.
- Write innovative out of classroom activities and approaches to biodiversity learning that are inclusive, enable students to acquire relevant learning skills and where they can see the relevance and links between learning and life.
- Create support materials and structures for teachers and students engaged in out of classroom learning related to biodiversity.
- Produce a methodology for biodiversity observation that is robust and that produces results that can be used by the scientific community.
- Engage a greater number of teachers and students in innovative out of classroom learning throughout Europe.



## What will happen in the project?

Schools from six countries are being invited to participate: Germany, Hungary, Norway, Poland, Slovakia and the United Kingdom. Each school will carry out simple biodiversity observations based around trees and enter this information onto the BEAGLE project website. This information will be gathered and results produced to see how different stages of tree life cycles take place across Europe throughout the year. Data can be compared to historical results and factors such as climate change to see the influence humans are having on the natural environment. This can be linked to the school curriculum and used for project work. BEAGLE will also enable collaboration with scientists in the six participating countries to analyse what patterns are taking place across Europe.

A bit more background about biodiversity and why it is vital!

Biodiversity encompasses all of the biological life on Earth. This can range from whole ecosystems and habitats to individual species and genes. The importance of biological diversity to human society is hard to overstate. An estimated 40 percent of the global economy is based on biological products and processes. It is impossible to estimate how much the beauty of nature means to our culture and quality of life. Quite simply we cannot imagine our existence without the living world around us. However, biodiversity loss is rapid and ongoing.

Over the last 50 years humans have changed ecosystems faster and more extensively than in any comparable period of time in human history. Humans are a major force in changing nature. Vast parts of the surface of the Earth are transformed to meet human needs and wants for agricultural production, water, energy, urbanization, tourism, transport and industry. As demographic pressures and consumption levels increase, biodiversity decreases, and the ability of the natural world to continue delivering the goods and services on which humanity ultimately depends are undermined.



Along with climate change, humans are threatening a mass extinction of species and long term damage to ecosystems. To start addressing the multiple threats to biodiversity we need to change our approaches to the way we live, we need to rethink how we can live within the means of the planet to support us now and in the future. This new way of thinking is named sustainability.

The key goals of sustainability are to live within our environmental limits, to achieve social justice and to foster economic and social progress. Issues such as food security, green consumerism, deforestation, depletion of natural resources, climate change and loss of biodiversity are the primary concerns of sustainable development. We can stop the loss of biodiversity only by the sustainable use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of species of plants and animals and their habitats. It is only by maintaining the richness of nature that we can meet the needs and aspirations of present and future generations.

To reduce the loss of biodiversity we need collaboration and cooperation between individuals, organisations and groups in society to act. Education plays a key role to develop this collaboration and change in society. But this process of change in society depends very much on the quality of education and it needs support for teachers. The overall goal of the BEAGLE project is to improve the quality of learning outside the classroom and enhance students' motivation to learn, so that the capacity of people to live sustainable lifestyles and bring about a more sustainable environment is strengthened.

And now...

The next section gives you a brief over view of the whole project step-by-step. The remaining sections provide you with ideas, detailed information and activities to complete the project in your school.

**We hope you enjoy taking part!**



## 2. Quick Guide to...

# beagle



### 3. The Benefits of Out of Classroom Learning

Out of classroom learning is where educational activities take place outside the normal classroom learning environment. Out of classroom learning has the aim of improving students' knowledge of a subject. However skills, values and personal development also form a vital element of a students learning and achievement.

The benefits of out of classroom learning include:

- Improvements in academic achievement.
- Providing a bridge to higher order learning.
- Developing skills and independence in a widening range of environments.
- Making learning more engaging and relevant to young people.
- Developing active citizens and stewards of the environment.
- Nurturing creativity.
- Providing opportunities for informal learning through play.
- Reducing behaviour problems and improve attendance.
- Stimulating, inspiring and improving motivation.
- Developing the ability to deal with uncertainty.
- Providing challenge and the opportunity to take acceptable levels of risk.
- Improving young people's attitudes to learning.

There is a strong connection between good quality out of classroom learning and performance in the classroom. Our project will have the ability to support several areas of the curriculum including geography, biology, citizenship, ICT and sustainable development. We believe working outside the classroom with real scientific data will enable the learning of students to be more successful and meaningful.

BEAGLE has been developed so schools can use their own grounds or the local environment to obtain results. It is intended that the students can be given the responsibility for examining and recording their own data and results. It is envisaged that the experiences they get will give them relevant experience of a scientific project that will deepen and enrich their learning.

BEAGLE provides the resources, support, guidance and training for teachers and students to make this a stimulating out of classroom experience. By working with schools and local authorities it is hoped that this will be an engaging project for students interacting with their local environment in a safe manner.



## 4. Keeping Safe - Health & Safety Outdoors

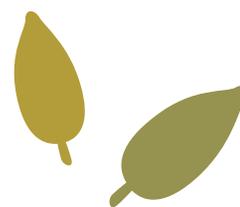
As the group leader you are responsible for carrying out a risk assessment for the sample site. For most schools there will be suitable trees either in your school grounds or a local park. You should make a preliminary visit to the site and identify potential hazards in advance of any field work, and become familiar with local conditions and facilities.

On your preliminary visit there are several things that you should be looking for:

- Assess whether the tree has a girth >50cm at chest height. If it is less than this then it should be safe but still avoid working near the tree in high winds or extreme weather. If larger than 50 cm girth you will need to carry out a visual survey of the tree.
- Carry out the visual survey.
  - Examine the tree to see if any branches are hanging loose.
  - Look for any disease. This may be indicated by unexpected leaf loss, early or strange discolouring of leaves or fungal fruiting bodies growing from the tree. If these factors are present then the tree may be stressed and need further investigation or a different tree should be found.
  - Avoid any trees where damage may have occurred, for example, if a rope swing is present or any signs of scarring from where a limb has fallen. Are there any trees around of the same species that have fallen which may indicate the health of the tree?
  - Has the tree been subject to exposure or extreme conditions? If the branches are all on one side it may have an imbalanced structure. Avoid these trees if possible.
  - Find out if possible whether there have been any dry periods or problems with the tree in the preceding 12 months. If there has it may be more liable to shed a limb or even fall unexpectedly. Usually trees in public areas are assessed regularly.
- Identify and record any safety concerns you have with the tree.
- Repeat any visual survey after autumn or after any extreme weather event.
- If you are unhappy with a tree then never work with it. It is always better to be safe!
- If the winds are strong but you are happy for students to work under the tree you can always give them hard hats in case any twigs fall.

A first-aid kit should be taken out into the site, along with a mobile phone. A map is also useful, especially if the site you are using is away from your school grounds.

If students are sampling trees in their own homes, make sure their parents are aware of the project and what their children are doing.





## Safety Tips

### **Choosing the sample site**

Please consider practical and safety issues when choosing a location. Do not sample anywhere where you may place yourself or others in potential danger due to local hazards (river banks, steep slopes, adjacent transport routes or systems, chemical or waste disposal outlets, etc). Consider the time it will take to reach your site and if this is feasible in the time available.

### **Preliminary briefing**

Arrange a preliminary briefing, if you can, before the date of your surveys. This means participants will understand the main purpose of each activity, the scope of practical activities and the features to look for in identifying trees and their phenophases.

### **Your survey site**

Review your risk assessment to remind yourself of practical and safety issues concerning your chosen location (see preceding section). Take a first-aid kit to the site, along with a mobile phone. A map is also useful, especially if the site you are using is remote. Allow time to reach your site which should include suitable trees. We recommend informing others of your chosen sampling location, time on site, and expected time of return.

### **Arriving on site**

Find a central area, preferably dry, to use as a base where bags and items not needed immediately can be kept safely and to where participants can return if they need anything or require assistance. Participants should ensure they have all the equipment they need and take it to their chosen sample site.

### **Safety Briefing**

Participants should be given a safety talk before the activities, to run through the main health and safety aspects and behaviour expectations.

### **Minimum working in pairs**

We recommend that, wherever possible, participants work in at least a pair. This has obvious health and safety benefits and also allows participants to swap over between the two activities, so that each experiences both the practical and data recording aspects of the work.

Please note that these are only brief health and safety tips. You should ensure that you comply with any health and safety regulations set by your school or local education authority.

## 5. Getting Started

You may wish to include this project as part of your curricular studies or as an extra-curricular activity. In order to help introduce the project and make it relevant, we have included some starting points below to lead into the monitoring work. You can adapt these to make them as long or as short as required.

### What lives on the tree?

Students can investigate what species may be living on or near their tree. This could include surveys of the number of nests in the tree or if there are burrows in the roots of the tree. You can also examine the insects on the tree by using pooters, by shaking branches and seeing what lands on a sheet underneath or by taking some sweep nets. This can then be linked to the importance of why we need native trees to house all of these organisms and why trees and woodlands are one of the most diverse ecosystems in Europe. You could also apply this data to food chains, food webs and food pyramids (see chapter 8 – Tree as a Living Island).

### Tree scavenger hunt

Give the students a set time to look for different things a tree may produce. This can be on the ground or on the tree. You could give a list which would include different seeds, leaves, twigs, animals, other plants living on the tree, colours or sounds (birds, wind, etc). Students can then bring their collections in to the classroom and make some identification keys, for example with leaf shapes. The findings can also be used to examine the differences in how trees disperse their seeds or the differences between conifers and broad-leaved trees.

### Trees and climate change

In the context of climate change, trees are sometimes being seen as a possible solution. Students can use news articles and information online to see how different organisations are using trees to combat climate change and make themselves 'carbon neutral'. You could also have a class discussion to decide whether these are good or bad solutions!

### What can trees be used for?

Students can bring in things from home which has originally come from trees. You can also go for a walk around the school grounds and identify anything inside or outside that has originated from trees. Once you have looked at everything, students can split these into different categories such as recreation, furniture, building, stationary, clothing, etc. Students can then design posters or web pages on all the uses of trees and their importance.

Some websites which may help you with these activities or ideas that you may have are listed here:

[www.field-studies-council.org/urbaneco/  
urbaneco/woodland/introduction.htm](http://www.field-studies-council.org/urbaneco/urbaneco/woodland/introduction.htm)

[www.forestry.gov.uk](http://www.forestry.gov.uk)

[www.woodlandtrust.org.uk](http://www.woodlandtrust.org.uk)

[www.naturescalendar.org.uk](http://www.naturescalendar.org.uk)



## 6. Monitoring and Recording Tree Data

### What would we like you to do?

To take part in the monitoring you will need to collect data from trees in your school or local area when they go through a physiological change (a phenophase). When one of the phenophases takes place we would like it to be recorded on the website as soon as possible. However, if the event has passed by a few days then record this anyway as the more data we get the better! This will give more information to all the schools involved across Europe.

For each phenophase we have given a description of what you need to look for. There is also a photo guide which will help you identify what you need

to be looking for. There is also a separate 'Guide to Tree Phenology' to help you identify your trees and record the events.

Ideally you will collect data from all the six phenophases. Do not worry if you cannot complete all of them, just do as many as you can. The six species we are monitoring are listed below together with a quick overview of the information you need to collect.

Tree species you may monitor:

- Oak (*Quercus* sp.)
- Beech (*Fagus sylvatica*)
- Horse Chestnut (*Aesculus hippocastanum*)
- Birch (*Betula* sp.)
- Rowan (*Sorbus aucuparia*)
- Lime (*Tilia* sp.)

### Information you collect in the field:



**Who?** (Record once per tree)

Name of observer

**Where?** (Record once per tree)

Location (note the grid reference, use GPS or use the online map on the project website)

Description

Solitary tree or forest

Distance to closest woodland (if known)

**What?** (Record once per tree)

Species

Girth of tree at 1.3m height

Tree height

**When?** (Repeat visits/recording per tree to monitor all events)

When the buds burst on the tree

When the tree first flowers

When the trees have their first leaves

When the berries are ripe or when the seeds have developed

When the leaves start to fall

When all the leaves are brown or yellow

**Take photos at each visit** (optional)

Whole tree (from same distance/spot)

Detail (twig/leaf/blossom, indicating the phenophase)

## Detailed Description of each Phenophase

### When the buds burst on the tree

*When the colour of the new leaves is visible through openings on the swollen bud.*



1 – Too early



2 – Record this!



3 – It is a bit late but still record this!

Photo Credits: 1 - Martin LaBar; 2 - axelkr; 3 - withrow. All on [www.flickr.com](http://www.flickr.com)

### When the tree first flowers

*When the petals have opened sufficiently for you to see inside the flower.*



Photo Credit: 4 - CaptPiper. On [www.flickr.com](http://www.flickr.com)

### When the trees have their first leaves

*The first leaf is fully open and the shape is recognisable (it does not need to be the full size of the adult leaf).*



5 – A bit early!



6 – Record this!

Photo Credits: 5 - ting in PVB; 6 - mooglove. All on [www.flickr.com](http://www.flickr.com)

**When the berries are ripe or when the seeds have developed**

*Only Rowan has berries and these should be red, all the others have seeds. Seeds should be fully developed and starting to fall from the tree. The photos below show some examples of what to look for.*



7 – Ripe berries on a Rowan tree



8 – Horse Chestnut Seeds

Photo Credits: 7 - Tim Green aka atoach; 8 - bbusschots. All on [www.flickr.com](http://www.flickr.com)

**When the leaves start to fall**

*When the first twigs and branches become bare. Note that leaves can start to fall before they change colour.*



Photo Credit: 9 - Simon Ward, Field Studies Council

**When all the leaves are brown or yellow (full tint)**

*When all of the leaves have full autumn colouring*



10 – This would be a bit early



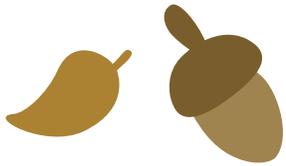
11 – Record this!

Photo Credits: 10 - anslatadams; 11 - snakeeyes-man. All on [www.flickr.com](http://www.flickr.com)

## Using the Website

When you have the data for your trees you will need to put this onto the website after each phenophase - [www.beagleproject.org](http://www.beagleproject.org).

You sign up for this project at the website [www.beagleproject.org](http://www.beagleproject.org). Here you will find the electronic version of the guide and teaching resources. You will get access to upload and publish your observations and compare your results with those reported by schools around Europe. You can then use this information for your own activities or use one of our follow-up activities below. There is also an online help section if you need it during the project.



## 7. Understanding Your Results

Your data is very important. Analysing and interpreting your data can help learning about how trees are part of the wider environment and how they can act as indicators of human impact on the environment.

Trees are useful indicators of a changing environment, changes that are influenced by us. By exploring tree phenology over a longer period we can find out if the timing of events is changing and why this might be. The activities below will help you do this.

You can also use your results to:

- Plot charts of how the key events of the trees match the weather during the year.
- On a map you can draw arrows to show how key events change across Europe over time.
- Make a video diary of the changes to the trees.
- Have a board display which can be updated with results and photographs from both your results and across Europe!

Note – although written as two separate activities, activity 1 and 2 below can easily be combined.

### Activity 1: Trees and Humans - analysing your data

You should by now have data for your tree(s) and entered this onto the project website. Here you will be able to see your results and compare them with results across Europe. You can start by exploring a number of questions:

- Are the results similar across Europe? Why/why not? (possible routes of enquiry could include climate and weather variations, soil fertility or diseases).
- Are there differences between the different species?

Examine Resource 1. This shows historical data for four of our six tree species in the UK. By investigating the questions below think about what causes each phenophase to take place (weather, climate, pollination, etc) and how these might be affected.

- Are all the trees showing the same patterns or are their differences between them? Do your results differ?
- Are the phenophases changing over time?
- Are the growing seasons starting earlier, finishing later?
- What reasons may there be for any changes to the phenology patterns?

Check out Natures Calendar for more information on long term trends ([www.naturescalendar.org.uk](http://www.naturescalendar.org.uk)).

Look at Resource 2. These show a number of long term trends. Can you find any relation between these, your results and the historical results in Resource 1? Does there appear to be a link between increasing carbon emissions, increasing global temperatures and changes in the phenophases?

### Activity 2: Trees and Sustainability

From Activity 1 above you will have explored how trees can be indicators of a changing climate, that these changes are long term and largely influenced by human activity.

This activity explores the role of trees as part of a wider ecosystem that helps stabilise the climate and provide the right conditions for human life. It also asks what we need to do to ensure the climate stays conducive for human life. You will explore a very important idea – ecosystem services. An ecosystem service is a beneficial product ecosystems provide for humans. For example, Mangrove forests absorb waves from the sea preventing erosion and flooding, forests store rainwater and release it gradually over time, bogs purify water and of course plants provide a huge source of food to eat! Trees provide a very important ecosystem service as we shall discover below.

The activity is based around Resource 3. You will need to print this off and ensure your student have a copy, either one copy each or in groups. We suggest

you copy Resource 3 in A3 size. Resource 4, 5 & 6 can also be used depending on your group; they help stimulate thinking but depending on the level or ability of your students you may choose not to use them or only introduce them after some initial thinking has taken place.

Take a look at the centre of Resource 3, it shows a tree cycle with parts of it missing. Can you fill in the missing blanks? Resource 4 will help. Explore and use questions to think about how the tree is part of a wider ecosystem that provides services beneficial to us:

- Where does the tree get energy from? Is this a renewable source of energy? (renewable energy comes from the sun).
- What happens to the 'waste' (fallen leaves) the tree produces? (it is recycled by invertebrates, fungi and bacteria in the soil to provide nutrients to the tree and other organisms).
- What does the tree absorb from the atmosphere and what does it produce? (it absorbs carbon dioxide and produces both oxygen and a little carbon dioxide).

By exploring these questions you should be able to conclude that trees are a good example of a sustainable system; one that produces no harmful emissions and actually absorbs carbon dioxide and produces oxygen. The tree provides an ecosystem service very important for us by helping to keep the atmosphere in balance. What would happen if carbon dioxide was not converted back to oxygen?

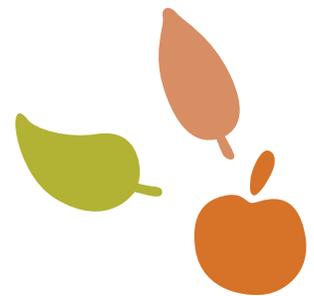
Now take a look at the boxes immediately below the tree. Think about the actions humans are doing that disrupt the services trees provide. Resource 5 gives you some suggestions if you need help. Each box is numbered so you can rank your answers should you choose to.

Finally, look at the bottom of Resource 3. We have left space here for you to think about what actions we can take to ensure trees continue to provide the ecosystem services on which we rely. There are three boxes for actions we can take as individuals, as a school and as a country. All three are important: we need to do what we can as individuals, but by

working together as a school or country we can be far more effective. Resource 6 presents some suggestions if you need them.

There are lots of extensions you could follow up this activity with. For example:

- Developing your own school action plan on reducing harmful emissions that affect climate change. Why not examine the possibility of becoming an Eco-School? ([www.eco-schools.org.uk](http://www.eco-schools.org.uk)).
- Lobbying for others, especially the government, to take climate change more seriously.
- Exploring solutions that reduce emissions and maintain a high quality of life for all (renewable power, hybrid cars, etc).



# Resource 1 - Phenology events over time

Note: Data source Natures Calendar ([www.naturescalendar.org.uk](http://www.naturescalendar.org.uk)); no data for Lime or Birch.

## Oak

Date	Budburst	First flowers	First leaves	Fruit/ seeds ripen	Leaves fall	Full tint
2005	14th March	1st May	24th April	20th Sept	13th Nov	14th Nov
2000	17th April	12th May	30th April	5th Oct	5th Nov	2nd Nov
1990	30th March		4th April			
1980			18th April			
1970			6th May			

## Beech

Date	Budburst	First flowers	First leaves	Fruit/ seeds ripen	Leaves fall	Full tint
2005	14th April		24th April	25th Sept	30th Oct	31st Oct
2000	16th April	6th May	27th April	28th Sept	28th Oct	25th Oct
1990	19th March	23rd April	26th April			
1980	2nd June	17th May	27th April			
1970		9th May				

## Rowan

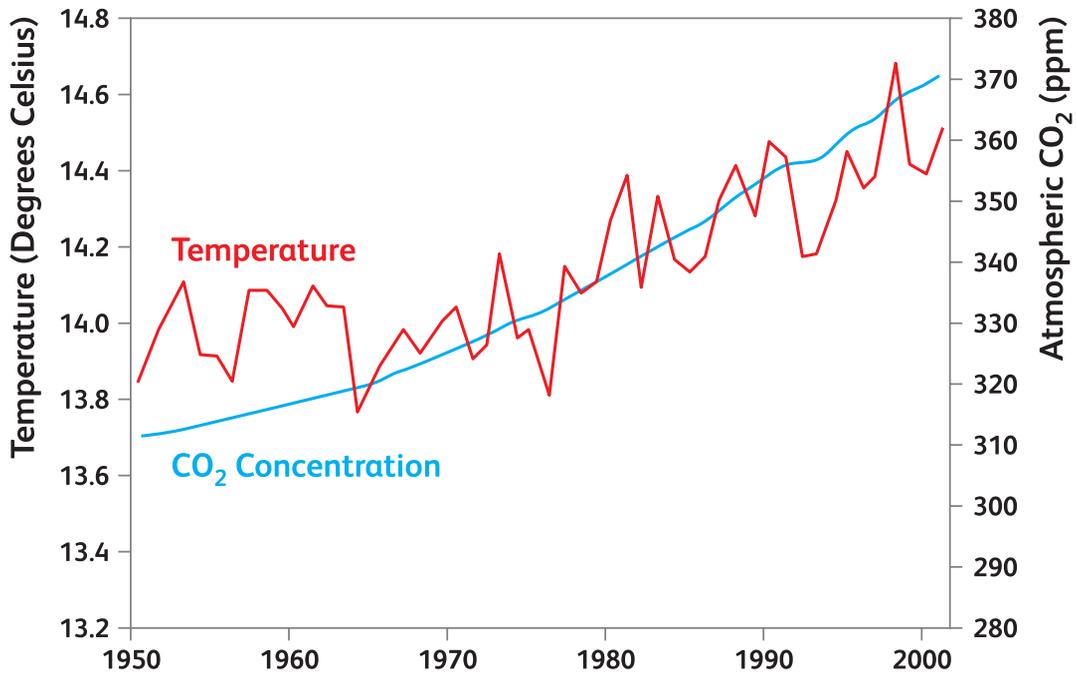
Date	Budburst	First flowers	First leaves	Fruit/ seeds ripen	Leaves fall	Full tint
2005	3rd April	8th May	14th April	18th August	22nd Oct	18th Oct
2000	2nd April	30th April	18th April	5th Sept	20th Oct	18th Oct
1990	21st March	1st May	29th March			
1980		14th May				
1970		20th May				

## Horse Chesnut

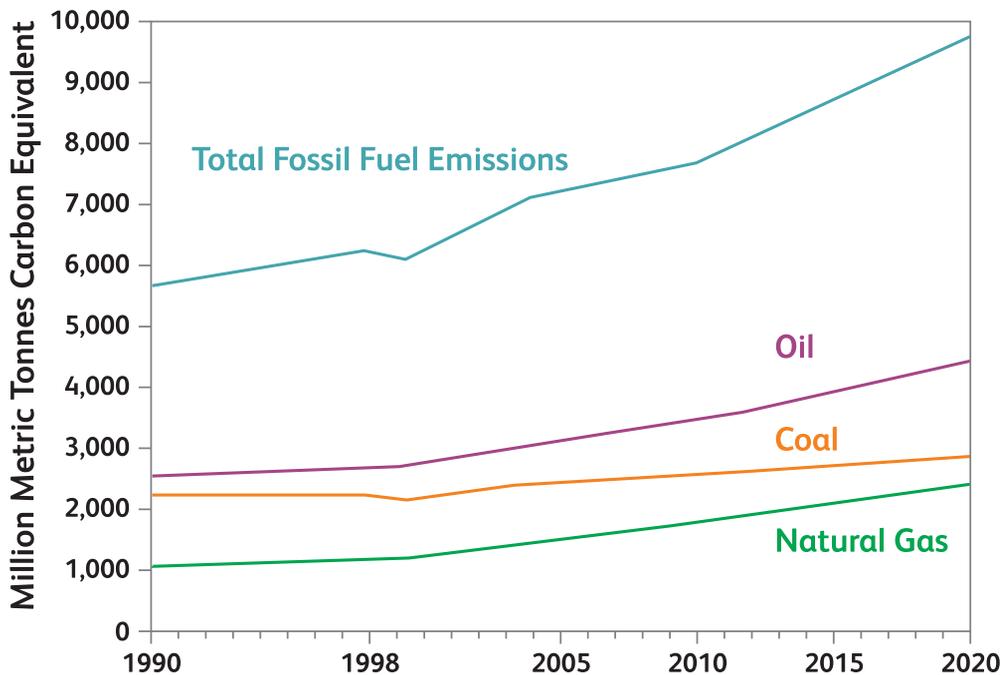
Date	Budburst	First flowers	First leaves	Fruit/ seeds ripen	Leaves fall	Full tint
2005	25th March	30th April	5th April	17th Sept	20th Oct	13th Oct
2000	23rd March	2nd May	7th April	27th Sept	24th Oct	16th Oct
1990	18th March	14th April	25th Feb			
1980	5th April	12th May	9th April			
1970		12th May	17th April			

## Resource 2 - Climate data

### Average Global Temperature and Atmospheric Carbon Dioxide Concentrations, 1950-2001

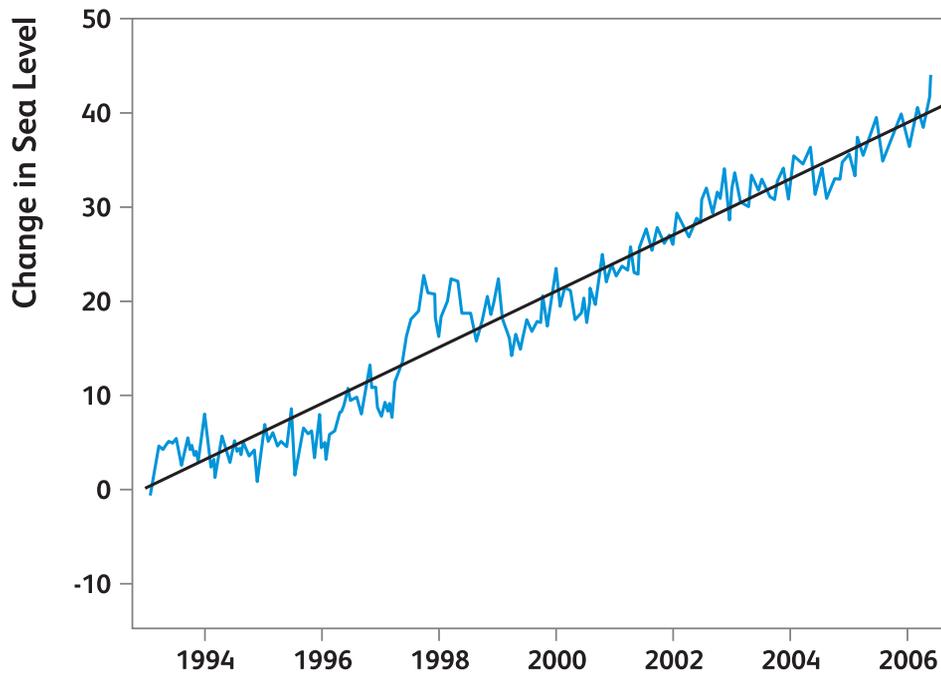


### World CO<sub>2</sub> Emissions

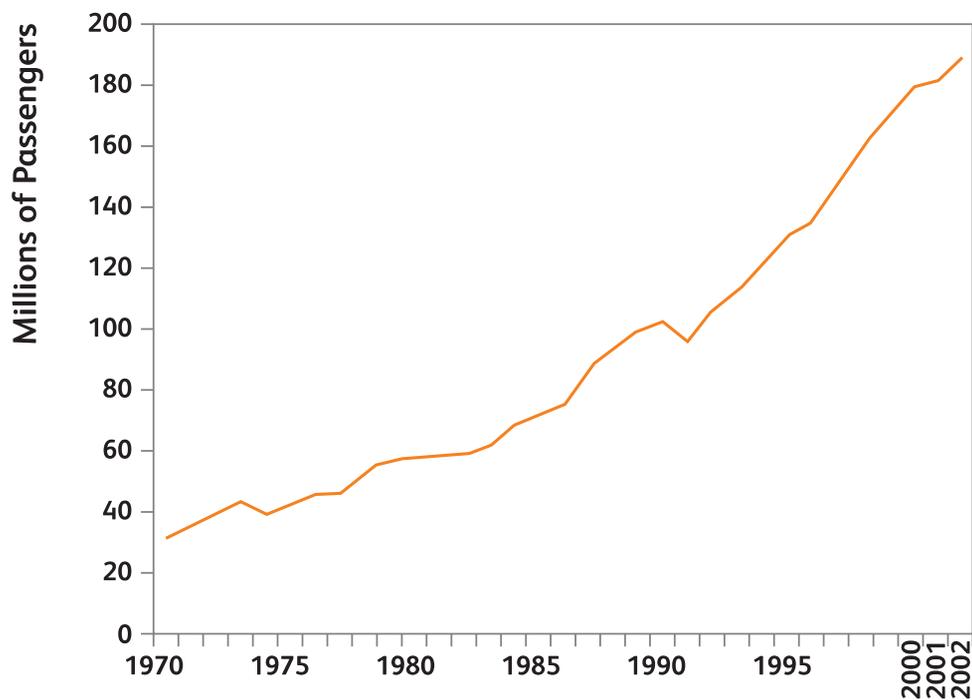


## Resource 2 - Climate data (continued)

### Mean Sea Level Rise



### Number of Passengers at UK Airports



# Resource 3 - Trees, Ecosystems and Sustainability



1	2	3
4	5	6

 Me

 School

 Country

# Resource 4 – Tree Cycle

Note: the proper order should start with photosynthesis in box one (top left) and end with respiration in box 6 (bottom right).

## Photosynthesis

Light from the sun gives the tree energy to convert CO<sub>2</sub> and water into sugars and lots of oxygen.

The sugars containing the carbon from photosynthesis are transported through the inner bark of the trunk around the tree, called phloem.

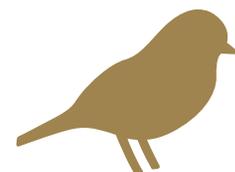
Dead leaves and twigs collect at the bottom of the tree. This is called detritus. Much of the carbon stored by the tree goes into the soil.

The roots grow by using the sugars created by photosynthesis. This causes small amount of CO<sub>2</sub> to be produced.

Much of the detritus on the ground is eaten by detritivores such as worms or is decomposed by fungi and bacteria. This causes small amounts of CO<sub>2</sub> to be produced.

## Respiration

The tree needs to use some glucose (sugar) and oxygen to survive and grow. This means a small amount of CO<sub>2</sub> is produced.



## Resource 5 - Problems

A few suggestions to help your students think... if they need help! All these actions add to climate change or destroy forests so affect trees directly or indirectly.

- Increasing car ownership.
- Using coal to produce electricity.
- Deforestation.
- Cheap flights.
- Destroying peat bogs.
- Buying too many things we do not need.
- Using the car for short journeys.
- Leaving lights and electrical appliances turned on.
- Over-heating the house in winter.
- Buying beef or soya from the Amazon.



## Resource 6 – Solutions

A few suggested actions to help your students start thinking...if they need it!

### Individual Actions

- Walk more
- Turn off lights
- Close windows when the heating is on
- Draw curtains in the evening
- Turn heating down by 2°C
- Reduce, reuse and recycle more

### Schools Actions

- Fit low energy light bulbs
- Install an energy efficient boiler
- Buy low carbon emission vehicles
- Generate energy using a woodchip boiler
- Insulate all school buildings to a high standard
- Produce your own renewable energy
- Serve locally sourced food
- Do not serve junk food
- Plant trees in the school grounds
- Only buy recycled products where available

### National Actions

- Set a national cap for carbon emissions
- Issue carbon credit cards
- Invest in renewable energy research and technologies
- Ban all cars failing emission standards
- Nationwide tree planting campaign
- More investment in public transport
- Build high speed train links between all cities
- Introduce a carbon tax

## 8. Exploring Biodiversity

In this final section of the teachers' guide you will find three activities to help you explore trees in more detail. These activities could be used at the start of your work with monitoring your trees or at any time during your work.

On the project website you will be able to report the results of these activities if you wish to do so.

### ACTIVITY 1 - Tree stories

Trees represent small ecosystems in which millions of irreplaceable stories take place each day. In many respects they are humanlike. They have their own forest families; they can show feelings as well as sadness and diseases. They differ from us with their lifestyle: unlike us they never damage the environment they live in.

Trees have no mouth yet in spite of this they communicate daily with us. We should try to understand them, to listen to them and to recognise signals they have been sending us, to learn lessons from their life and behaviour and what they mean for us. In this period of climate change and huge loss in biodiversity, trees can be a source of our inspiration and fountain of wisdom. They carry a message for the future and they themselves are a prerequisite of the future. What do you think trees would say if they could speak?

### Learning outcomes:

1. To understand the importance of trees to man and to the living planet.
2. To understand the role of trees to reduce biodiversity loss and reduce the impact of climate change.
3. To recognize the basic principles of a sustainable lifestyle.

**Skills:** observation, investigation, sorting information, deduction, system thinking

**Resources:** worksheets "Leaf to you", "Windblown words", "Stories of my tree"

**Venue:** Part A – classroom  
Part B – school yard, street, park, meadow

**Time:** Part A – 45 minutes  
Part B – 30 minutes regularly during the year

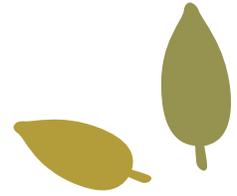
### Methodology:

#### PART A

1. At the beginning of a class put this simple question to your students: "What does a tree mean to you?" Give them enough time to state their answers and record them on the board or a flipchart.
2. Tell students that every tree although not having a mouth talks. Even though it is not easy to understand the tree language one tree has decided to write you a "leaf" letter. The tree has not sent this letter by post but by wind. Unfortunately when flying to you some words were blown away from the letter by the wind.
3. Give out worksheets "Leaf to you" and "Windblown words" to each pair of students. Their task is to fill in the gaps with the correct words and to understand the message of the letter.
4. Read completed "Leaf to you" together and check all answers. Explain unfamiliar information or new terms. Stop at particular topics of the letter and lead discussion using follow-up questions, for instance:
  - What things do people and trees have in common?
  - How are trees important for humans, other living plants & animals and the planet Earth?
  - How are humans and trees managing and using natural resources?
  - Which of the trees treasures or abilities are the most important according to you and why?
  - Do you know any songs, poems or legends about trees?
  - How can trees communicate and express their stories?
  - Do the diseases of trees have connection with man and climate change?
  - What can we learn from trees?
  - What part do you think you play in the story you have just read?

## PART B

5. Tell students that every tree tells many remarkable stories and adventures. Now, they can learn how to understand trees and recognise their voice. Pass the worksheet “Stories of my tree” to every pupil. Go through all the items in the table and talk about possible stories they could contain.
6. The mission for every pupil is to choose a tree/trees close to them (school yard, city park, street), ideally BEAGLE trees they are monitoring within the project. They should use the recording sheet to keep a record of stories observed during each visit to the tree/trees during each phenological phase.
7. After collecting a sufficient amount of data, for instance at the end of every season, they will write a letter called “Stories of my tree”. They can upload their letters to their BEAGLE trees on [www.beagleproject.org](http://www.beagleproject.org). Thanks to them, trees will have a chance to speak to everybody.



# Worksheet: Leaf to you

My name is Tree. My story is a long one. It is a story of happiness and friendship, but also of sadness.

Maybe you have never thought about how similar trees and humans are. Just like you I am very old, developing from the waters of our Earth over 3.8 million years ago. The beauty of the Earth we see all around us today is due to the miracle called ..... We both have been a part of it, although each of us plays a different role in it. I, you and all other plants and animals exist only due to our environment – the sun, water, nutrients, air, ..... and soil. Though we are not identical we ..... on each other. The ..... remains our common and only home.

Nature has given us several special abilities. We have the ability to accommodate many plants and animals. We are a home and a hotel for them, a world they cannot exist without. Did you know that as many as 300 types of insect can live in one ..... tree?

You have discovered many ways in which trees can help you. Our wood helps you to build houses and ships, forest fruits and wildlife provide food to eat. The most important treasure from trees is oxygen. Millions of years ago the Earth's air was not safe for man. It contained a large quantity of harmful carbon dioxide. Together with other green plants we learned to use this gas to create oxygen. We released ..... into the atmosphere and enabled life to develop. We became the green lungs of the Earth.

With the growing number of people our lives with Man started to change. Energy from the sun was not enough for Man. He learned how to obtain more energy so as to light up the night time – .....; to be warm in winter – .....; to have his table always full without effort – modern .....; to travel fast – ..... For his lifestyle he needs more and more energy which he obtains by burning coal, oil and ..... Thus he releases ..... into the atmosphere and causes it to warm up.

My life is not what it used to be. The water that falls from the skies is no longer clean. The climate is getting warmer. My health is getting worse. I suffer from diseases. Damaged roots do not absorb water. Leaves have been falling too soon. Flowers do not ripen into fruits.

Man knows that he is a part of nature too. Everything he has changed in the natural world will impact on him. He has to make proper use of natural resources. Have a look, for example, at us Trees. We have to eat, drink and work all the time. However, we do not pollute the ..... we are living in. What about you, have you thought about how you have been using natural resources? As a matter of fact, with this letter I wanted to tell you that my story is also your story. Its future is now in your hands.

# Windblown Words

life

lighting

depend

Earth

heating

beech

oxygen

transport

climate

farming

natural  
gas

carbon

environment

# Worksheet: Stories of my Tree

Name of the tree:

Locality:

Phenological phase:

Date:

Stories:

Notes:

Tree as a home

Tree as a factory

Tree as a natural pharmacy

Tree benefits for me

Spirit of tree - history, tales, myths, poems

Tree problems, threats and sorrows

Tree care and first aid

# Leaf to you - completed

My name is Tree. My story is a long one. It is a story of happiness and friendship, but also of sadness.

Maybe you have never thought about how similar trees and humans are. Just like you I am very old, developing from the waters of our Earth over 3.8 million years ago. The beauty of the Earth we see all around us today is due to the miracle called **life**. We both have been a part of it, although each of us plays a different role in it. I, you and all other plants and animals exist only due to our environment – the sun, water, nutrients, air, **climate** and soil. Though we are not identical we **depend** on each other. The **Earth** remains our common and only home.

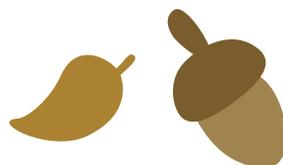
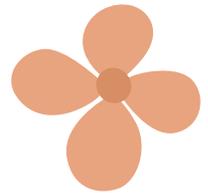
Nature has given us several special abilities. We have the ability to accommodate many plants and animals. We are a home and a hotel for them, a world they cannot exist without. Did you know that as many as 300 types of insect can live in one **beech** tree?

You have discovered many ways in which trees can help you. Our wood helps you to build houses and ships, forest fruits and wildlife provide food to eat. The most important treasure from trees is oxygen. Millions of years ago the Earth's air was not safe for man. It contained a large quantity of harmful carbon dioxide. Together with other green plants we learned to use this gas to create **oxygen**. We released oxygen into the atmosphere and enabled life to develop. We became the green lungs of the Earth.

With the growing number of people our lives with Man started to change. Energy from the sun was not enough for Man. He learned how to obtain more energy so as to light up the night time – **lighting**; to be warm in winter – **heating**; to have his table always full without effort – modern **farming**; to travel fast – **transport**. For his lifestyle he needs more and more energy which he obtains by burning coal, oil and **natural gas**. Thus he releases **carbon** into the atmosphere and causes it to warm up.

My life is not what it used to be. The water that falls from the skies is no longer clean. The climate is getting warmer. My health is getting worse. I suffer from diseases. Damaged roots do not absorb water. Leaves have been falling too soon. Flowers do not ripen into fruits.

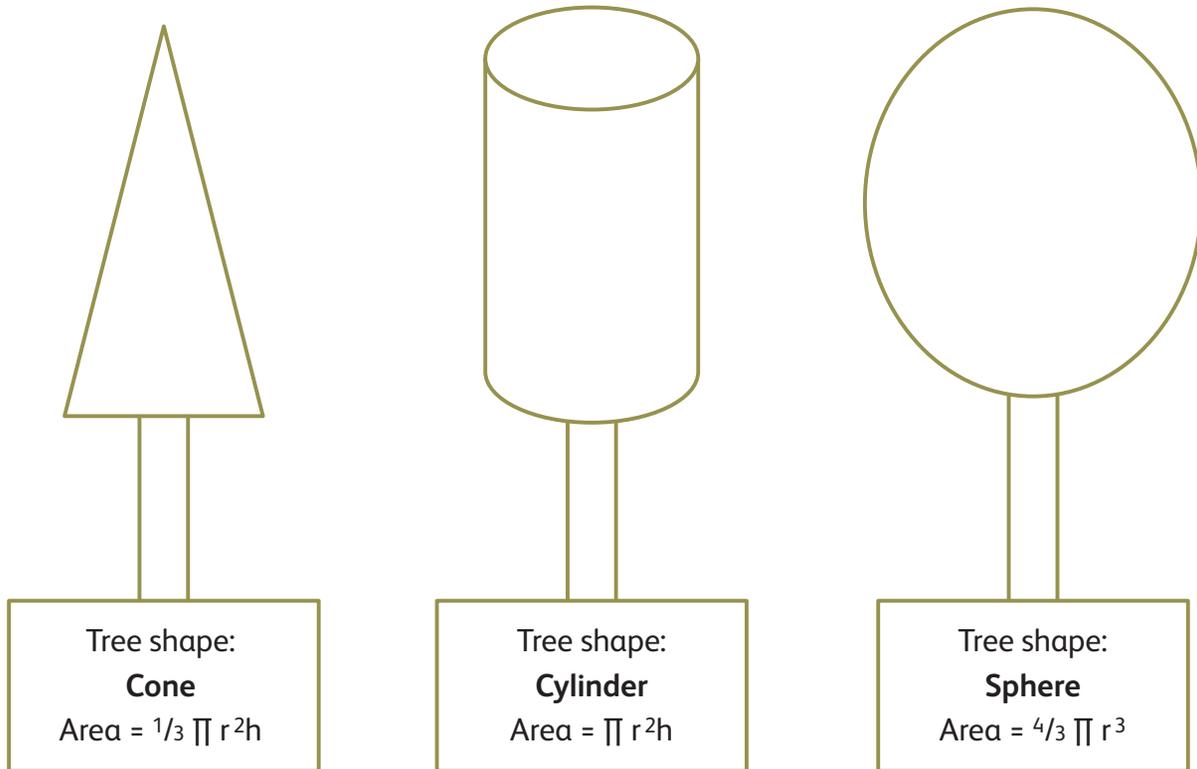
Man knows that he is a part of nature too. Everything he has changed in the natural world will impact on him. He has to make proper use of natural resources. Have a look, for example, at us Trees. We have to eat, drink and work all the time. However, we do not pollute the **environment** we are living in. What about you, have you thought about how you have been using natural resources? As a matter of fact, with this letter I wanted to tell you that my story is also your story. Its future is now in your hands.



## ACTIVITY 2 - Carbon Dioxide and trees

All trees, including the ones you will have seen as part of the BEAGLE Project, play a large part in storing carbon and processing carbon dioxide into oxygen by the process of photosynthesis. This process normally takes place in the leaves. Trees come in all shapes and sizes, which ones are better to absorb carbon dioxide?

Below are three different trees:



The heights of all the above trees are 12 metres. The radius of each tree is 4 metres.

### Questions:

- Calculate the volume of each of the trees. Which of the trees has the greatest volume and would therefore be able to process the greatest amount of carbon dioxide?
- Most deciduous trees will only have leaves for no more than nine months of the year. How will this affect the amount of carbon dioxide that is being processed by these trees? Conifer trees have needles and will photosynthesise all year. However, conifer trees also block light from hitting the ground and so can reduce biodiversity. Weighing up carbon dioxide absorption and biodiversity, what is the best solution if you were to plant an area of trees?
- Many organisations are now using trees as a way of reducing their carbon footprint. In 2003 the UK produced approximately 54 million tonnes of carbon dioxide. One tree processes on average one tonne of carbon dioxide per year. It would be difficult to counteract the effects of CO<sub>2</sub> with trees alone. Create a mind map of different ways in which we can reduce or combat levels of CO<sub>2</sub>.
- Go online and calculate your own carbon footprint. There are many websites where you can do this, for example [carboncalculator.direct.gov.uk/carboncalc/html/](http://carboncalculator.direct.gov.uk/carboncalc/html/). How many and what combination of the different shaped trees would you have to plant each year just to counteract your own carbon footprint? Which shape tree may be the best to plant? Look at the graphs of CO<sub>2</sub> emissions over recent years from section 7; is this a sustainable solution in the long term when the population in Europe is also growing?

## ACTIVITY 3 - Biodiversity story: Tree as a living island

Trees are one of the most visible and magnificent among all land organisms. Trees are one of the longest living organisms in the world. Some of the oldest oaks in Poland reach an age of more than 600 years. The oldest recorded living tree, a bristlecone pine, grew in the mountains of California and reached an age of over 4700 years! It makes trees the most stable and long-existing element of land biodiversity.

In the landscape each single tree looks like a green island hidden in the blank spaces of old maps. What a great temptation for organisms of crowded ecosystems to colonise such a promising island! Like a piece of dry land for a ship-wrecked man, such 'green islands' offer lots of natural goods: space to live and rest, food, water and shade. Sunshine filtered through dense foliage gives good camouflage against predators. You would be surprised how many animals and plants have come to use these elements of our tree during their life cycle. They compete with each other, eat leaves and fruits, hunt prey, lay eggs in nests or hollows and dig shelters in the trunk or under tree roots. Tree bark can be covered by a dense garden of lichens and mosses.

The fallen leaves and branches rot and crumble, offering hiding places and food for a vast array of fungi, ants, woodlice, beetles, earthworms and other forms that live mostly or exclusively in this habitat. When the tree is cut down or fallen, the soil and ground litter dries out and warms up creating a new environment for a different array of animals, fungi and microorganisms that are not successful in the darkness of a closed canopy or forest.

**Subjects:** Biology, English, Citizenship.

### Learning outcomes

- To observe different relations in the community connected with trees.
- To understand how energy flows through trees.
- To understand the relationships between insects and plants found on trees and their role in the tree ecosystem.

### Resources

The following resources might be useful:

- Functional key (from BEAGLE website)
- Observation sheet 1 and 2
- Binocular for observation of birds
- Magnifying glass for insects
- Sample boxes
- Tweezers
- Collecting pot
- Sweep net
- Cotton sheet
- Paper
- Brush
- Camera

### Methodology

There are several good starting questions for this activity. For example:

- Why are there so many species?
- Why do animals and plants use trees in so many ways?
- Why do some species sing in the summer time while other species in the early spring?
- What happens when humans behave in unsustainable ways?
- Why are all these tree dwelling plants and animals important?
- What would happen without pollinators such as bees and flies?

All activities should bring us to important reflection: Destruction of one single tree also means a "death sentence" to several other species!

Preferably the tree is the same as for phenological observation. Minimum and maximum options:

1. Time for observation: one lesson (30 to 45 minutes)
  - Introduction (explanations, dividing into groups etc.)
  - Handing out tasks and equipment
  - 15 to 30 minutes for observations and investigations (see Field protocol sheet)
  - Taking pictures
  - Summarizing by the working groups
2. Monitoring throughout the year: observing in 4 different phenological phases
  - When the trees have their first leaves
  - When the tree first flowers
  - When the berries are ripe or when the seeds have developed
  - During the winter
3. 10 min per week which can be done in lessons of as an extra-curricular activity outside of classroom sessions.

Of course it is impossible to count or classify all species. Try to group organisms by the role which they play in the community associated to your tree. The functional key will help you to place observed species in the functional categories listed on observation sheet 2.

## Out of classroom observation

1. Start the observation from a distance of 50 metres. Watch the birds, squirrels or other animals using binoculars. Note them in the Field protocol (observation sheet 1).
2. Reaching the tree observations should cover all accessible elements of the tree and the soil surface under the canopy: leaves, trunk, branches, surface roots, deadwood, dead leaves. Note the observations in observation sheet 1.
3. Trunk: Which animals, plants, lichens, fungi, holes and cavities can be observed on the trunk?

4. Leaves: Examine leaves on and under the tree from both sides of the leaf. Which organisms, prints of eaters (galls) and traces of mining insects can be observed?
5. Soil surface (1 m<sup>2</sup> under the tree) including visible roots: Look for earthworms, woodlice and other decomposers. Examine the holes under the roots. Look for traces of animals eating fruits (footprints, faces, rest of seed shells).
6. Branches and canopy: What can be observed from the ground (nests, mistletoe etc.)?

## Analysis

You will need to allow time to analyse your results. Try to encourage students to move from their recording of data to expressing their own views and opinions based on data. Here are some suggestions:

1. Find the appropriate functional group for each organism you observe: species eating the leaves, wood, fruit, feeding on flowers, pollinators, decomposers, predators, temporarily living and breeding, visitors. Fill in observation sheet 2 (Functional groups). Are there any relationships between the functional groups?
2. Discuss interrelationships among functional groups and between the tree and the species.
3. Discuss the situation if the tree was removed by man or fell down and left to decay naturally. What happens to the community living on the tree?
4. Which pollinators did you observe? Why are pollinators so important?
5. Discuss the situation when the tree buds earlier in the season - what are the consequences for the species connected to the tree? What about other changes?
6. Do the communities living on trees change throughout the year (changing seasons)? Discuss your observations.
7. Compare the results among the countries of the BEAGLE project.
8. How could climate change affect the community living on the tree?
9. Which trees will be found in your area in the year 2080? Make use of figure 1a-d.
10. How can your behaviour contribute to more sustainable development of your area?

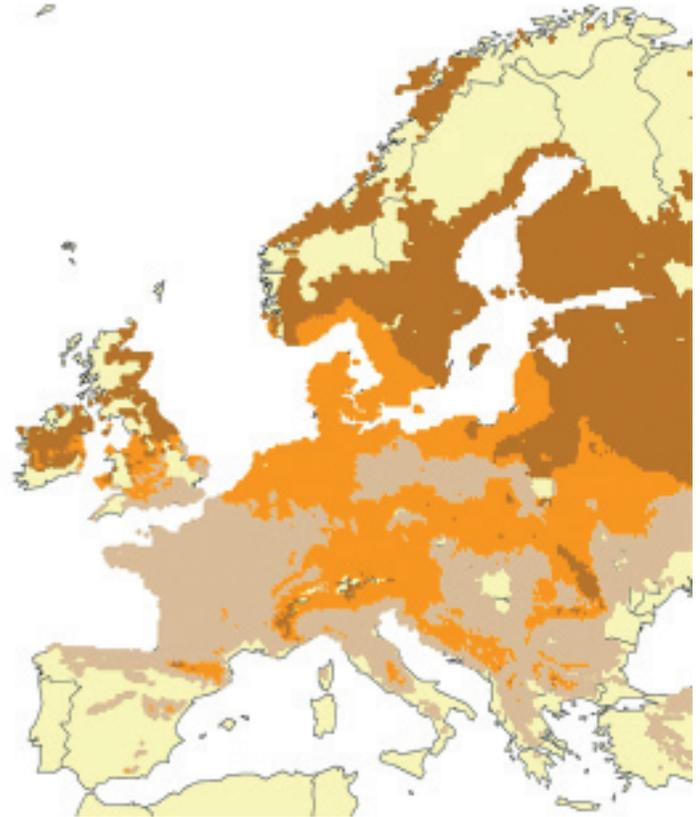
## Figure 1a-d

Compare the maps given below: Present distributions of beech and oak throughout Europe are presented on the left side (1a,c). At the right side (1b,d), possible distributions are shown for the year 2080, based on scientific scenarios (see [www.alarmproject.net](http://www.alarmproject.net)). Grey: lost areas, dark brown: new areas, orange: remained areas. The scenario A1 refers to unsustainable economic growth strategies and climate warming by 4°C.

Results for other scenarios and other tree species you obtain on [www.pronas.ufz.de](http://www.pronas.ufz.de) (from February 2010).



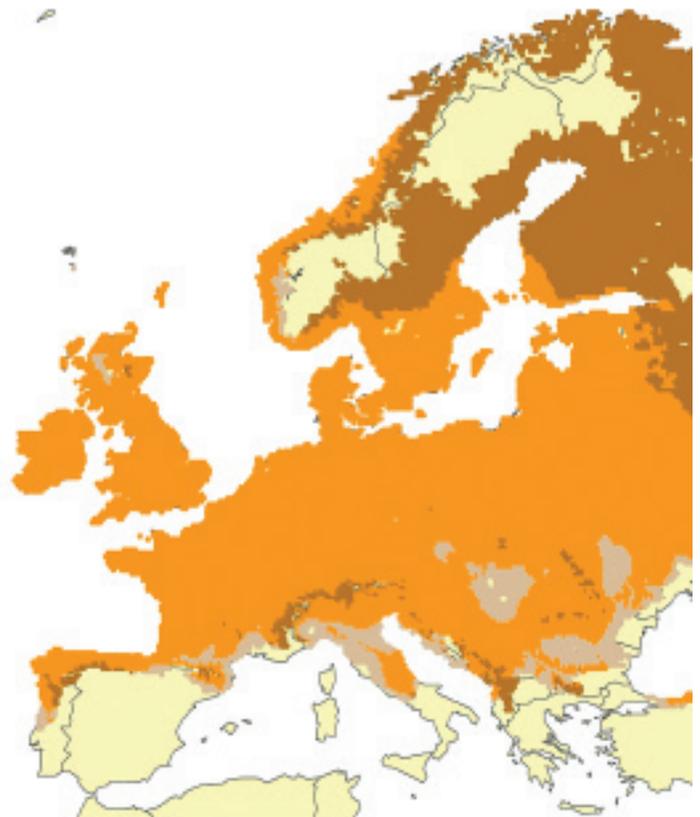
a) Beech *Fagus sylvatica* (present)



b) Beech *Fagus sylvatica* 2080 (Scenario A1)



c) Oak *Quercus robur* (present)



d) Oak *Quercus robur* 2080 (Scenario A1)

# Field protocol (Observation sheet 1)

## Biodiversity on the tree

Please fill in the numbers of different forms / species you can find!

Category or name of species (in alphabetic order)	On the trunk	On or in the leaves	On the branches	In the canopy	On the ground in the leaf litter	On the roots
ant						
bark beetle						
bat						
blackbird						
bracket fungus						
bee						
butterfly						
caterpillar						
deer						
earthworm						
fly						
gall						
ivy						
jay						
leaf miner						
lichen						
mistletoe						
moss						
moth						
mouse						
mushroom						
millipedes						
owl						
snail						
spider						
squirrel						
stag beetle						
tit						
wasp						
wild boar						
woodlice						
woodpecker						
other ...						

## Functional groups (Observation sheet 2)

Biodiversity on the tree

What do organisms do on the tree – which functions do they have?

Functional groups								
Eating leaf	Eating wood	Eating seeds or fruits	Pollinators	Decomposers	Predators	Temporarily living and breeding or nesting	Visitors	Permanently living

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### Observations on the behaviour or phenology of species

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## 9. National Contact Points

Please get in touch with one of the organisations below:

### UK – Field Studies Council

BEAGLE Project  
Field Studies Council Head Office  
Preston Montford  
Montford Bridge  
Shrewsbury SY4 1HW

Tel: 01743 852126  
Fax: 01743 852101  
Email: [global@field-studies-council.org](mailto:global@field-studies-council.org)  
Website: [www.field-studies-council.org](http://www.field-studies-council.org)

### Norway – Centre of Schools' Science Education, University of Bergen

Skolelaboratoriet i realfag  
Universitetet i Bergen  
Allégt. 41  
N-5007  
Bergen

Tel: +4755582259  
Email: [post@miljolare.no](mailto:post@miljolare.no)  
Website: [www.miljolare.no](http://www.miljolare.no) & [www.sustain.no](http://www.sustain.no)

### Hungary – Hungarian Society for Environmental Education

1113 Budapest,  
Zsombolyai utca 6

Tel: +36 1 3214796  
Email: [beagle@mkne.hu](mailto:beagle@mkne.hu)  
Website: [www.mkne.hu](http://www.mkne.hu)

### Germany – Helmholtz Centre for Environmental Research

4 Theodor-Lieser Strasse  
Halle  
06120

Tel: 49 345 5885315  
Email: [Karin.Ulbrich@ufz.de](mailto:Karin.Ulbrich@ufz.de)  
Website: [www.ufz.de](http://www.ufz.de)

### Slovakia – Slovak Environment Agency

28 Tajovskeho  
Banska Bystrica  
975 90

Tel: +421 48 4374175  
Email: [katarina.koskova@sazp.sk](mailto:katarina.koskova@sazp.sk)  
Website: [www.sazp.sk](http://www.sazp.sk)

### Poland – University of Warsaw, Centre for Environmental Studies

93 Ul. Zwirki I Wigury  
Warsaw  
02-089

Tel: +48 22 8222261  
Email: [ucbs@uw.edu.pl](mailto:ucbs@uw.edu.pl)  
Website: [www.ecbs.edu.pl](http://www.ecbs.edu.pl)

