In response to the climate emergency

Leeds CITY COUNCIL

TEACHING RESOURCE

WOODLAND CREATION

WELCOME!

This education pack has been produced through Leeds City Council's Woodland Creation project – part of our response to the Climate Emergency declared in Leeds in 2019. Through this pack we hope to help children (and adults!) learn about climate change, its causes and impacts, and how planting trees can help combat it.

The pack includes background information, discussion points, hands-on activities and games. The activities link well with the Key Stage 2 and 3 Science, along with Citizenship and Geography, and curriculum links can be found on page 42. You can find resources for many of the activities in the Activity Toolkit and more in-depth information in our Extra Notes. We've also provided information on how our Woodland Creation scheme will work, and other ways to get involved.

Help the environment! Please save paper by only printing the sections you need, and by carefully reading the printing instructions before doing so. If you laminate game resources they can be reused again and again.

We hope you have fun doing these activities! Please tag us #woodlandcreationleeds if you post any of your activities on your social media. Follow us on social media to find out how we're getting on!

@leedsparks

Leeds Climate, Energy and Green Spaces Service

Child Friendly Leeds

Best wishes,

Climate, Energy and Green Spaces Service
Leeds City Council

CONTENTS

WHAT IS THE WOODLAND CREATION INITIATIVE?

Climate change is making our world heat up, and unless we act fast there are going to be huge consequences for both human life and the natural world. As we explore in this pack, much of climate change is driven by the amount of carbon there is in the atmosphere. In 2019, Leeds City Council declared a Climate Emergency, and subsequently made a commitment to making Leeds carbon-neutral by 2030. You can find out about how we plan to do this by searching for Climate Change on leeds.gov.uk, but here we're focussing on tree planting.

Trees are really important in helping to combat climate change, and bring many other benefits. As well as capturing carbon emissions and providing wildlife habitat, increasing tree cover creates new green spaces for people to enjoy whilst cooling down urban environments, and acts as a form of natural flood management, helping to lessen the impact of flood events like those that have caused such damage and disruption in Leeds in the last few years.

Thanks to feedback from The Big Leeds Climate Conversation and the Leeds Youth Council, we know that combatting climate change and protecting biodiversity are important to young people of Leeds and we're excited that we have come up with a project that does both!

Leeds City Council's Climate, Energy and Green Spaces service have committed to creating new woodlands all across the city. The trees we are planting will contribute to the White Rose Forest project, and on the whole we aim to double tree cover across the Leeds region by 2050.

Over the next 25 years 5.8 million trees will be planted across Leeds through our Woodland Creation project, creating 1250 hectares of woodland. We are going to plant 50 hectares of woodland each year!

We won't be planting just any old trees – we've carefully selected species that can withstand potential future climate change, and will be complementing these with trees we grow ourselves in our plant nursery - the Arium - from seeds gathered in Leeds parks and greenspaces by volunteers and members of the public.

There will be opportunities for individuals, schools and groups to get involved every step of the way – from gathering seeds, to seeing how they're grown on at the Arium, to helping plant our new woodlands.

We can't wait to get stuck in – can you?

WHAT IS THE EMERGENCY?

Our Woodland Creation is part of Leeds City Council's response to the Climate Emergency, declared in 2019. In its Climate Emergency report, the council accepted that 'very urgent action is required to make our contribution to containing global temperature rises with 1.5degreesC'. But why are temperatures rising and why is this so important?

In order to find answers, we need to look at how our atmosphere works, and learn about something called the Greenhouse Effect.

For the purposes of this pack, we're going to simplify the definitions, but there are some Teacher's Notes at the back to give you an understanding of the bigger picture. We will direct you to these at the relevant points in your journey.

THE GREENHOUSE EFFECT

If you've ever been inside a greenhouse or a conservatory, you'll know they can get really hot inside! The Earth is surrounded by a layer of gases that act like the glass panes of a greenhouse. They let heat from the sun in, but don't let it all escape. Our 'greenhouse gases' normally keep the planet at just the right temperature for us – and the rest of the natural world - to live. Without them, the Earth would be too cold and life as we know it would not be able to exist!

Extra Notes 1

ACTIVITY:
MAKE YOUR OWN GREENHOUSE!

AIM:
To show how the Greenhouse Effect works

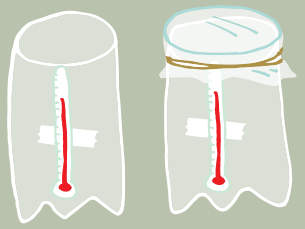
LENGTH OF ACTIVITY:
10-15 minutes to set up, then leave them for 30 minutes before taking measurements

WHERE TO DO THE ACTIVITY:
outdoors if it is a sunny day – if you are doing it indoors you will need a light source

WHAT YOU NEED:

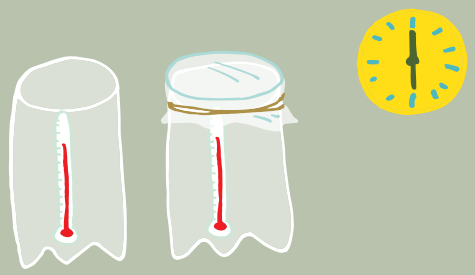
- 2 x 2l plastic bottles per group
- 2 x thermometers per group
- Sticky tape
- Clear plastic wrap to go over the top
- Rubber bands to seal the plastic in place
- Water (optional); ice cubes (optional)
- Paper and pencil to record your results

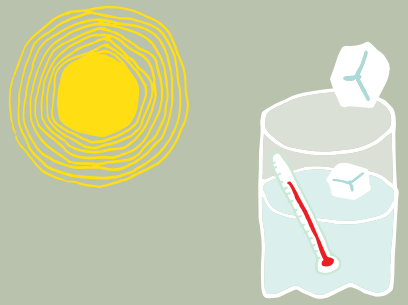
STEP BY STEP:



1. Carefully cut the curved tops off the bottles (it may be best for an adult to do this). Then, place a thermometer into the bottom of each bottle, making sure children will be able to take a reading without moving it or opening the bottle (you may want to use tape to stick it to the side of the bottle, facing out).

2. Cover the top of one of the bottles with plastic wrap and seal it with the rubber band. (Alternatively you may be able to fit the top of the bottle back on!). This represents the gases in the atmosphere.



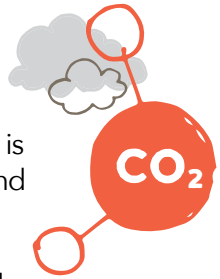


3. Carefully carry the two containers outside and put them side by side in the sunshine. The thermometers in each both need to be facing the same way. Make sure children know which theirs is! Leave them in place for 30 minutes or longer, then come back to them and take a reading of the temperatures in each. Which one is hotter? Why do you think that is?

4. Further investigations:
   - put water in the bottles and measure how warm the water gets in each
   - put ice cubes in the bottles and time how long it takes for the ice to melt in each
   - put water in, mark the water level on the side of the bottles, add ice cubes and measure what the change in water level is by the end of a certain period of time.

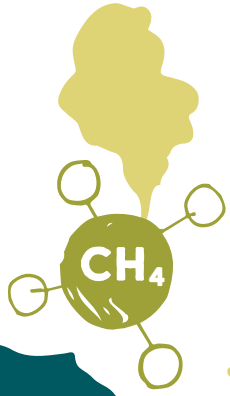
WHAT ARE 'GREENHOUSE GASES' AND WHERE DO THEY COME FROM?

The main three gases that keep the greenhouse effect going are carbon dioxide (CO_2), methane (CH_4) and water vapour (H_20).



Carbon dioxide is what humans and other animals breathe out, in a process called respiration.

Water vapour in the atmosphere mainly comes from evaporation, which is what happens when water in the rivers and seas is warmed by the sun and turns into gas. As water covers so much of the earth, there is a LOT of water vapour in the atmosphere.

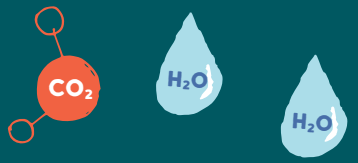


Methane – a very stinky gas – comes from rotting plants, burping cows and trumping humans! More importantly, it also leaks out when humans extract fossil fuels from under the ground. Methane reacts with other gases and turns into carbon dioxide and water vapour.

THE CARBON CYCLE

Carbon dioxide and methane are both part of the carbon cycle.

Carbon is constantly being moved around in nature.

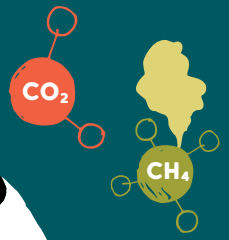


1 Carbon is taken in by plants through photosynthesis (more on this later), and is used to help them grow.

2 When plants die and rot down, the carbon is released back into the atmosphere as methane, which turns into carbon dioxide for other plants to take in.

3 Some plants might be eaten by animals, who burp out methane and who – later – will die and rot down, releasing even more.

4 The methane or carbon dioxide released into the atmosphere can be taken in by plants and the cycle continues.

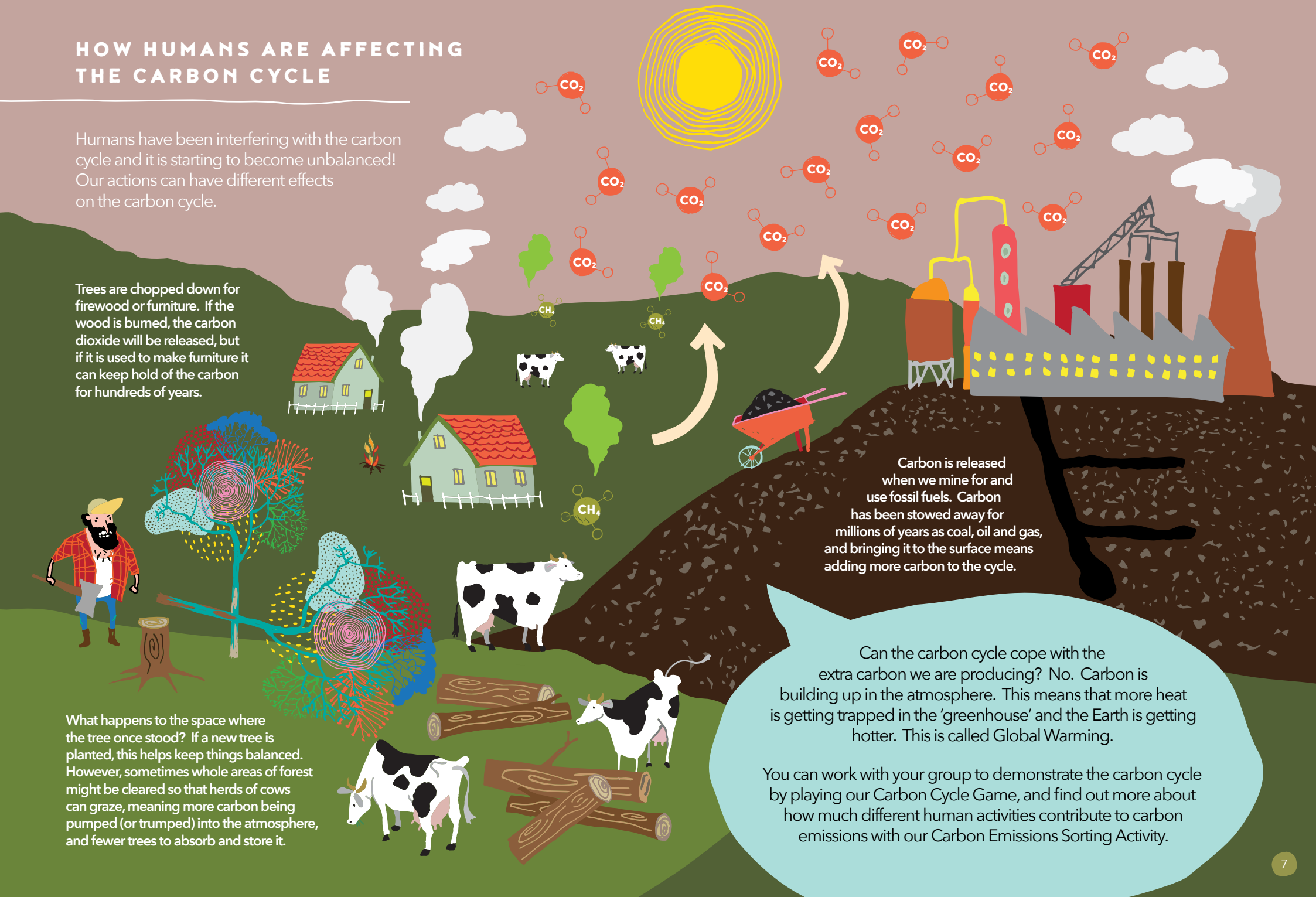


As long as everything is in balance, life as we know it stays the same.

Extra Notes 2

HOW HUMANS ARE AFFECTING THE CARBON CYCLE

Humans have been interfering with the carbon cycle and it is starting to become unbalanced! Our actions can have different effects on the carbon cycle.



Trees are chopped down for firewood or furniture. If the wood is burned, the carbon dioxide will be released, but if it is used to make furniture it can keep hold of the carbon for hundreds of years.

Carbon is released when we mine for and use fossil fuels. Carbon has been stowed away for millions of years as coal, oil and gas, and bringing it to the surface means adding more carbon to the cycle.

What happens to the space where the tree once stood? If a new tree is planted, this helps keep things balanced. However, sometimes whole areas of forest might be cleared so that herds of cows can graze, meaning more carbon being pumped (or trumped) into the atmosphere, and fewer trees to absorb and store it.

Can the carbon cycle cope with the extra carbon we are producing? No. Carbon is building up in the atmosphere. This means that more heat is getting trapped in the 'greenhouse' and the Earth is getting hotter. This is called Global Warming.

You can work with your group to demonstrate the carbon cycle by playing our Carbon Cycle Game, and find out more about how much different human activities contribute to carbon emissions with our Carbon Emissions Sorting Activity.

ACTIVITY: THE CARBON CYCLE GAME

AIM:
To show how the carbon cycle works

LENGTH OF ACTIVITY:
20-30 minutes

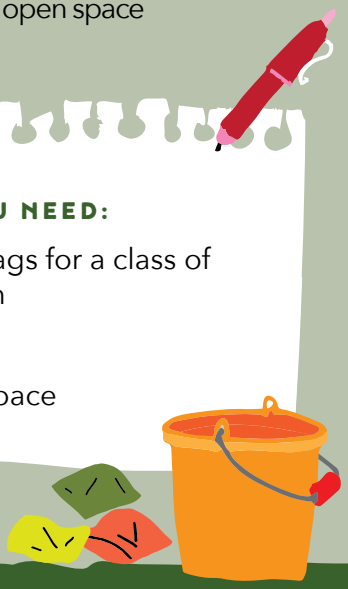
WHERE TO DO THE ACTIVITY:
An open space

WHAT YOU NEED:

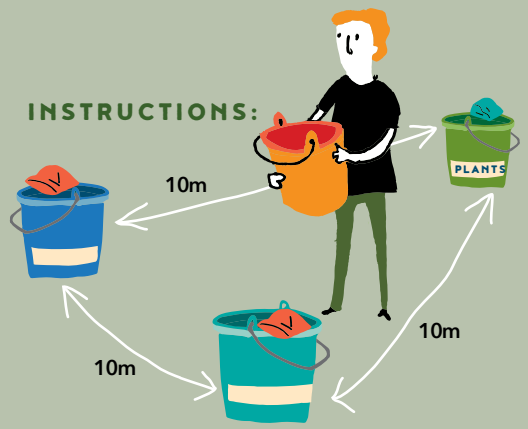
40 bean bags for a class of 30 children

4 buckets

An open space

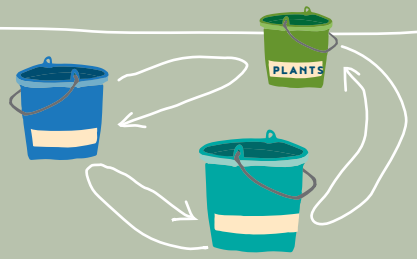


INSTRUCTIONS:



Put ten bean bags in each bucket. Place three buckets about 10m apart in a triangle formation. The buckets represent the ATMOSPHERE, PLANTS and ANIMALS; the bean bags represent carbon.

Split children into three teams and ask them to line up from their bucket, on the outside of the triangle. You stand in the middle with the fourth bucket. Discuss which way round the carbon is cycling before you start.



Round 1: the natural carbon cycle.

Carbon is absorbed from the atmosphere by plants, which provide oxygen and food for animals, who breathe out carbon dioxide. (This is a very simplified version!)

Children run to the next team's bucket, take a bean bag, run back to their bucket and drop it in, then go to the back of the line. ***NB The Atmosphere team take theirs from the Animals, the Animals take theirs from the Plants and the Plants take theirs from the Atmosphere.***

When everyone has had a go, stop and count how many bean bags there are in each bucket. If they are more or less equal, the system is in balance!

Round 2: human interference.

Humans add more carbon dioxide to the atmosphere by burning fossil fuels.

Repeat the activity (having evened up the bean bags in the buckets if needs be) but this time, explain that you have decided to start mining FOSSIL FUELS/STORED CARBON from your bucket!

What does this mean? It means you are going to be putting extra carbon in the atmosphere! While the children do their carbon cycle race, you need to throw your bean bags, one by one, into the Atmosphere bucket. When everyone has had a turn – count up! Which bucket has the most bean bags, so where is there most carbon? Is this balanced?

VARIATIONS:

Humans plant trees and increase the amount of carbon dioxide absorbed: Plant team can take 2 bean bags at a time from the Atmosphere bucket.

Humans farm cows and increase the amount of methane produced: Atmosphere team take 2 bean bags at a time from the Animals.

Humans make furniture from wood and recycle paper, storing carbon: Teacher removes bean bags from the Plant bucket and puts them in the Stored Carbon bucket in the middle. ***NB the Plants may run out!***

For it to be sustainable, more trees need to be planted to replace the ones that have been made into furniture, so again, Plants can take 2 bean bags from the atmosphere.

ACTIVITY:
CARBON EMISSION SORTING ACTIVITY

Carbon conundrums

Lots of things that humans do add carbon into the atmosphere. Some activities produce much more than others. Do you know which are the most carbon-producing?

AIM:
To show how polluting certain activities can be

LENGTH OF ACTIVITY:
20-30 minutes (but resources will need to be printed out first)

WHERE TO DO THE ACTIVITY:
In a classroom – children can work individually or in a group.

WHAT YOU NEED:

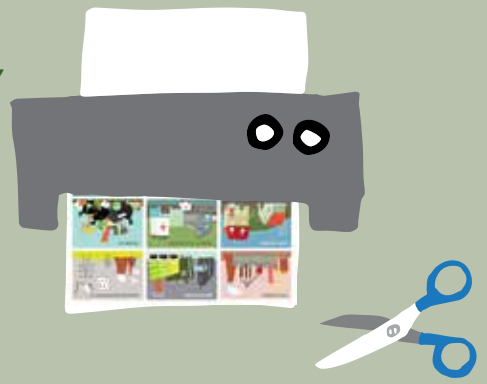
ACTIVITY TOOLKIT 1

Printer

Scissors

Sticky tape

STEP BY STEP:



1 Print and cut out TWO sets of the double sided playing cards from **ACTIVITY TOOLKIT 1** for each group.

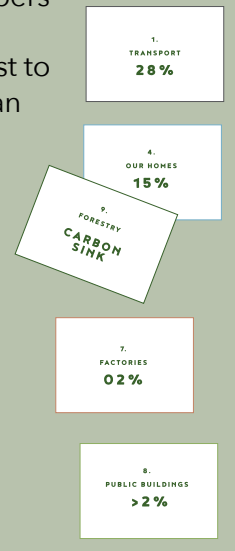
2 Using the first set of cards only, with picture sides facing up, ask the children to first pick the odd one out. (Answer: FORESTRY, which actually removes carbon from the atmosphere.)

3 Then, ask them to work in their groups to put the others in order according to how much carbon they put into the atmosphere, from least to most.

4 Then, provide them with the second set of the cards, this time with the numbers facing up. Ask them to order the cards smallest to largest. (There will be an odd one out again!)

When they have completed the task ask them to turn these cards over. Do the pictures match? Are there any surprises? This topic is explored in greater depth in

Extra Notes 3



ACTIVITY: CAUSE AND EFFECT

What does Global Warming mean for us?

Global warming affects all life on earth but when thinking about its impacts on a global level, we tend to look at how global warming will impact on people. Global warming will lead to sea levels rising and weather becoming more extreme – but what does this mean for humans and their habitats?

AIM:
To show the effects of global warming

LENGTH OF ACTIVITY:
20 minutes for activity (but resources will need to be produced first)

WHERE TO DO THE ACTIVITY:
In a classroom – children can work individually or in a group.

WHAT YOU NEED:

ACTIVITY TOOLKIT 2

Printer and Scissors

Paper and glue to stick cards onto once matched (optional – you may want to reuse the resources instead!)

STEP BY STEP:

1. Provide each child/group with the worksheet/cards from **ACTIVITY TOOLKIT 2.**

2. Explain that a cause is an event or reason that makes something happen.

   An effect is the result of the cause.

3. Then, ask them to work in their groups to match the cause (on the blue cards) to the effect (on the red cards) Can they turn these into sentences using 'because' or 'therefore' or 'which means'?

There is more information including impacts on sea life in **Extra Notes 4**

ANSWERS:

CLOSER TO HOME

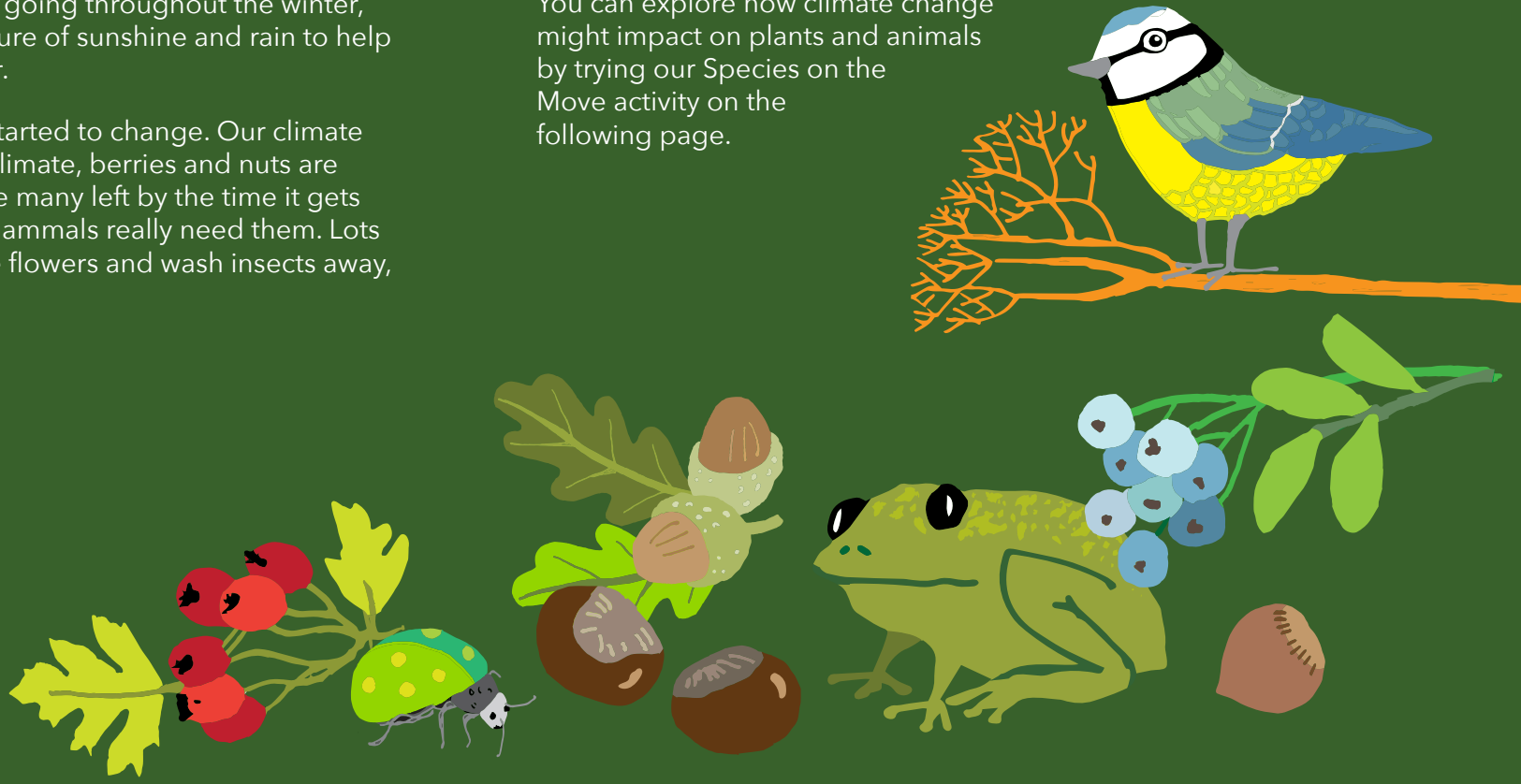
When thinking about how global warming and climate change impacts on our part of the world we can start looking in more detail about their impacts on wildlife.

The wildlife we find in this part of the world is specially adapted to the climate here. Trees drop their leaves in autumn and bluebells flower on the woodland floor before they grow them back again in spring. Birds and small mammals rely on berries and nuts being ripe at certain times of year to keep them going throughout the winter, and pollinating insects rely on a mixture of sunshine and rain to help their food plants to flower in summer.

In the last few decades things have started to change. Our climate is getting warmer. With the warmer climate, berries and nuts are ripening earlier and there may not be many left by the time it gets to winter when the birds and small mammals really need them. Lots of heavy rain in summer can damage flowers and wash insects away, meaning bad news for pollinators.

This means that some species are having to move away from this area. They normally move northwards as its cooler there. However, sometimes they can't find all the things they need in a habitat. This doesn't mean we will have no species at all – species from further south will move up to our area. We want to make sure they can find a home so we need to plan carefully when creating and connecting habitats.

You can explore how climate change might impact on plants and animals by trying our Species on the Move activity on the following page.



ACTIVITY: SPECIES ON THE MOVE

AIM:
To show the effects of global warming on wildlife

LENGTH OF ACTIVITY:
10-15 minutes to prepare the resources then 30-45mins for the activity

WHERE TO DO THE ACTIVITY:
In a classroom – children can work individually or in a group.

WHAT YOU NEED:

ACTIVITY TOOLKIT 3

Printer

Scissors

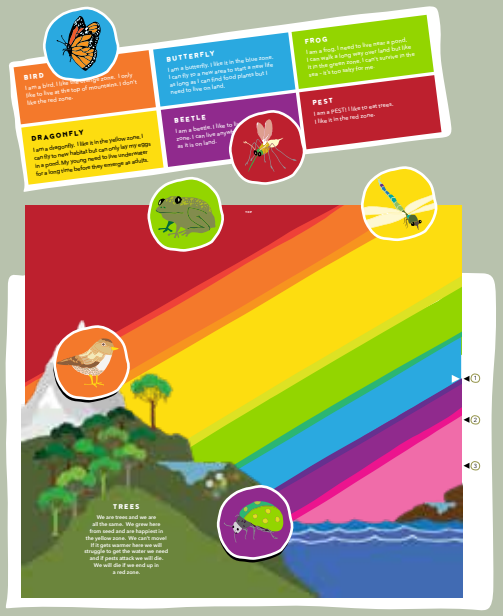
You can find specific examples of species that might be leaving or moving into our part of the country in

Extra Notes 5

STEP BY STEP:

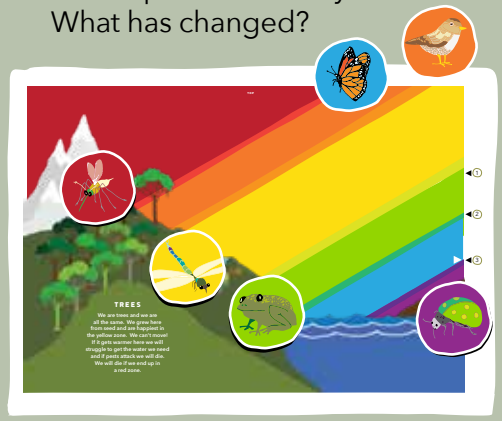
1. Print out single sided the 3 sheets of **ACTIVITY TOOLKIT 3** following the intructions in the toolkit carefully.

   Now you are ready to try and help some wild animals find a home!



2. The rainbow rectangle needs to be in position 1. Using the hints given, place the animal counters on the scene in places you think they'd like to live. If you can't find somewhere you think they would like, that's fine! Put any leftover ones to one side for now.

3. Next, move the rainbow rectangle down to position 2, then repeat the activity. What has changed?



4. Repeat again with the rainbow in position 3. What has changed this time?

   The colours on the slider represent temperature zones, red being the warmest. The numbered positions on the slider represent points in time: NOW (1), IN 10 YEARS (2) and IN 20 YEARS (3). Temperatures will rise over the coming years due to climate change, so the coloured zones on the slider will move position relative to the scene, and the habitat features required by different animals may or may not be in the right zone at all times. You should be able to see that the types of animals able to live here will change over this time. Some will be able to move to other suitable areas; some can only survive in certain conditions (and some – trees – can't move at all!) Some species will move into this area that we've not seen before. Some may not be welcome!

   We've described what you should see happening to the different animals overleaf.

5. There are a few ways in which your class could summarise what is happening in the scenarios: will they write a sentence to describe what happens to each animal as temperatures rise, or make a table to represent their findings? Ask them to write a story based on the animals we've looked at, or make a poster to tell people about how climate change impacts on wildlife.

ACTIVITY:
SPECIES ON THE MOVE (continued)

	Position 1	Position 2	Position 3
Bird 	I am happy at the top of the mountain. Lots of the mountain is the right temperature for me.	My range is reduced – I can only live at the top of the mountain but a lot of this area is too warm for me now.	All of the mountain top is too warm for me now. I can no longer live here.
Butterfly 	I am happy on these grassy slopes – lots of food for my caterpillars and it's just the right temperature for me!	I've had to move down the hill as it's too warm for me further up. There is less good habitat for me here so my range is reduced.	There is no habitat available for me now. I can't live here any more.
Frog 	I'm enjoying life here in and around my pond. The pond has all the right conditions for frogs to develop healthily - all the food and shelter we need.	I can spend time on land in my preferred zone but will have to come back to the pond to breed; the pond may be too warm for my young to survive.	My range is much reduced and I will have to travel further to find ponds to breed in. The water in the green zone here is too salty for me – I need fresh water.
Dragonfly 	The pond here is too cool for me – the conditions aren't right for the pond creatures I like to eat so there is no food for me! There's no habitat here for me at the moment.	The pond is perfect for me now! I can get everything I need here! I will fly over to the pond and lay my eggs here. My young can live in the pond before climbing out and turning into adult dragonflies.	This is perfect for me – great habitat for dragonflies.
Beetle 	There's not much habitat for us at the moment! We can only live in this tiny spot next to the sea!	There is no habitat for us here at the moment. The spot we used to live in is too warm for us now and the land over the water is too cool!	Now, the land on the other side of the sea is just right for us! But how will we get here?
Pest 	I can't live here… yet! There are no trees here, so nothing for me to eat!	This area's getting to be just right for me… but there are still no trees in this zone for me to eat!	Perfect! A tree for me to eat! It will die… but then I will move on to the next one.
Trees 	These kinds of trees are happy in the yellow zone. It is just the right temperature for them and they can get everything they need.	These trees are not quite so happy in the orange zone – it's starting to be too warm for them and they're struggling to get all the water they need. They can't move away from this spot though!	These trees in the red zone are NOT happy! They will struggle to survive in these conditions anyway, but with an invasion of pests they will definitely die.

This table shows what will happen to the animals in the situations represented when our rainbow slider (representing a coloured temperature scale) is put in positions 1, 2 and 3. These positions represent now (1), and points in the future, 10 years from now and 20 years from now.

DISCUSSION POINTS:

What could we do to help frogs and other animals that need ponds? We can create more ponds for them to breed in. Even a tiny pond can be a valuable habitat.

How could beetles find a home on the other side of the water when this population has died out? They can be reintroduced from other parts of the country. There are breeding programmes for endangered species where they are bred in captivity then released into suitable habitat.

Why are trees especially vulnerable to pests that might move in to an area? Because they can't move! What impact might it have on local wildlife if all of these trees die? See p17 for information on why trees are important. All of this would be lost if the trees in this area all died.

What can we do to make sure we still have trees and woodlands here if temperatures increase? There are lots of different types of trees! We can plant trees that like warmer temperatures and do not have pest species associated with them. We can plant a mix of different types of trees so that if pests do invade they don't wipe out the whole habitat.

FOLLOW ON ACTIVITY:
use our tree identification guide at www.theariumleeds.co.uk to see how many different types of tree there are in your local woodland.

WHAT CAN WE DO TO HELP?

We've explored the greenhouse effect and looked at how humans are causing the climate to change by putting too much carbon in the atmosphere. We've discussed how this affects life on earth and how it might impact on people and wildlife closer to home. But what can we do about it?

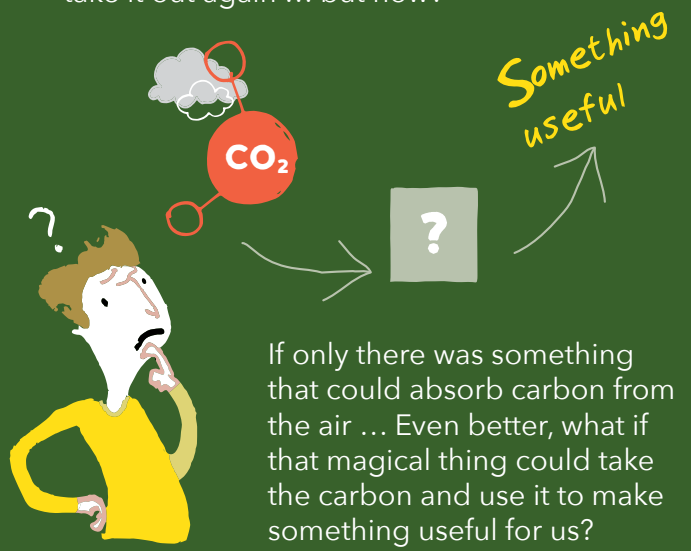
There are two main ways that we can help.

OPTION 1: REDUCE THE AMOUNT OF CARBON WE PRODUCE

On the next page we've provided an activity to help with a guided discussion about the environmental impact of things children do in their day-to-day lives and positive choices they can make that will reduce the amount of carbon they produce (this is known as their carbon footprint). This links with our Climate Change Home Challenge sheet, which we recommend you set as a long-term project for your class/group to complete at home, bringing in evidence, photos or items from home to show which activities they've done. There are also links to schemes you can get involved with as a school to help you become more environmentally friendly.

OPTION 2: REMOVE CARBON FROM THE ATMOSPHERE

It's great to reduce the amount of carbon we put into the atmosphere but, as we've seen, there's already a lot in there! We really need to take it out again … but how?



If only there was something that could absorb carbon from the air … Even better, what if that magical thing could take the carbon and use it to make something useful for us?

As it happens, nature started work on this marvellous invention hundreds of millions of years ago.

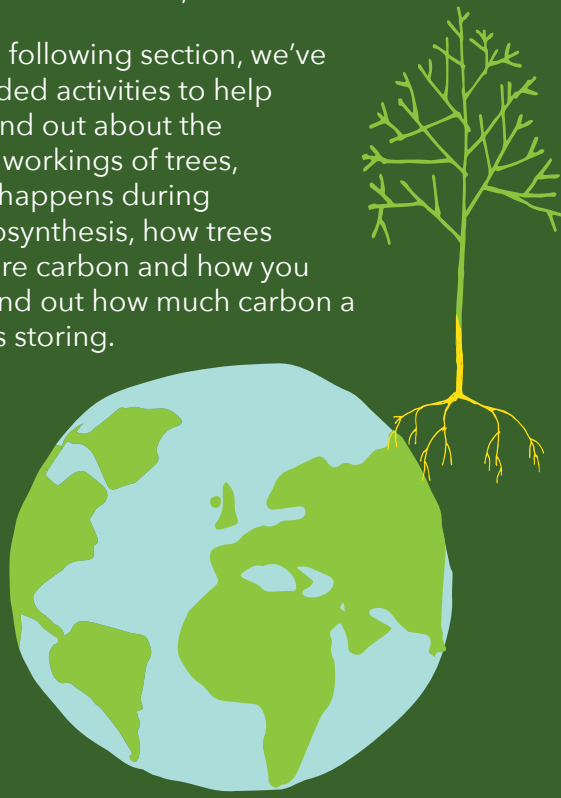
After perfecting the art of photosynthesis, and experimenting with sizes, shapes, colours and other adaptations, Nature has presented us with a dazzling array of carbon-fixing creations we call plants.

VOCAB:

Carbon Capture is the process of removing CO_2 from the atmosphere. It can be via natural or human made methods.

Plants occur all over the world, with special adaptations to help them live in hot, dry, warm, wet and cold conditions. All plants remove carbon, but the most efficient, and therefore our focus, are trees.

In the following section, we've provided activities to help you find out about the inner workings of trees, what happens during photosynthesis, how trees capture carbon and how you can find out how much carbon a tree is storing.



ACTIVITY: HELPING AT HOME

AIM:
To show the small changes we can make that will make a big difference to the environment

LENGTH OF ACTIVITY:
10-15 minutes to print and make cards then 30-45mins for the activity

WHERE TO DO THE ACTIVITY:
In a classroom – children can work individually or in a group.

WHAT YOU NEED:

ACTIVITY TOOLKIT 4

Printer

Scissors

Extra Notes 6

STEP BY STEP:

1. Print and cut out ONE set of double-sided playing cards from **ACTIVITY TOOLKIT 4** for each group.

2. Ask the children to describe what they did this morning.

   Chances are they woke up in a **bed**, turned on the **light**, put on **clothes**, ate some **food** (was it cereal and milk? Or a bacon butty?). Maybe they walked to school but some of them will have come in a **car**. Did they remember their **water bottle**? And a **snack**? At school they will probably have done a worksheet, writing and drawing on **paper** using a pencil.

3. Use the flashcards provided to help with group discussions about different aspects of home life.

CLIMATE CHANGE HOME CHALLENGE

Print out an activity grid for each child. After discussing the things we can do to help at home, ask the children to work on the activity grid in **ACTIVITY TOOLKIT 4** over the next few weeks.

HELPING AT SCHOOL

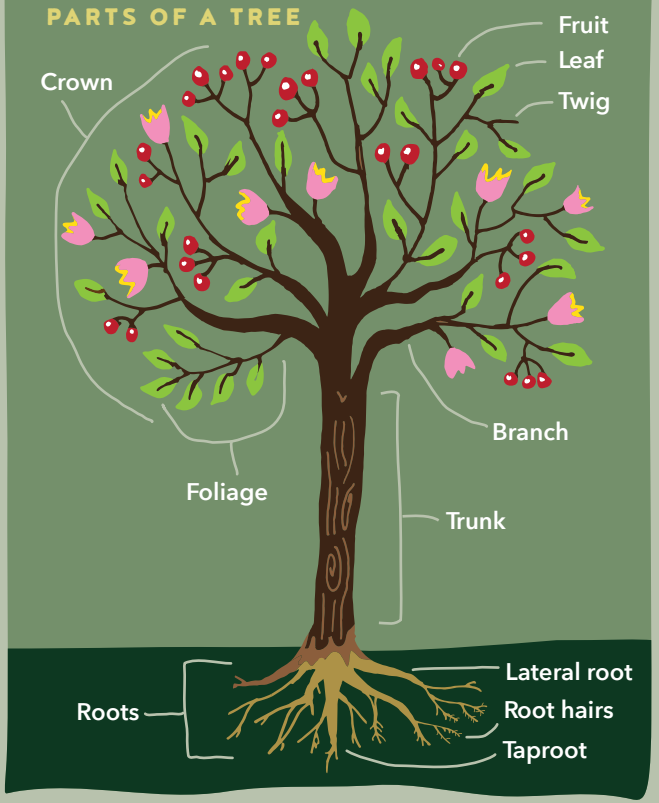
There are lots of schemes to help schools be more environmentally friendly. Check out the ***Woodland Trust's Green Tree Award*** or ***Keep Britain Tidy's Eco-Schools Award*** to see how you could get involved in one of these.

ACTIVITY: BUILD A TREE!

WHAT IS A TREE?

According to Colin Tudge's 'The Secret Life of Trees', a tree is 'a big plant with a stick up the middle', but obviously there is lots more to them than that! Each part of the tree, from the roots to the leaf tips, performs an important function.

PARTS OF A TREE



AIM:
To show different parts of the tree

LENGTH OF ACTIVITY:
10-15 minutes

WHERE TO DO THE ACTIVITY:
An open space that is not too dirty!

WHAT YOU NEED:
Nothing!

STEP BY STEP:

1. Ask two strong children to stand back to back – they are the heartwood of the trunk and must stand tall and strong to support the tree.
2. At the foot of the tree a child must sit on the floor; this child is the taproot and must make slurping noises as they take up water from the ground.
3. Next, four or five children should stand around the heartwood with their hands stretched above their heads; they are the branches with the leaves which form the crown; the leaves are absorbing carbon dioxide from the air and soaking up the sunlight to make energy for the tree; they rustle and move in the wind.
4. Another four or five children stand around the tree; they are the living wood around the heartwood that bend and stand up, carrying water and nutrients to the rest of the tree.
5. The next layer is the bark; five or six children are required to protect the tree.
6. Any children left can lie on the floor with their arms and hair outstretched as the root network of the tree.

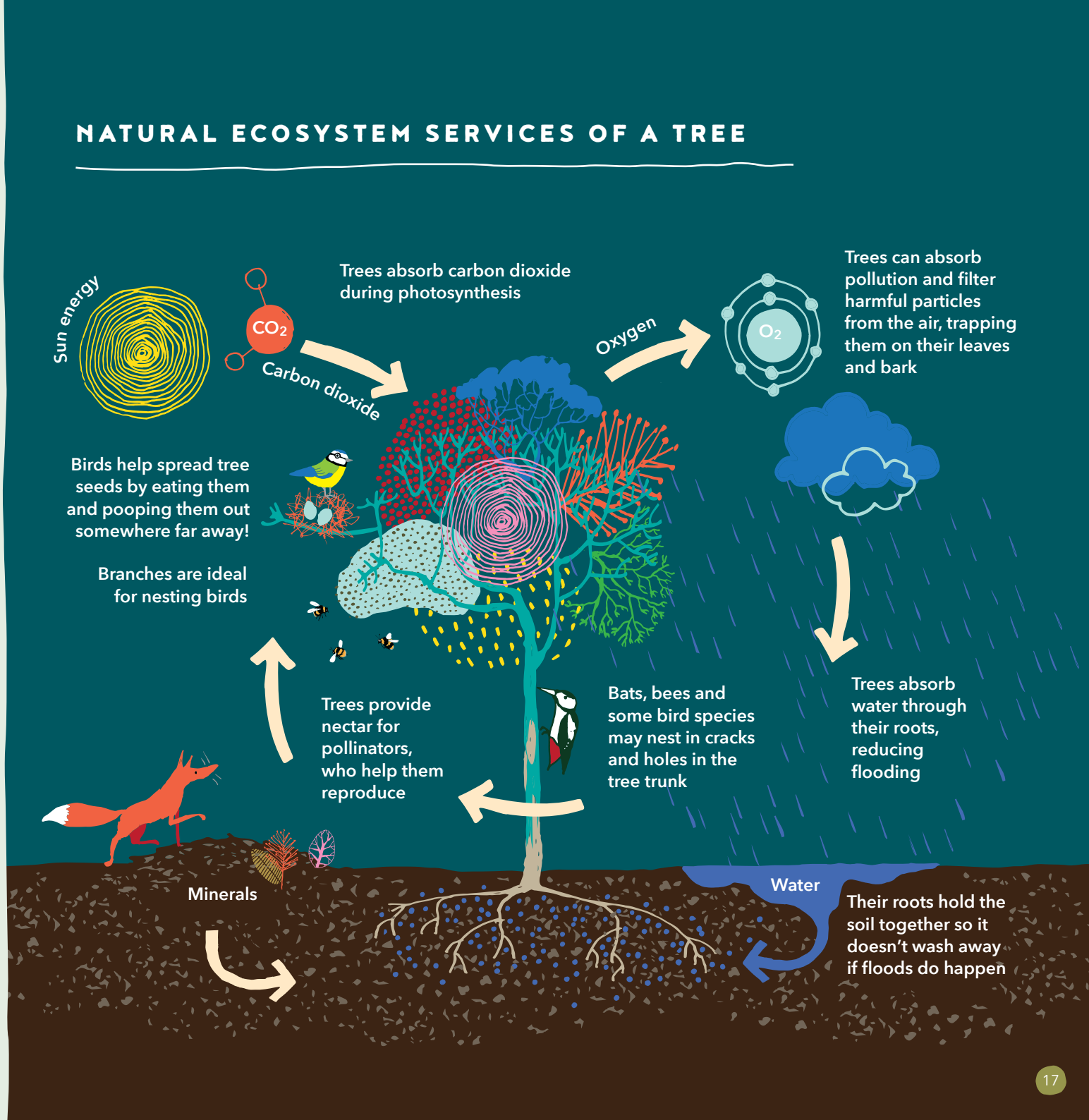
HOW CAN TREES HELP?

A single tree can provide nesting and roosting sites for birds and other animals, and flowers and food for insects. Its canopy can provide cool shade on a hot sunny day – and there may be more of these thanks to climate change; its roots can hold the earth together, helping to limit the impact of ever-more-likely flooding which could otherwise wash the soil away.

Lots of trees growing in the same space can provide all of the above, but working together they can do all of these things better. Leaf litter will carpet the ground and provide the perfect habitat for minibeasts to scurry and crawl about in. Shade-loving ground plants can thrive; tall and not-so-tall tree species will find their place in the woodland's structure, providing a varied choice for animals looking to find a home. Several colonies of insects, birds and small animals may exist in different parts of the woodland, and with larger potential gene pools their populations will be healthier and more resilient to climate change.

However, one of the most important things a tree can do is capture carbon by removing carbon dioxide from the air.

NATURAL ECOSYSTEM SERVICES OF A TREE



ACTIVITY: PHOTOSYNTHESIS GAME

How do plants remove carbon from the atmosphere?

They do this via PHOTOSYNTHESIS. We have two activities to help demonstrate this – one to introduce the concept and the other to explain a bit more about the logistics.

AIM:

To show what leaves need in order to photosynthesise

LENGTH OF ACTIVITY:

15 minutes (but toolkit needs to be prepared beforehand)

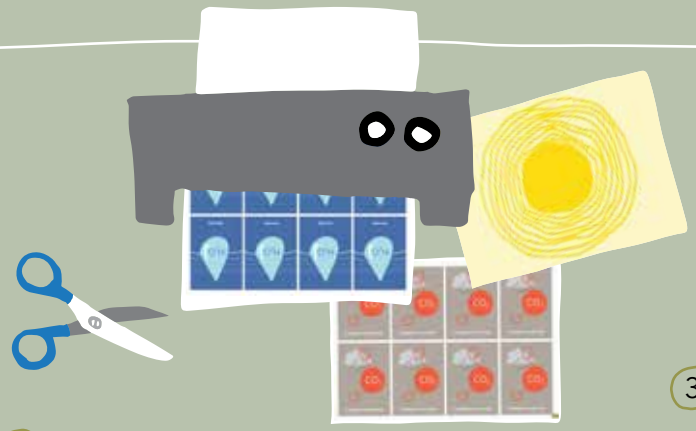
WHERE TO DO THE ACTIVITY:

An open space

WHAT YOU NEED:

Large cloth or paper leaves big enough for 2 kids to stand on (if you don't have these, just use cones to represent the leaves)

ACTIVITY TOOLKIT 5



VOCAB:

PHOTOSYNTHESIS – a very long word that means 'making things using light'. During photosynthesis, plants take in carbon dioxide through their leaves, and water from the soil. Sunlight triggers a reaction which converts them into oxygen – which is released from the leaves – and carbon-rich sugars which the tree stores and uses to grow.

STEP BY STEP:

1. Print and cut out the **ACTIVITY TOOLKIT 5** cards and sun. Make sure you have enough cards for

2. the number of children.

Gather the children together and ask them what they know about photosynthesis. Once they have grasped the fundamental idea (that leaves need sunlight, water and carbon dioxide to make sugar and oxygen) you can start the game. One child is the sun, the others are

3. equally split into carbon dioxide and water.

The carbon dioxide and water run around, while the sun slowly moves their arms round in a big circle. When the sun's hands are high in the sky, the children must run to a leaf. Only two are allowed on each leaf. The leaf can only photosynthesise if a carbon dioxide and a water are on it when the sun is up, so go round and tell each leaf pair whether they have helped their leaf photosynthesise or not. Don't tell them why though – you can ask the group at the end why they think some leaves photosynthesised and some didn't. Keep ...ing until it works pr...rly!

ACTIVITY:
CARBON CAPTURE LEAF GAME (thanks to the Forests for the Future pack, 2011)

AIM:
To show how trees use photosynthesis to help capture carbon

LENGTH OF ACTIVITY:
15 minutes (but resources need to be prepared beforehand)

WHERE TO DO THE ACTIVITY:
An open space

WHAT YOU NEED:

A long rope (10+m long)

Green circles big enough for 2 children to stand on

ACTIVITY TOOLKIT 6 – 16 water/oxygen and 16 carbon dioxide/sugars 'molecule' cards (laminated for reuse)

A box to represent a tree storing carbon

1

2

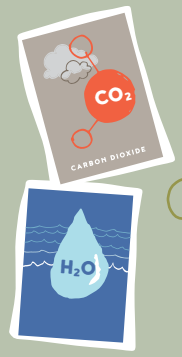
3

4 **STEP BY STEP:**

The rope is laid out in a large leaf shape, with an opening at the end of the stem and the box placed a short distance from the stem. The green circles represent chloroplasts which are [illegible] these [illegible] the leaf shape.

5

6 [illegible] dioxide and water cards are distributed evenly between the children (if there is an odd number of children, one can be the sun). Ask the children how each of these enters the leaf: the CO_2 enters through stomata, or holes in the underside of the leaf, and the water enters via the stem, having been sucked up by the roots.



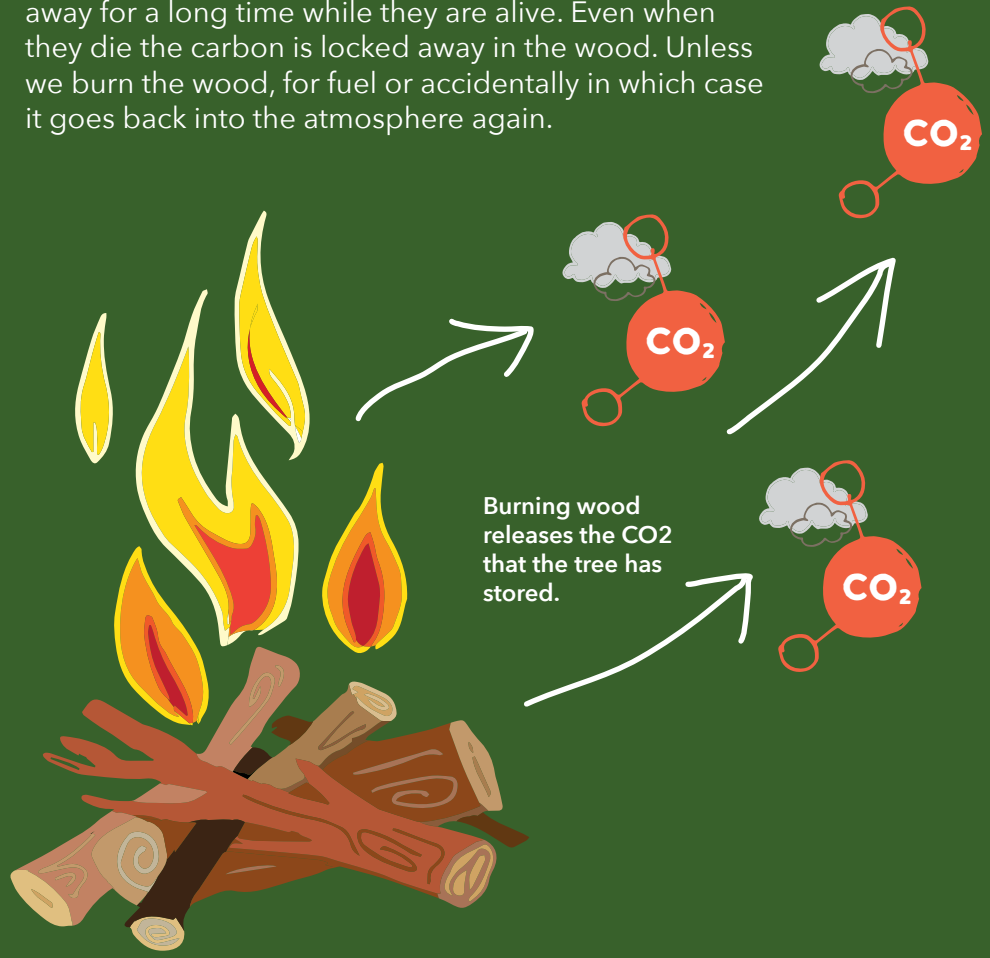
7 The children with the CO_2 cards stand around the edge of the leaf and those with the water cards line up at the opening of the stem. When you say 'go', all the 'molecules' can enter the leaf.

Then, when the 'sun' is held aloft, mixed pairs of 'molecules' must find a chloroplast (green spot) to stand on (so there is a CO_2 and a water 'molecule' on each 'chloroplast' – the children are holding different cards).

DISCUSSION POINTS

WHAT WOULD HAPPEN IF MORE TREES WERE CUT DOWN AND BURNT, OR LEFT TO ROT?

Trees can live a really long time so they lock that carbon away for a long time while they are alive. Even when they die the carbon is locked away in the wood. Unless we burn the wood, for fuel or accidentally in which case it goes back into the atmosphere again.



WHAT WILL HAPPEN IF MORE TREES ARE PLANTED?

Trees, like humans, have growth spurts when they are young, so younger trees capture more CO_2 than older trees. Older trees perform the important task of storing the carbon for the length of their lifetime, and beyond if they are made into something after they've been cut down. Different trees live for different lengths of time but an oak, for example, will grow for 300 years, but can live for a further 700 (after which it could be turned into a table or a chair and the carbon would continue to be stored).

COULD OTHER PLANTS DO THE SAME JOB?

Other plants photosynthesise but as small plants are only short-lived, any carbon/sugars they produce are quickly released back into the atmosphere. Trees live for longer, and grow for many years, so they store carbon for a long time.

HOW MUCH CARBON IS STORED IN A TREE?

We know that trees store carbon, and that they do this mostly while they are young and growing at a speedy rate. They can carry on storing this carbon as long as they live, and beyond that if they are cut down for timber and made into something.

On the following page we've provided an activity to help you estimate how much carbon a tree in your grounds might be storing.

ACTIVITY: CARBON CALCULATOR

How much carbon a tree is storing?

Approximately half of the dry weight of a tree is carbon, stored in their trunks, roots and leaves. It is really difficult to accurately work out the dry weight of a tree. It involves cutting it down, digging out the roots, drying it and weighing it. Obviously this isn't practical to do, so luckily scientists have worked out an approximate way to calculate the amount of carbon by measuring its circumference (the distance around the tree trunk).

Their measurements were based on a certain species of tree and are unlikely to be accurate for other species, but for our purposes we're going to say they can be used on any kind of tree.

AIM:
To find out how much carbon our local trees have captured

LENGTH OF ACTIVITY:
10-15 minutes

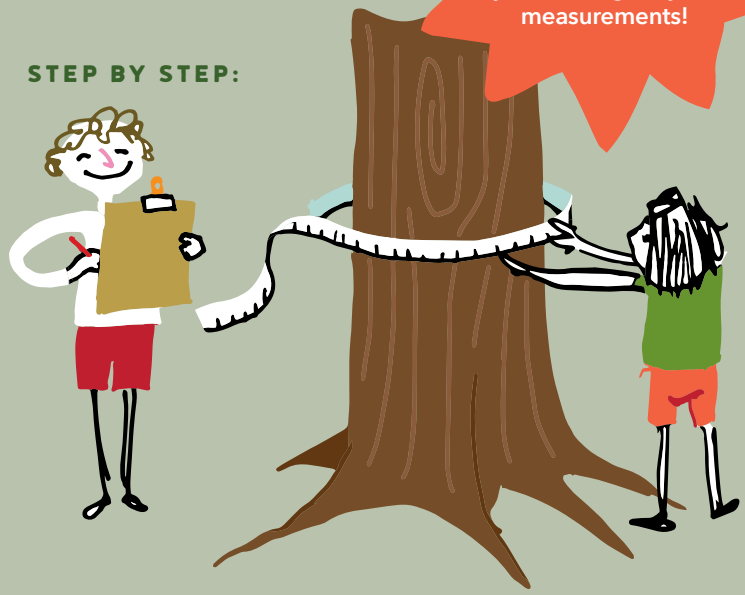
WHERE TO DO THE ACTIVITY:
School grounds or local greenspace (ideally somewhere with several trees)

WHAT YOU NEED:

A tree (ideally several trees)
Measuring tapes (enough for children to work in pairs or small groups)
Clipboards, pencil and paper

NB some tapes are double sided so be clear which side you're using for your measurements!

STEP BY STEP:



1. Demonstrate the activity by selecting a tree to measure. Show them how to measure the circumference of the tree. Ideally the measurement should be taken 1.3m from the ground – if you can, show the children how to do this, and encourage them to take their measurements at the same height. If measuring 1.3m from the ground is too tricky, they can just measure at their own chest height. They will need to measure the circumference by wrapping their measuring tape around the tree. If it's a large tree you may find that your tape doesn't go all the way round. In this case one child will need to put their finger on the starting point, another can mark the end of the tape, and the measurement can start from zero again. Measurements should be recorded.

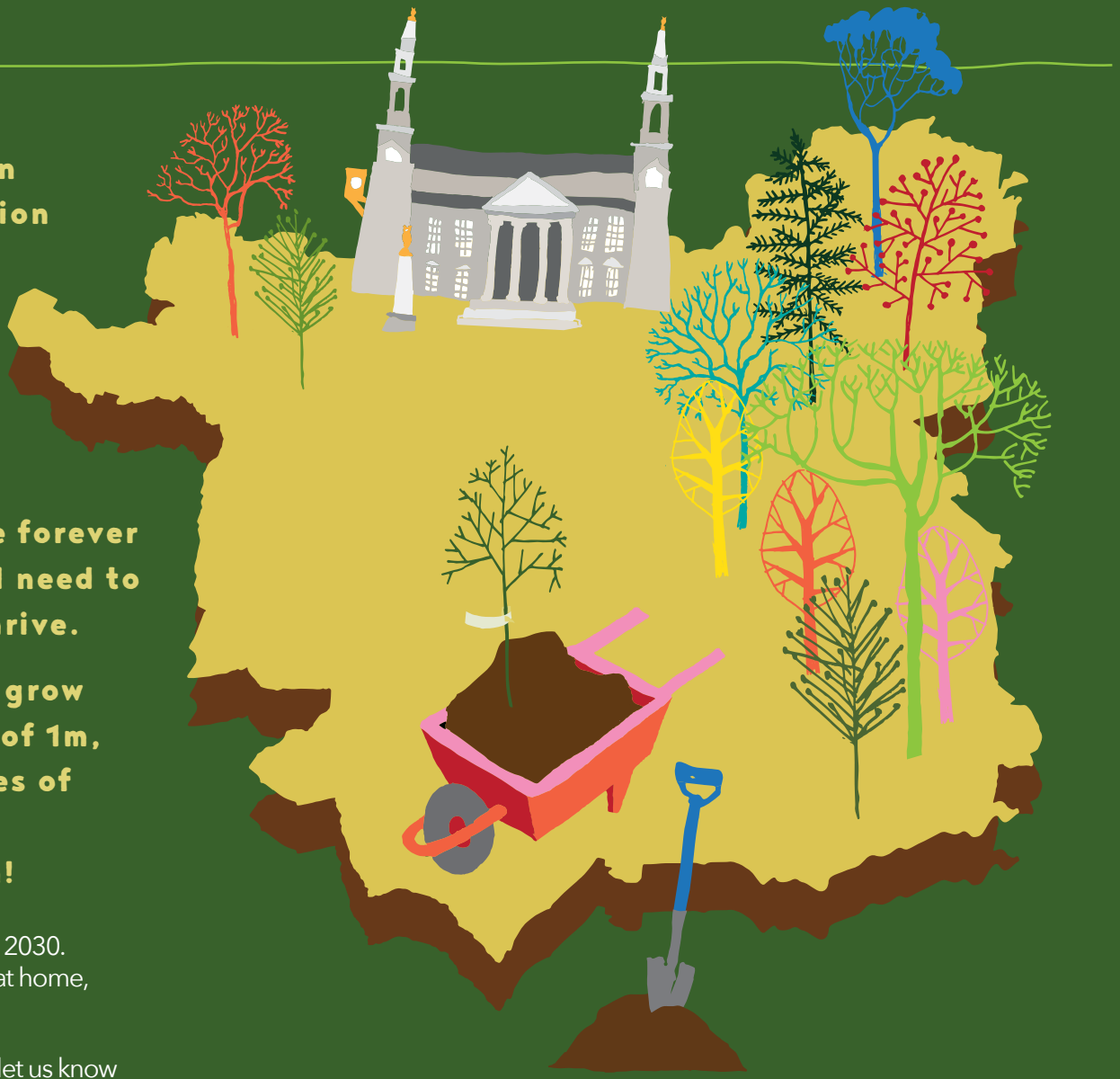
2. Split your class up into pairs or small groups and send them to do the same on their own trees. For accuracy and mathematical exercise, measurements can be done three times for each tree, and the average used for the calculation.

3. Compare results to the table below and estimate the dry weight of your tree – just match your measurement to the nearest one in the table. Remember that half of a tree's dry weight is carbon, so you will need to divide this number by 2 to calculate how much carbon it has stored. (If you multiply your answer by 3.67 you can work out how much CO_2 the tree used to make this carbon!)

Tree's circumference (cm)	Tree's dry weight (kg)
50	106
100	668
150	1964
200	4221
225	5771
250	7641
275	9842
300	12410
325	15350
350	18700
400	26674

Over the course of our woodland creation initiative, we are going to plant 5.8 Million trees on leeds city council land alone, and our partners in the white rose forest will be planting even more on private land. With careful management, these will form diverse and wildlife rich habitats. We are not expecting all of the trees to still be here forever – trees need space to grow and some will need to be removed to give others a chance to thrive.

Even if just 1 in 10 of the trees we plant grow to be mature trees with a circumference of 1m, we will have absorbed 3.68 Million tonnes of carbon dioxide from the atmosphere and captured over a million tonnes of carbon!



We are excited to be helping Leeds become carbon-neutral by 2030. There are lots of ways you can get involved both at school and at home, and we've outlined some of these over the following pages.

Follow our social media for further updates on the project and let us know what you and your groups have been doing to help.

Gather your own seeds

You don't have to take part in a workshop – you can gather seeds in your school grounds or local green space. We've provided a how-to guide below.

Would you like to contribute even more to our Woodland Creation Scheme?

Through the months of September to November, seed collection boxes with accompanying interpretation will be provided in some of our local parks and partner sites. People of all ages can get involved and gather seeds to be planted at the Arium. Information is available on Leeds City Council and The Arium websites. There are boxes for each listed tree seed type and where seeds collected at the park can be deposited. The boxes are kept at indoor locations at various parks, with signs advertising the scheme and signposting their location. Only beech nuts, conkers, sweet chestnuts and acorns will be collected.

Example of sign found on a collection box/identifying document. Clearly shows defining characteristics of seed/tree to minimise collection of wrong species.

To help you identify the seeds we need, use ACTIVITY TOOLKIT 7 as a guide.

Find out what makes a good woodland in Extra Notes 7

Locations:

1 Temple Newsam Café
2 Gotts Manor Golf Club
3 The Arium
4 Three Cottages Café, Meanwood Park
5 Farnley Hall Park
6 Middleton Park Visitor Centre
7 Golden Acre Park Café
8 Tropical World Gift Shop
9 Kirkstall Abbey Gift Shop
10 White House Café Otley Chevin
11 TCV Hollybush Kirkstall
12 Wetherby Town Hall
13 Lotherton

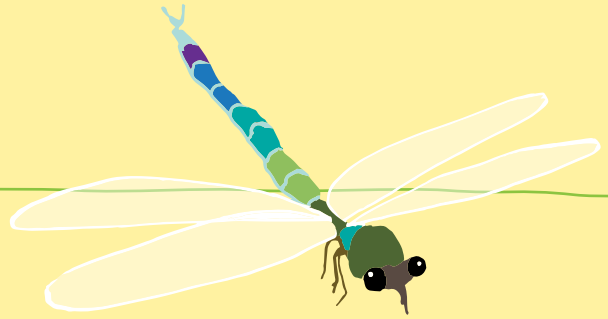
THE ARIUM – ITS CRUCIAL ROLE

The Arium, the largest local authority plant nursery in the country plays a crucial role in the Woodland Creation initiative. The Arium sources and grows trees locally, both from seed sourced externally, and from local seed collection in our parks and woodlands across the city. This reduces transportation and the potential spread of pests and diseases affecting tree imports. As tree planting is becoming a primary council strategy for reducing carbon emissions, the ability of Leeds City Council to sustain, source and grow its own trees provides a significant advantage should tree supply for woodland planting become oversubscribed nationally.

Each autumn is a **Seed Collection Campaign** engaging communities across the city to get involved in seed collection in their local park. Seed collection boxes will be in place across the city to deposit collections. These will then be gathered at the Arium for planting.

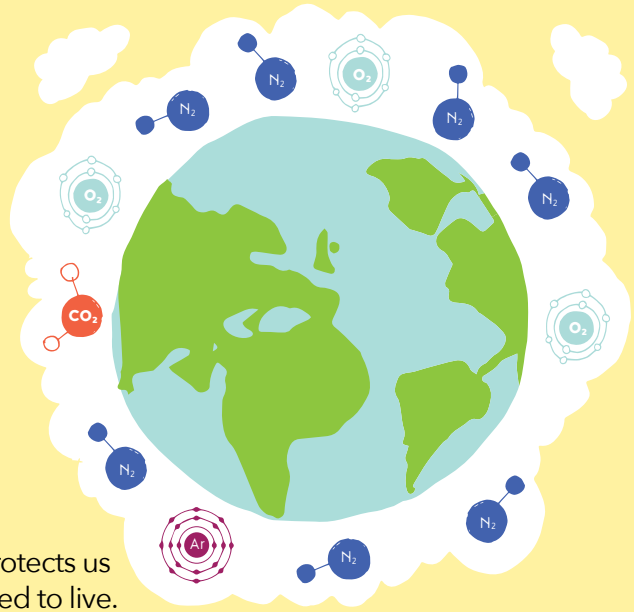
Once at the Arium a practice known as **stratification** will be employed, whereby natural conditions are simulated indoors to encourage growth. This may involve keeping the seeds warm, then cold, then warm again for various periods of time, to mimic the passing of the seasons usually experienced in their natural growth areas. The large scale of the Arium planting facilities and given the right equipment and availability of seed, it will generally take 2 years to grow saplings from seed, ready for planting.

The Arium will introduce educational visits for schools, volunteers and the general public to learn about the woodland creation initiative in Leeds and see the scale of the operation at the Arium.



1 THE GREENHOUSE EFFECT

What is Earth's Atmosphere? And why is it important?



Our atmosphere is a thin layer of gases that surrounds our planet and protects us from the harsh vacuum of space. The mixture of gases in the atmosphere are what keep us alive, containing oxygen (O_2) which we need to breathe, carbon dioxide (CO_2) which plants need to photosynthesise, and many other gases that all play their own important role in maintaining life on earth.

The earth is surrounded by layer of gases called an atmosphere. The atmosphere protects us from space and provides the gases we need to live.

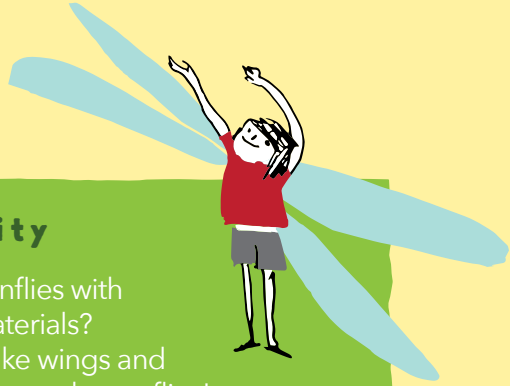
This combination of gases is in a delicate balance.

Gas	Chemical Symbol	Average % in atmosphere
Nitrogen	N_2	78 %
Oxygen	O_2	21%
Argon	Ar	0.93%
Carbon Dioxide	CO_2	0.04%*

If the percentages were to change too much then all kinds of strange things could happen … and they have, in the past!

Around 300 million years ago, oxygen made up 30% of the atmosphere, allowing the ancestors of insects to grow to a ginormous size. Some dragonflies living at that time had wingspans of up to 71cm!

High oxygen levels in the atmosphere would allow insects to evolve to be larger.



Suggested activity

Why not make giant dragonflies with your group out of scrap materials? The children could also make wings and turn themselves into enormous dragonflies!

If there was much more oxygen then there it would also be much more dangerous, because oxygen is needed for combustion (burning) so fires would be much worse and the very air might even catch fire.

Too much oxygen and we risk the earth being engulfed in a giant fireball

The atmosphere causes something called the greenhouse effect, which describes the way that heat from the Sun is trapped by the gases in the air.

* https://nssdc.gsfc.nasa.gov/planetary/factsheet/earthfact.html

What is the greenhouse effect?

The greenhouse effect is not a bad thing. It is a process that happens all the time and without it the planet would be extremely cold. In fact, without the greenhouse effect the world's temperature would be an average of -18°C. This is cold enough that all the earth's water would be frozen solid and it would be very difficult, or impossible, for any life to exist.

Without the greenhouse effect life on earth would be impossible

Some energy is reflected by the surface back into space, but most reaches the surface and warms the surface of the planet.

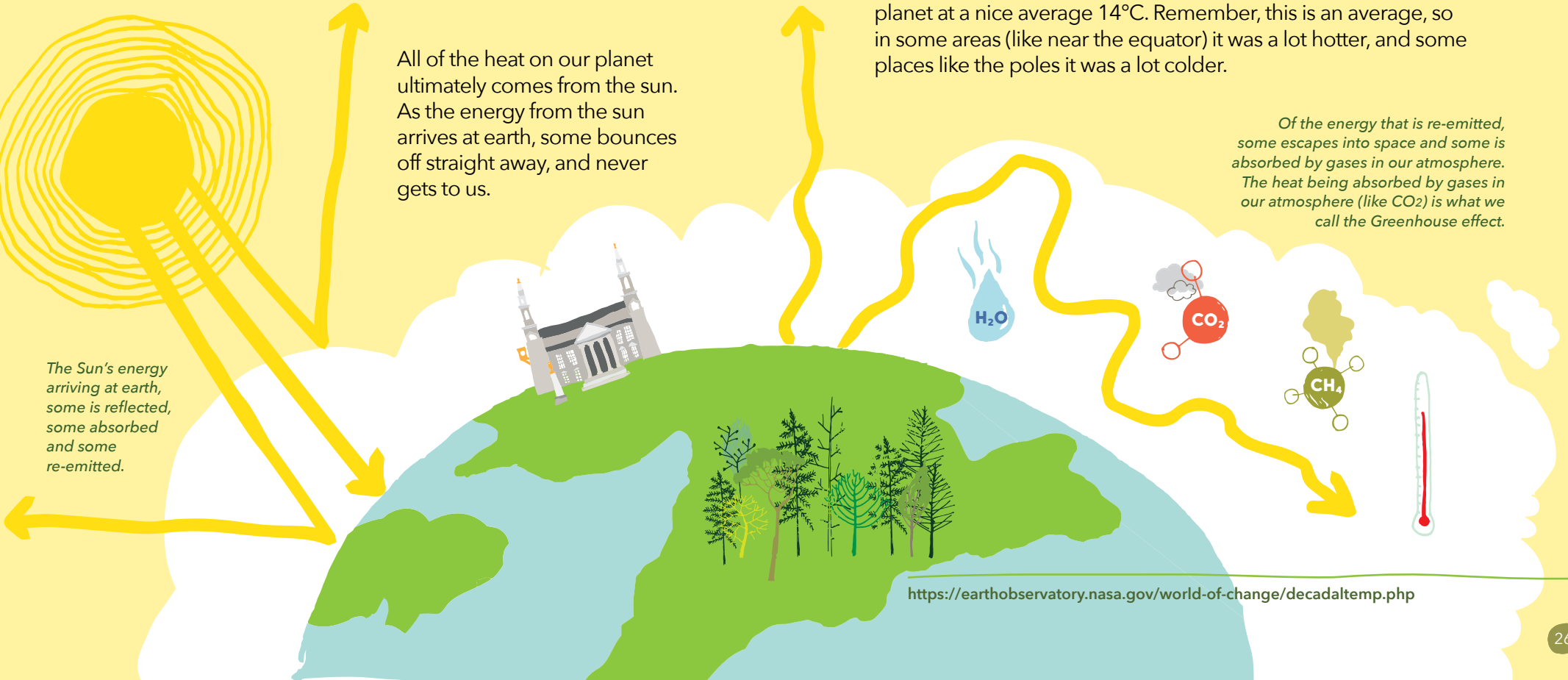
Much of the energy that was at first absorbed by the ground is then re-emitted back away from the surface as heat. Some of that heat ends up escaping out in space again, but some is trapped within the atmosphere.

The heat being absorbed and trapped by gases in the atmosphere is what we call the greenhouse effect. Before humans started interfering with the atmosphere, the greenhouse effect kept our planet at a nice average 14°C. Remember, this is an average, so in some areas (like near the equator) it was a lot hotter, and some places like the poles it was a lot colder.

All of the heat on our planet ultimately comes from the sun. As the energy from the sun arrives at earth, some bounces off straight away, and never gets to us.

Of the energy that is re-emitted, some escapes into space and some is absorbed by gases in our atmosphere. The heat being absorbed by gases in our atmosphere (like CO_2) is what we call the Greenhouse effect.

The Sun's energy arriving at earth, some is reflected, some absorbed and some re-emitted.



https://earthobservatory.nasa.gov/world-of-change/decadaltemp.php

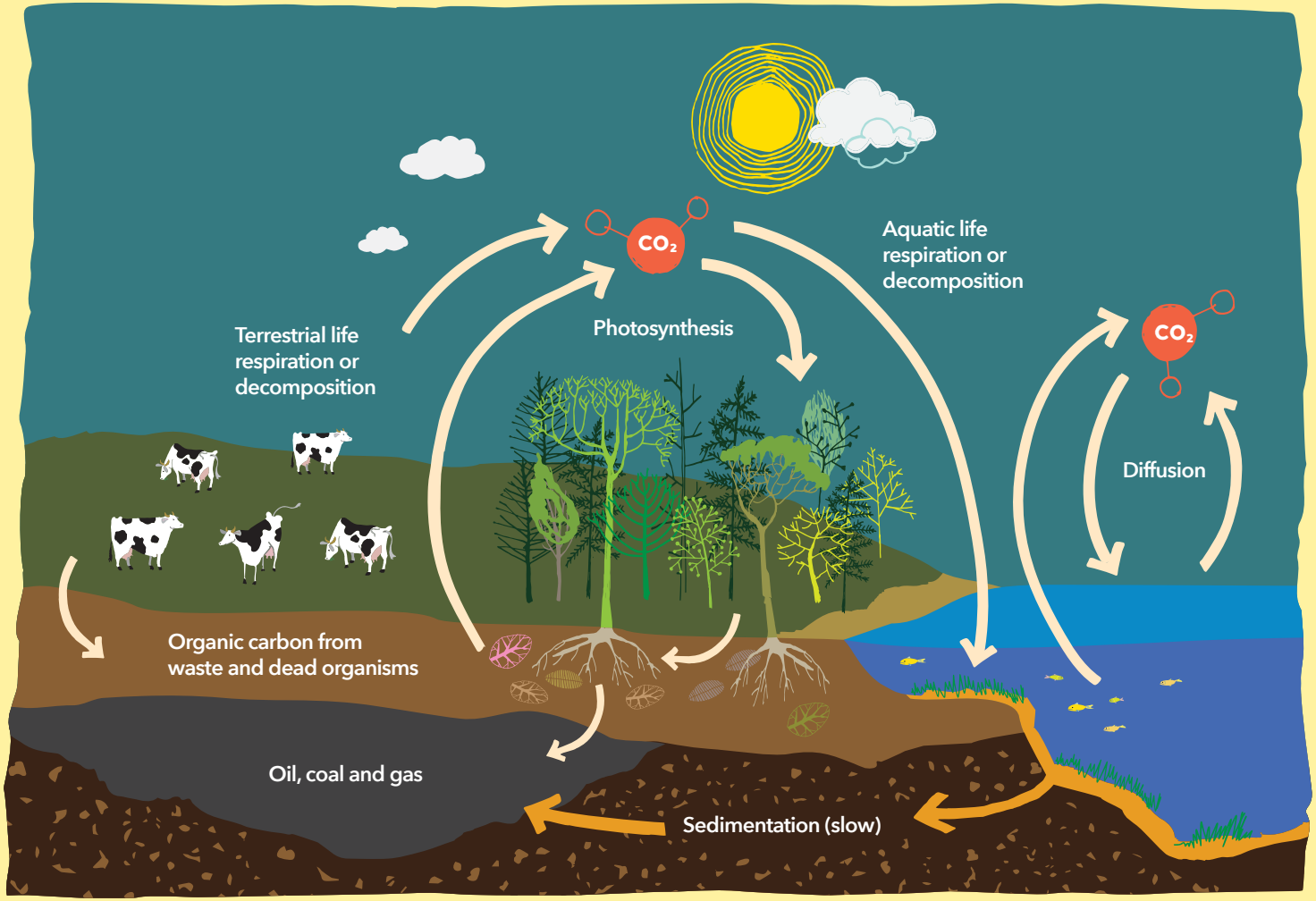
2 THE CARBON CYCLE AND THE IMPACT OF HUMANS

Natural Inputs: the carbon cycle

Animals (including humans) and plants all carry out a process called respiration. This involves taking in oxygen and giving off CO_2. Your body is doing this every time you breathe in. Other things that release carbon into the atmosphere include the rotting – or decomposition - of organic matter.

So is you breathing causing climate change? Not really. We are just an important part of the carbon cycle. The carbon we release ultimately should be taken out of the atmosphere at some point, either by plants or dissolving in water and be stored safely.

The circular nature of this process of releasing and re-absorbing carbon is why we call this the Carbon Cycle. As long as this process is in balance, we have the amount of greenhouse effect that all the organisms in the globe have evolved with and adapted to.

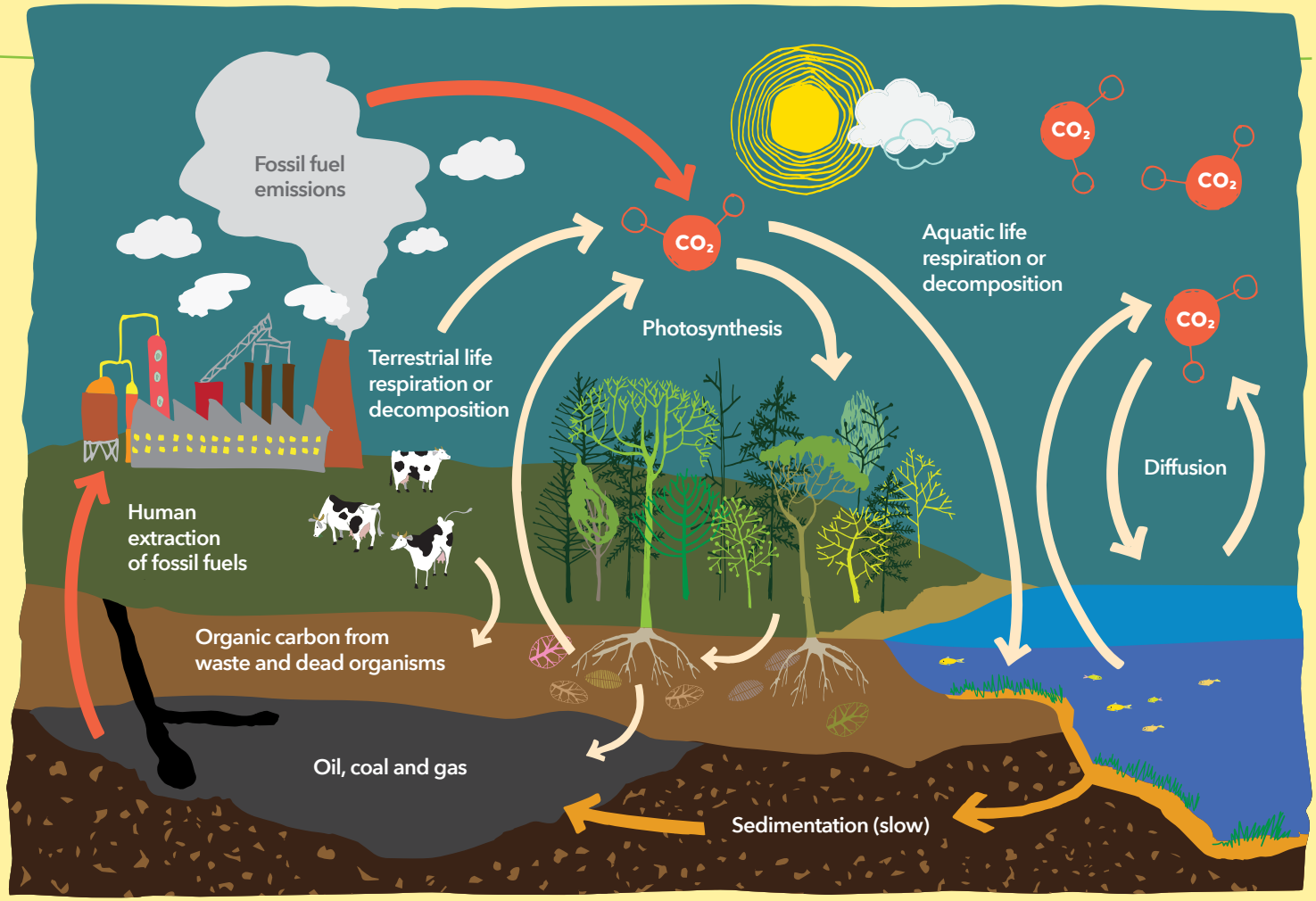


An illustration of the carbon cycle. Without human influence carbon is cycled and eventually stored under the earth as oil, coal and natural gas.

EXTRA NOTES

Human interference

Unfortunately this balance has been messed up by humans. Five hundred million years ago, during the late Cambrian period, the atmosphere had a LOT more carbon in it – thought to have been released by the disturbance of sea-bottom mats of microbes by burrowing organisms - and global temperatures increased by about 5°C. Several factors played a part in getting these levels back down to the levels we see today but key players are plants, who over millions and millions of years, absorbed the atmospheric carbon through photosynthesis; when they died, their carbon compounds (and those of other organisms) became locked up underground as what we call fossil fuels - oil, coal and gas.



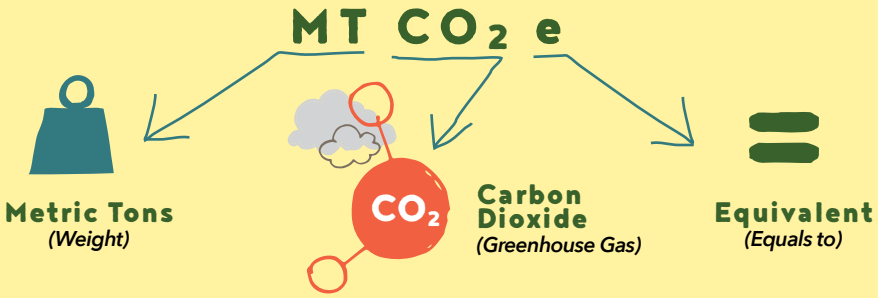
When humans started burning fossil fuels the process of storing carbon under-ground that has been taking place for millions of years was reversed.

Early humans used coal for fires, but over time, use of coal and other fossil fuels has increased – massively so since the onset of the Industrial Revolution of the 19th century, which saw the introduction of coal-powered machinery to take on work previously carried out by people and animals. Nowadays we still remove fossil fuels from the ground and burn them to produce energy, and this releases the carbon back into the atmosphere as CO_2.

Other processes like construction, water treatment, farming and making products for our homes also produce CO_2 and other greenhouse gases. This all means we produce more carbon dioxide (and other greenhouse gases) than the planet's carbon cycle can naturally deal with. This leads to an increase in the greenhouse effect.

Extension Knowledge – A new Unit of Measure

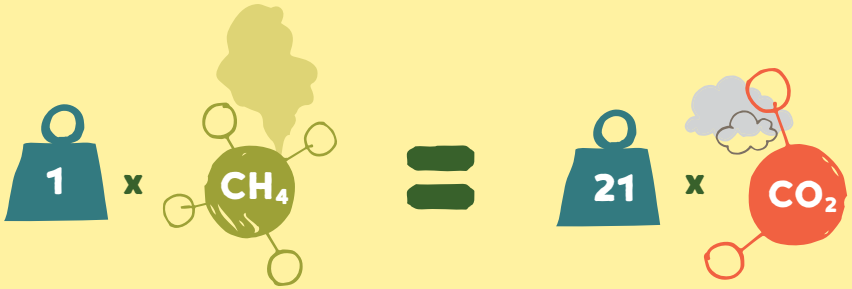
In reality atmospheric chemistry is a bit messy, involving multiple types of gases. To make things easier scientists often convert the amounts of different gases into 1 unit based on the climate change effect of carbon dioxide. This makes comparing different industries and processes easier.



This is based on the climate change impact of CO_2.

So for example 1 ton of Methane (CH_4) is actually 21 times stronger than CO_2 so:

1 MT of CH_4 = 21 MTCO_2e



*https://ourworldindata.org/co2-and-other-greenhouse-gas-emissions#per-capita-co2-emissions

**https://ourworldindata.org/grapher/annual-share-of-co2-emissions?time=latest&country=~GBR

HOW MUCH EXTRA CO_2 IS THERE?

Studying the amount of extra CO_2 in the atmosphere and where it comes from is very difficult*.

Global

At the moment humans on earth add over 36 billion tonnes of CO_2 a year to the atmosphere. This is not divided over the planet equally. China produces the most, accounting for over 27% of CO_2 in 2017, followed by the USA (15%). However, it's more complicated than just saying that one country produces more than another - you have to think about the amount of people in those countries, and the size of them. For example, India produces almost 7% of CO_2 emissions compared to the UK's just over 1%. When you take into account population, the UK produces over 3 times the amount of CO_2 per person than India does.

There is a strong link between the wealth of a country and the amount of CO_2 produced per person. Richer people tend to use more stuff and richer countries have access to more things. Unfortunately poorer countries are probably the ones who are going to be affected worst by climate change.

VOCAB:

EMISSIONS – The production or giving off of something. In this case when we talk about emissions we mean the amount of greenhouse gas produced.

UK

In 2018 the UK produced an extra 365.7 million Tonnes of CO_2 equivalent. This is about 1.06% of the Global emissions**.

This CO2 and greenhouse gases come from a variety of sources, from transport and business to the things you do at home.

3 CARBON EMISSIONS SORTING ACTIVITY

KS3/4 extension:

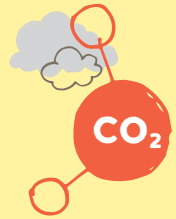
Use the following points to shape further discussion of carbon emissions of the different activities:

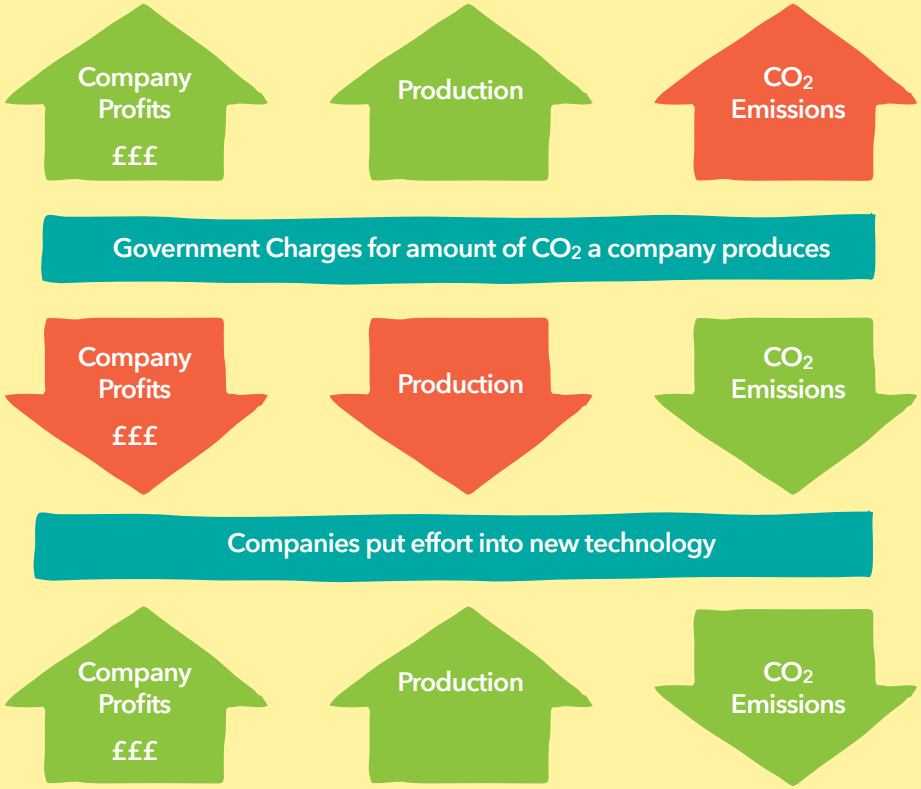
- Forestry and land use change (including changes in forestland, cropland, grassland, wetlands, settlements and harvested wood products) are a carbon sink. This means these activities absorb more carbon than they produce.
- Industrial Processes come surprisingly low. Why?
  - The UK doesn't make much of the high emitting products like iron and steel anymore. Therefore we import steel from other countries, so the emissions are not in the UK figures … but they will appear in another country's.
  - Also processes used in this country have become a lot more efficient
- Transport is the Highest emitter
  - This doesn't even take into account international travel or shipping.
  - Why not? Do you think international flights should count towards a country's emissions? Which country – the one where the plane takes off or the one where it lands?
- Energy Supply, although high, has dropped a lot in the last 20 years. It fell below transport in 2016. Why?
  - Rise of renewables
  - Closure of Coal fire power stations – partially due to carbon pricing
  - Closure and reduction in coal mining and handling

Carbon pricing puts an actual price on carbon emissions. The more carbon emitted through the production of goods and energy, the more expensive they are to the consumer. Carbon pricing sets prices for coal-fired and renewable energy – for example – at similar levels, meaning consumers can make a conscious choice for greener options.

Discuss carbon pricing and the effect it has had on forcing businesses to make processes more efficient.

A simplified version is:





4 THE EFFECTS OF CLIMATE CHANGE: WATER, WATER EVERYWHERE!

Globally:

Sea levels

If temperatures rise, ice melts. If ice from glaciers and on land melts then it will eventually make its way into the oceans. Also, as temperatures rise, the ocean temperature also rises. Warm water expands, taking up more room than cooler water.

Both of these add up to a rise in sea levels over the world.

Sea levels rose between 16 and 21 cm between 1900 and 2016, and continue to rise at increasing rates. This might not sound like a lot of water, but for people who live in coastal regions it is already causing flooding. It may also mean changes for the ocean's water currents which are vital to a lot of life and weather systems on earth.

Weather and Climate

Weather and climate are very closely linked. Climate is long term, when we look at things over periods of years. Weather is more about what you see out of the window.

Climate drives and affects the weather. Warmer climates and warmer oceans can feed extreme weather systems. As temperatures increase, we will start to see more extreme weather systems throughout the world. That means more hurricanes and typhoons, and more flooding and storms. It also means some areas will see longer hotter summers with not enough rain which can lead to crops failing and people going hungry.

Leeds is having to invest in more flood defences due to more rainfall combined with less land which can absorb water. This flood in 2019 was much less damaging than the 2015 flood, partly due to flood defences and humans adapting and building to withstand more extreme weather events.

Locally:

Localised flooding

One of the main impacts of climate change is differences in amounts of rainfall. In some places this leads to drought, but with the way we're able to store water in the UK, we can usually cope with dry weather. Another, more serious, effect can be flooding, which can have devastating effects on local communities.

Climate change is one factor involved in flooding; another one is change of land use. Urban areas or even some farmland don't absorb or hold lots of rain water and it ends up flowing into rivers too fast, causing flooding. Areas of forest are very good at absorbing extra rain water – this is why we think it's so important to plant woodlands!

Case Studies – Leeds Floods

In Leeds we have had several flooding events in recent years, including the infamous Boxing Day floods of 2015 which destroyed homes and cost the city millions of pounds with all the damage and restoration.

Since then, Leeds has put in a lot more flood defences. These extra flood defences include hard defences (e.g. building walls and reinforcing river banks) and soft defences like the habitat changing and tree planting as part of the flood alleviation works in Killingbeck in Leeds.

5 CLIMATE CHANGE – IMPACTS ON WILDLIFE

Global impacts

Ocean acidification

Did you know that oceans and water bodies also absorb carbon dioxide from the air? They actually absorb about a quarter of the amount produced through the burning of fossil fuels, so they play a vital role in offsetting the potential impacts of human activity. This process, however, is slowly lowering the pH of the ocean, making it more acidic. Even slight changes in acidity are a bad thing for lots of ocean creatures who are not adapted to these pH levels. Many of these sea creatures – including mussels and coral - use calcium as part of their shells or skeletons: calcium becomes weaker and even dissolves in more acidic oceans.

The UK:

Biodiversity changes

Many animals and plants are very sensitive to temperatures and climate.

In the UK we are lucky enough to have a huge range of different climate zones and habitat, from the sunny warm climate in Cornwall that allows palm trees and other sub-tropical plants to grow, to wind-swept alpine habitats in Scotland, that allow plants to exist that are normally found only close to the Arctic Circle. As the climate changes and we get higher average temperatures these habitats are going to change. Some species will be able to adapt and some will not.

VOCAB:

ADAPTABILITY – Ability of an organism to cope with unexpected disturbances in the environment. Temporary or long term.

BIODIVERSITY – the amount of different plant and animal life in a habitat or place. High biodiversity is good and important for the health of the environment

SPECIES ON THE MOVE

The Species on the Move activity demonstrates what might happen to different animals as an area gets warmer.

Diseases and Changes of Pest species

It isn't just animals and plants that are limited by climate and weather. There are multiple diseases that we are lucky enough to not have in the UK. With all the potential movement of animals and plants due to climate change we could end up with some brand new diseases that we don't yet have.

With warmer winters we will get more insect activity, including carriers of disease like mosquitos that can pass malaria and dengue fever on to humans.

More Locally – Leeds and Yorkshire: Species Ranges

As animals and plants adapt and move, we may find that different species start to call Leeds and Yorkshire home.

CASE STUDIES – WINNERS AND LOSERS IN LEEDS SPECIES

LOSERS

TANSY BEETLE

The tansy beetle is a beautiful shiny, iridescent beetle. In the UK it can only be found on the banks of the River Ouse in Yorkshire, and a small recently rediscovered population in East Anglia. It needs a specific wetland habitat to survive, and a plant called Tansy (which the beetle gets its name from).

The Tansy beetle is a beautiful iridescent beetle that is named after its preferred meal, the tansy plant. – Picture by Geoff Oxford under Creative Commons Licence

Despite having wings, the beetle doesn't travel very far at all during its life, which makes it particularly vulnerable to habitat loss and climate change as it won't be able to travel in order to find better habitat.

The good news is that scientists and conservation organisations, including people at Leeds City Council, have been working to create ark sites for this beautiful beetle. The main limit to this species surviving is its lack of ability to travel. In fact it can only naturally travel a maximum of 200 meters in its lifetime. With human help we can hopefully re-introduce this species into specially prepared habitats in the future. Unfortunately, with climate change affecting our wetland, those new habitats may be outside Yorkshire and we may lose this enigmatic symbol of the wide variety of life we have here.

CASE STUDY – MOORLAND HABITATS

The North York Moors are one of the jewels of Yorkshire, hosting a wide variety of endangered and scarce creatures and plants. It is also a massive carbon store, with an estimated 6 million tonnes of carbon stored in the waterlogged peat under the moorland. If all the carbon locked away in England's Peat (a large amount of which is in the North York moors) was released it would be about the same as 5 years' worth of England's CO2 emissions. This is a lot, and therefore it is important to try and keep that carbon locked away.

Unfortunately one key element of a moorland habitat is being damp and with a potential increase in dry weather periods we have seen some moorland areas dry out. Combined with damage to the habitats from lack of management and human misuse, some of the peat is potentially going to release some of its stored carbon. There is also an increased chance of fires in moorlands in the Yorkshire and the wider UK.

In 2019 we had an extremely warm, dry winter period, leading into a dry spring. This created perfect conditions for moorland fires across our moorland areas. Marsden Moor and Ilkley Moors were particularly badly affected.

Some of these fires were started by humans, and some started naturally, but the fires continued for days and fire-fighters struggled to get them under control.

Wildfire can be devastating for wildlife, especially if it is out of control.

If these trends continue we could lose these amazing habitats, and the carbon stored in the peat could be released into the atmosphere, speeding up and increasing climate change.

Luckily people like the North York Moors Authority are working hard to restore and maintain our peat moorlands. They are fighting to combat the effects of climate change, so we all need to work to reduce climate change and keep our moorlands.

WINNERS

Not every animal or plant is disadvantaged by climate change. Some animals especially can fairly easily travel and find new suitable habitats, this is especially true for species that migrate. Here in Yorkshire, as temperatures increase we may find an increase in some interesting species that can now make their home here.

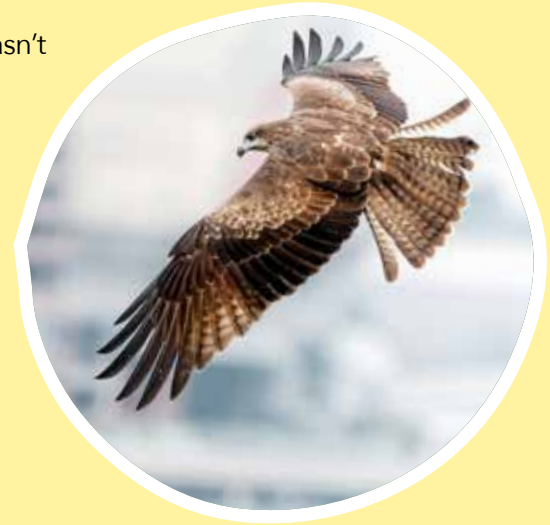
CASE STUDY – BLACK KITES

Black Kites are a bird of prey that usually breeds in Africa, Asia and parts of Europe. It is an occasional visitor to the UK, but normally our climate is a little bit too cool in their breeding season for them to stay. As the climate changes and we have warmer springs some of them may decide to stay and have chicks in the UK.

Some people suggest that if it wasn't for the English Channel the birds would have bred in the UK already. They are capable of surviving here, and they would quickly move North as climatic conditions became suitable.

We already know that there is food and habitat for Kites in Leeds, due to the successful re-introduction of Red Kites that have spread from the Harewood estate to all over the city.

In other locations Black and Red Kites co-exist and live close together. So you never know we may see a brand new bird of prey circling in Leeds skies.



In other areas of the world the Black Kite lives and breeds in cities. With warmer springs predicted, they may soon call Leeds home as well.

CASE STUDY – ASIAN HORNET

One not so welcome potential new resident would be the Asian Hornet. These flying insects, although impressive looking, do carry a risk to humans due to their aggressive nature and willingness to defend their nests with stings. They also prey on and eat many of our pollinating insects including the honey bee.

Please don't confuse this with our native European Hornet which is largely very calm and very unlikely to sting. It also mostly feeds on insects that would otherwise be a pest species so is a welcome addition to our ecosystem.

The Asian Hornet has already made a home in France and the occasional nest has established itself in the South of the UK.

Currently it is struggling to take a hold here due to Britain's cold winters and a pro-active response by government. If you ever find an Asian Hornet then you can report it on the gov.uk website, or on the Asian Hornet Watch App.

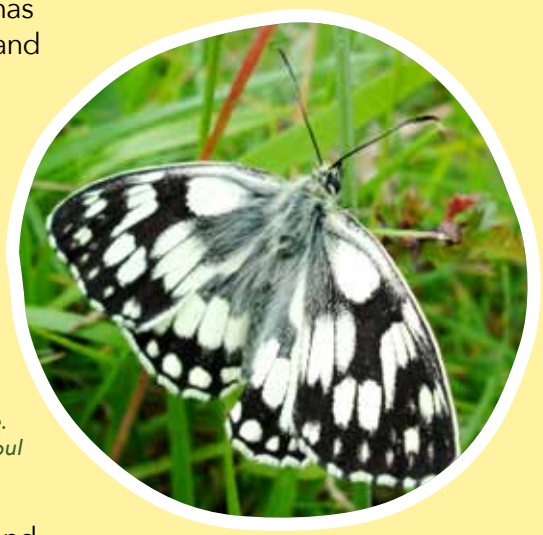
Unfortunately as our climate warms and winters continue to be less harsh, it may become more and more difficult to eradicate this insect and we may have to learn to live with our new neighbours, even as far north as Leeds.

In its native habitat the Asian Hornet is a part of the natural balance of nature. Here they may end up damaging our already struggling pollinator populations.

CASE STUDY – MARBLED WHITE BUTTERFLY

Another insect that may be already benefitting from the warmer winters and springs that we have been getting is the Marbled White Butterfly.

In the last 20 years this butterfly has expanded its range northwards and can now be found in Yorkshire. In 2011 a butterfly spotted at Townclose Hills made the news. Now they have spread to several places in the limestone grasslands in that area.



The Marbled White butterfly is a stunning insect that can now be found throughout Yorkshire. Its migrating nature makes it well suited to adapting to climate change. Picture by Ranger Steve Joul

The Marbled White needs open areas of unimproved grassland and meadows. These habitats are still fairly rare in Leeds and need active management to maintain them. Although, as we'll find out later, planting trees is a great way to slow climate change, we need to balance this with preserving other scarce habitats due like wildflower meadows.

CROP CHANGES

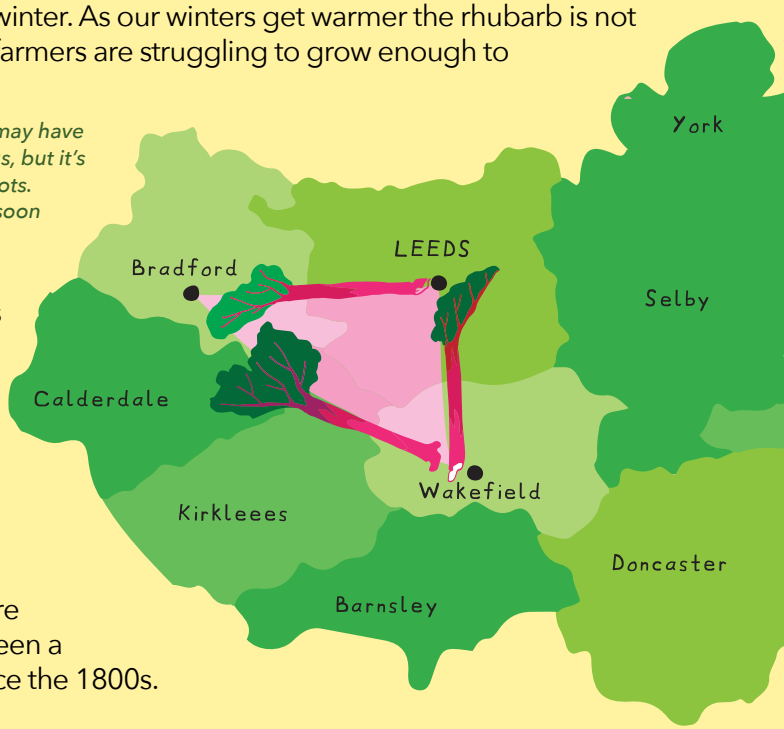
As well as wild organisms we also need to think about our farming and crop plants. Farmers around our country know exactly what plants and animals grow well in their area. As the climate changes those crops might change and farmers are going to have to grow different things in different places.

CASE STUDY – COULD WE LOSE THE RHUBARB TRIANGLE?

The weather in Leeds is absolutely perfect for growing forced Rhubarb. We are world famous for our rhubarb production around here and have even been awarded Protected Designation of Origin which means that it has special association with Leeds.

Rhubarb needs to grow outside during the start of its life where it needs to have cold roots over winter. As our winters get warmer the rhubarb is not growing as well, and farmers are struggling to grow enough to make any money.

Our recent warmer winters may have made things a bit nicer for us, but it's too warm for the rhubarb roots. Yields are going down and soon farmers may have to switch to growing different crops.



Hopefully our farmers will be able to use technology to adapt, but it is looking like the Rhubarb Triangle may be soon a thing of the past.

This will be a big loss to our history. Yorkshire forced rhubarb has been a part of our history since the 1800s.

6 HELPING AT HOME

Bed (furniture)

The choices we make about the furniture in our homes can impact on the environment. Cheaply produced furniture sometimes doesn't last as long, and may need replacing every few years. However, more durable furniture can be really expensive and might not always be practical in a family home. The next time a piece of furniture needs replacing in your home look out for second hand furniture, or affordable furniture made from sustainable sources – look for the FSC mark. Whatever you buy, if you look after it, it will last longer and someone else might be able to use it after you've finished with it.

Light

Do you know what kind of electricity you use in your house? You can choose to use renewable energy – it is much better for the environment than using coal-powered electricity. It's also good to save electricity – using energy saving light bulbs and only having the lights on when you really need them.

Clothes

Clothes can last for a long time if we look after them, but in today's society some people see cheap clothing as something to wear a couple of times and throw away. Many clothes are made from synthetic materials which may not keep their quality long, but ironically may take a long time to break down once they are disposed of. On top of that, the way that they are made and the materials they are made from can produce pollution, adding harmful gases to the air, and if people are buying new clothes all the time then more will need to be produced. Children grow out of their clothes really fast, so you don't really have a choice about whether or not you need new ones. However, if you look after your clothes, they can be passed on to someone else when you've grown out of them, or if they're too tatty they can be recycled. If you can, choose clothes made from natural fibres like cotton or wool – these are produced in a more sustainable and environmentally friendly way, they will last longer and at the end of their lifetime they will break down more easily.

Food

Food production has a huge impact on the atmosphere, and changes to what you eat can really made a difference. Using land to farm animals for meat or milk produces less food than using the same space for growing crops, and so meat production requires more land – which sometimes means clearing large areas of forest to make way for grazing. On top of that, farm animals produce gases (we talked about methane earlier) which contribute to climate change, and the meat they produce often travels thousands of miles before it gets to your plate. Meat has a huge carbon footprint and research has shown that cutting meat out of your diet can reduce your carbon footprint by 60%. Wow! If you do still want to eat meat, buy local – look for the Red Tractor mark which shows it has been responsibly produced in the UK. The Red Tractor mark can also be found on fruit, vegetables, dairy, cereal packets and bread.

EXTRA NOTES

Snacks

Lots of schools only allow healthy snacks, which is great. However, sometimes some people might have snack with chocolate in it! Enjoy it while it lasts as chocolate actually might end up becoming extinct by the time you are grown-ups! The cacao beans are grown in rainforests near the equator, and need certain conditions to thrive. Climate change means that the areas they currently grow in are going to get much hotter, and the conditions won't be right for cacao beans to grown there anymore. Disaster! However, an organisation called the Rainforest Alliance is working with cacao bean growers to try and provide the right conditions for cacao beans to grow, and this has the added advantage of being good for the rainforest habitats, allowing them to continue storing and absorbing carbon from the atmosphere. Next time you choose a chocolate bar, follow the frog! This means that the cacao beans used to make it have come from Rainforest Alliance-certified growers. The frog can also be found on packaging for tea and coffee.

Driving cars

There are more and more electric cars around now, but most cars still use diesel, and this causes pollution which contributes to global warming. Sometimes it's not possible to walk instead of drive – it might be too far or there might not be time – but not all car journeys are necessary, and short journeys produce more harmful gases per mile than long ones!

Water bottle

Lots of people like to buy their water in a bottle rather than get it from the tap. Most disposable plastic water bottles are recyclable, but so many of them are sold around the world – about 20,000 every second (yes! Every second!) that there is no way they will all be collected up, and many will eventually end up polluting the oceans and endangering wildlife. Many new bottles aren't made from recycled plastic anyway, despite it being much more energy efficient to make bottles from recycled material, and less polluting. Drinks companies prefer to use new plastic because recycled plastic isn't as clear. You can be part of the solution by using a reusable water bottle, choosing cans instead of bottles if you're buying from a shop, and making sure you recycle all the plastic bottles you use.

Paper

Paper is made from wood pulp, which is made by cutting down trees. There is a lot of energy involved in making 'new' paper – machinery is needed to cut down trees, extract the wood and process it into paper, and this can produce greenhouse gases. It takes 70% less energy to recycle paper. That is a lot! So … think carefully about whether you need to use paper at all. If so, can you reuse something you've already written on? If not, is the paper you use recycled? If it's a worksheet, is it printed on both sides? Once you've finished with your paper, you can either turn it over and use the other side for something else, or recycle it. Some people might even shred the paper and use it for bedding for their pets!

7 WHAT MAKES A GOOD WOODLAND?

When designing and planning our woodlands we have to think about many things. We are carefully planning where we're going to plant our new woodlands, and choosing the right mix of trees to enable the woodland to flourish, grow, and provide long-lasting habitats that can withstand climate change while helping to counteract human impacts on the environment.

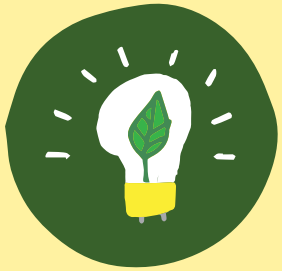
Lots of factors come into play when planning to plant a woodland. These are some things you would need to think about if you were going to plant your own woodland:

Permission

You will need permission to plant your new woodland, especially if planting outside the school boundary. Contact Leeds City Council if you are considering planting in a local greenspace.

Utilities

Companies that deal with water, sewage, electricity or other utilities run pipes and cables under and above ground. Check there aren't pipes running underneath the area you're planning to plant in. We cannot plant trees above underground facilities as the roots could cause problems in the future. It is also important to avoid planting under overhead cables – the trees may interfere with them when they grow tall.



Current use of site

Before choosing a site for planting, think about how that space is currently used. Do people walk through it on a regular basis? Is it used as a space to play sports or dump garden waste? Think about whether these activities are likely to stop when trees are planted there, and how you can make sure your trees are going to be damaged because of where you have chosen to plant them.

Wetness of site

Some sites are un-used because they are too damp to use for other things like sports fields or buildings. Luckily we have plenty of woodland tree species that grow okay in damp conditions. If your area is very wet, look at wet woodland species like alders and willows.

Future use of site

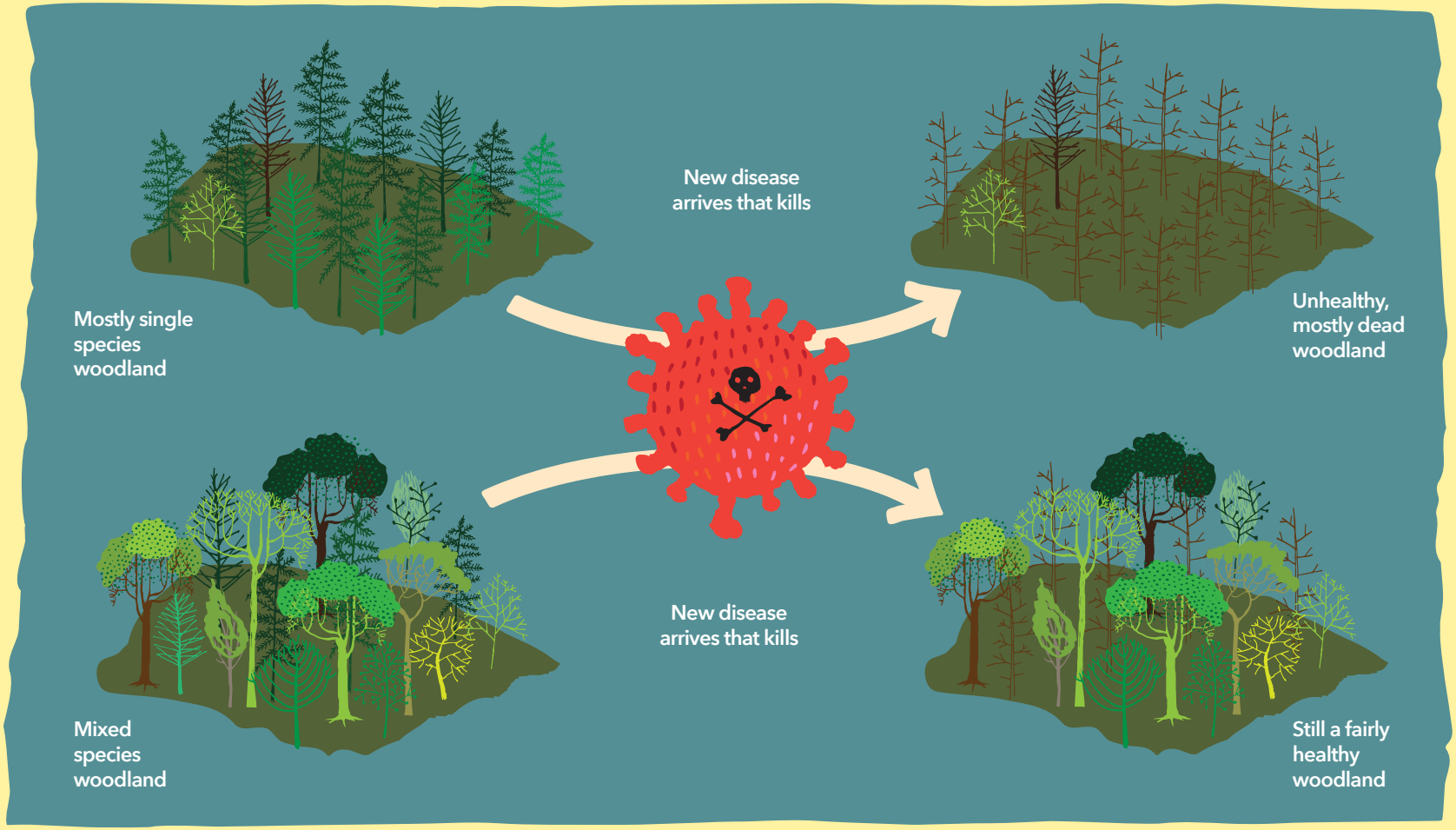
Your trees will be there for a long long time. Consider how big they will grow and how you want to use the space you're creating. Who is going to maintain it? Will your staff be trained in how to make use of it? Will children be allowed to play in it?

Species Diversity

A healthy woodland is a diverse woodland. You don't want a woodland that is completely, or mostly, one species. This is known as a monoculture and it means that the woodlands cannot be home to as many animals.

VOCAB:

DIVERSITY is a measure of the number different types/species of, in this case, tree species in a given area.



It also puts the forest at risk of disease. Many diseases focus on certain species of tree, if you only have that species then the whole woodland is at risk.

It is important to choose a mix of trees that not only can cope with the current conditions, but that can also cope with potential changes in the future – however hard we are hoping that these changes will be minimised.

A mixed species woodland is not as damaged when new diseases arrive that effect species. Monocultures should be avoided, due to their lower biodiversity value and vulnerability to disease.

CURRICULUM LINKS

	KS1	KS2	KS3	KS4
Make your own greenhouse		**Science:** working scientifically / States of matter	**Science:** working scientifically	**Science:** Earth and atmospheric science
Carbon Cycle Game			**Science:** Earth and atmosphere	**Science:** Earth and atmospheric science
Carbon emission sorting activity		**Maths**	**Science:** Earth and atmosphere **Geography:** Human and physical	**Science:** Earth and atmospheric science
Cause and effect		**Geography:** Human and physical **English:** Writing - vocabulary, grammar and punctuation	**Science:** Earth and atmosphere **Geography:** Human and physical	**Science:** Earth and atmospheric science
Species on the move	**Science:** Living things and their habitats	**Science:** Living things and their habitats / Animals, including humans / Evolution	**Science:** Genetics and evolution	
Helping at home (discussion)	**Citizenship:** Preparing to play an active role as citizens	**Citizenship:** Preparing to play an active role as citizens / Breadth of opportunities	**Science:** Interactions and interdependencies	
Climate Change Home Challenge	**Citizenship:** Preparing to play an active role as citizens	**Citizenship:** Preparing to play an active role as citizens / Breadth of opportunities	**Science:** Earth and atmosphere	
Build a tree		**Science:** plants	**Science:** Structure and function of living organisms	
Photosynthesis game			**Science:** Structure and function of living organisms	**Science:** Photosynthesis
Carbon Capture Leaf Game			**Science:** Structure and function of living organisms / Material cycles and energy	
Carbon Calculator		**Maths** **Science:** working scientifically	**Maths**	**Maths**
Tree identification	**Science:** Plants / Seasonal changes	**Science:** Plants / Living things and their habitats		
Seed collection	**Science:** Plants / Seasonal changes	**Science:** Plants / Living things and their habitats		

Please contact woodlandcreation@leeds.gov.uk for more information on using these resources.