

Forests & Climate

Background Information (PPT Notes)

Greenhouse Effect - Carbon Cycle – Photosynthesis – Respiration

1. What is the greenhouse effect — and why does an increased greenhouse effect lead to climate change?

There is no longer any doubt the world's climate is changing. Human activity during the last 100 years, with deforestation and the burning of oil and natural gas, has increased the amount of carbon dioxide gas (CO²) in the atmosphere to a level the Earth is not “used to”.

The atmosphere surrounds our planet as a layer of gas, a layer that works in the same way as the glass in a greenhouse. Sunlight passes through this layer and is absorbed as heat by the Earth. Some of this heat is radiated back into space, but the extra CO² in the atmosphere is now trapping much of this heat. That is why the Earth's temperature is rising and why our climate is changing.

During the last 100 years, the global surface temperature has risen by 0.7 °C. In the next 100 years, scientists predict that it is likely that the temperature will rise a further 1.5 to 6 °C. This can cause many unforeseen changes.

Already, we can see that polar ice is melting. Sea levels are expected to rise, flooding islands and changing the coastline. Weather events will become more extreme, with more storms, more rainfall and more droughts. This will lead to increased desertification in areas around the equator.

All of this can and will have a great impact on humans and all life on Earth. People will have to leave their homes. Species will become extinct. The prospects are

overwhelming, but we are not helpless. If we act now, it can make a big difference to the extent of the problems we will be facing over the next 100 years.

Planting trees is one way to counter climate change. Saving energy is another. In addition, invention of new solutions is a third way. They are all important. We must all act in our daily lives to have the greatest impact. We are currently part of the problem, however by making creative changes, we can be part of the solution.

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2. What is the carbon cycle and how does it influence the climate?

Carbon exists in many different places in our environment. These places are called

Carbon Sinks:

- In trees and tree root systems
- Dissolved in all water, oceans and lakes
- In the bodies of all plants and animals
- In the atmosphere as CO₂ (that we breathe out and plants breathe in)
- In rocks and soils

- Underground as fossil fuels like oil, coal, gas, and as diamonds, crystals, etc.

Carbon is constantly exchanged between the different carbon sources and carbon sinks, in a process known as the **Carbon Cycle**. Carbon is primarily exchanged in the form of CO₂. Carbon sinks actually absorb and store CO₂ and reduce its concentration in the atmosphere. If fossil fuels are burned, that releases high amounts of carbon into the atmosphere.

Humans and the carbon cycle:

Each year humans emit 7,900 million tonnes of carbon into the atmosphere through the burning of fossil fuels and deforestation. Carbon sinks such as lakes, oceans and afforested land trap 4,600 million tonnes. This means that we are currently increasing the amount of carbon in the atmosphere by 3,300 million tons per year. This is not sustainable. To deal with this, we must immediately:

- Emit less CO₂
- Store carbon in new and existing forests and wood products
- Develop alternative energy sources to coal, oil and gas

Fungi and the carbon cycle:

Fungi play a significant role in this storing, cycling and recycling of carbon and other vital nutrients. This is only beginning to be understood and appreciated now. They have white thread like roots that form a net, connecting tree and plant roots together. It called the Wood Wide Web, invisible under our feet. To learn more about this amazing symbiotic relationship: Watch Paul Stammet's short video – Fantastic Fungi: The Forbidden Fruit: <https://youtu.be/EDkR2HIIeBc>

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3. How does planting trees helping to reduce climate change?

There are two ways of reducing the amount of CO² in the atmosphere:

- We can emit less CO²
- We can remove CO² from the atmosphere and store it

Trees can do both!:

Forests have a key role in regulating the climate. Trees make their food through the process of photosynthesis, which involves absorbing CO² from the atmosphere and storing carbon as wood in their bodies and organic matter in the soil in and around their roots.

Trees and Photosynthesis:

Using the energy from sunlight, green leaves absorb CO² from the air. Inside the leaf cells, CO² joins together with water and changes into the sugar substance *glucose*. The tree transforms glucose to wood, branches, fruit, leaves, roots etc. In this way, CO² remains inside the tree as carbon. There is only one waste substance and this is Oxygen (O²). All animals, including humans, need O² to breathe. This is a brilliant example of the way trees/plants and animals rely on each other to live.

Photosynthesis: CO² + Water + Sunlight → Sugar + Oxygen

Trees & Respiration:

It is only the green parts of a plant that can perform photosynthesis (leaves). All other parts of the tree "*breathe*" or *respire* like animals and other organisms without photosynthesis. In darkness, the whole tree respire.

Respiration: Sugar + Oxygen → CO² + Water + Energy

Tree Growth and CO² capture:

As long as a tree grows, it will absorb more CO² than it delivers via its breathing. When a tree is fully grown, it reaches a stable level where it the amount of CO² it takes up equals the amount it releases.

Once the tree is old and deteriorating it will release more CO² than what is absorbed in photosynthesis. When the tree is completely decayed all the CO² bound in the tree will have returned to the atmosphere. This is all part of the *Carbon Cycle*.

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Forestry and Carbon storage:

Forestry is a way for people to take an active role in the *Carbon Cycle*. We can plant trees that absorb CO² and harvest trees when they are mature and absorb less CO² than they previously released. If we plant new trees every time one is cut down, the trees we are removing from the forest are CO² neutral. If we plant trees on a larger area than originally harvested, we initiate a greater absorption of CO², as well as greater storage of CO². Research shows that the faster a forest grows; the more CO² is absorbed.

From a climate point of view, it is better to cultivate the forest and make use of the trees rather than “leaving it alone”. These are forest plantations, where they are planted for the commercial production of timber and wood. That is provided of course, that the forest is managed sustainably and that all necessary environmental and biodiversity concerns are taken in to account in the production and harvesting of the timber. The trees we fell (cut down) and extract contain a lot of carbon. This carbon can be stored for many years in wood products. If the wood is burned, it releases carbon back into the atmosphere.

Planting commercial forests as part of the solution:

To be truly sustainable, we need to plant at least 3 kinds of forest plantations that we can harvest from:

- **Short term:** These are quick growing and can be harvested within 20-40 years, eg. Hazel, Ash, Willow, Alder, Poplar Plantations. These can be used for biomass, fencing, building and to make hurls, etc. They can be coppiced, which means they are cut to the ground and will regrow. They are also valuable in terms of biodiversity.
- **Medium term:** These are for harvesting within 60-80- years, eg. The same as above and also Birch, Larch, Cherry, Holly, Spindle, Walnut. Currently most plantations are Sitka Spruce, which grows quickly and is used in building and for pulp to make paper and cardboard. Once cut, conifers do not regrow and have to be replanted. There is a need to diversify the species grown here.
- **Long term:** These are trees that are planted for harvesting by the next generations, eg. Oak, Sweet Chestnut, Yew, etc. They grow more slowly, store more carbon and show that we are planning for a sustainable future.

We can also examine how we harvest trees from plantations. We need to move away from **Clear Felling**, where all trees in the plantation are cut down at the same time. There are alternatives such as **Continuous Canopy Cover**, where trees are selected, cut down and taken out, not all at the one time. We also need to move



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away from large-scale monoculture plantations. (**Monoculture** means planting only one species).

Currently, our commercial sawmill industry is set up for the clear fell harvesting and processing of spruce. In these changing times, we need to be creative and start making the transition to sustainable forestry, where we are both managing our forests, protecting our forest industry and livelihoods, while also and protecting our vital ecosystems and the life-giving services they provide.

It is important to remember that there also is a need for old growth forest and forests that are for wildlife only and not harvested from. We can also help by planting native trees and hedges in our gardens, school grounds, community spaces, farms and other land.

Food for thought:

Currently, an Irish person emits on average about 13 tonnes of CO² a year. A mature tree contains on average 5 tonnes of CO². We can now say that we each must plant between two and three trees per year to be carbon neutral. However, bear in mind that it takes quite a few newly planted trees to be the equivalent of one large tree that is mature for felling.

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4. How does the use of wood help the environment?

Wood stores CO² in the form of carbon.

1 m³ of wood contains carbon from about 1 tonne of CO²

If we use wood to make our houses, bridges, furniture, paper, etc., the carbon will be stored away from the atmosphere as long as the wood product exists (Carbon Sink). In Europe, estimations show that we have accumulated about 60 million tons of carbon in wood products.

The use of wood as material has several benefits for the environment:

- Wood products have a long life. The average lifespan ranges from 2 months as newspapers to 75 years for building materials
- Wood products can usually be recycled and the carbon continues to be stored
- Wood products can be burned and used as CO² neutral bio-energy
- Wood can replace other materials for construction such as concrete, steel, aluminium and plastic – all of which are more energy intensive to produce

Here is an example of how wood as material benefits the environment:

If we use 1m³ of wood for a house, we have spared the atmosphere 1 ton of CO². The carbon stays in the wood material.

If we use 1 m³ of wood instead of 1 m³ of concrete, steel, plastic or aluminium (which are more energy intensive materials to produce), we will have spared the atmosphere on average another 1 tonne of CO².

Therefore, in total: 2 tonnes of CO² are not emitted to the atmosphere if we substitute other materials and use 1 m³ of wood for construction. By comparison, 1 tonne of CO² equals the emission from the burning of 430 litres of petrol!

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5. How can wood be recycled?

Wood is a renewable and versatile raw material and it has many lives:

❖ **Wood products:** Timber is sawed and used directly as building materials, furniture, paper, packaging, signs, fencing, crates, etc.

❖ **Recycling:** Used construction timber and other wood materials can be reused. They can also be chipped and used as fibre boards, etc. Paper can be recycled several times.

❖ **Bio-energy:** Wood products can be used one final time as CO₂ neutral bio energy. Waste/by-products from sawmills and other wood industries are frequently used as an energy source – both for heat and electrical power. By recycling wood the total CO₂ savings increase significantly.

6. Are we destroying the World's Forests – and the Climate –by using wood?

There is a big difference between felling a tree in tropical or subtropical forests and in temperate forests. However our lifestyles and demand for cheap meat and food

often mean that we are indirectly responsible for the burning and clear-felling of tropical forests far away from us, such as is happening in the Amazon.

Forestry in temperate forests:

In Europe and Asia, the forestry sector is very much aware that the future of forest management is closely linked to nature conservation and reforestation. In the past, there has been unsustainable cutting and mis-management of our forests, so this experience has taught us to:

- Replant the forest after felling
- Increase forest area being planted
- Cultivate the forest sustainably
- Have an environmentally friendly wood production

Forest cover in Europe and Asia is growing. Europe's forests are increasing by 510,000 hectares every year – and only 64 % of this annual increment is harvested. We have cut down our ancient forests in Europe - now we have to replant and protect them. There is still much work to be done!

Deforestation in tropical and subtropical forests

Deforestation in tropical and subtropical countries is an enormous problem, in terms of ecology, biodiversity and the climate. The tropical rainforests are often called the



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World's Lungs. They are ancient, enormous and filled with an enormous number of animal and plant species.

Unfortunately, large areas of rainforest are cleared every day. They are harvested for timber or burned to create space for beef production, monoculture plantations and farmland for cash crops. This is not a sustainable practice. However, we in the western world have to be aware that a lot of the time these clearings are happening to produce cheap meat and cash crops for us in Europe and the USA. So once again, this shows how we are all connected to each other and these ecological systems.

Globally, 13 million hectares of forest is cleared annually. This is an area equal to the size of Greece. **Rainforest clearing is the cause of 20% of global CO² emissions.** Countries with rainforest are often poor and many of the people who live there feel they have no other option than to exploit this resource to survive. Therefore, an important part of the fight against climate change is to make agreements with rainforest-rich countries as to how they can protect their forests – and for the world community to help pay for this protection. ***Currently our climate, biodiversity and environment is paying the price and that cannot continue if we want to live in a healthy and bio-diverse planet.***

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7. What is sustainable forestry?

Sustainable management of forests means considering the forests ecological, economic, social and cultural values. The forest manager uses the forest to grow and produce wood, but is also responsible for maintaining forest health and biodiversity, as well as taking into account alternative and non-commercial forest use, such as tourism etc.

In sustainable forestry, the environment is accounted for by doing the following:

- ✓ Mapping the forest and creating green forest plans, to distinguish the areas for tree production and areas to be protected
- ✓ Taking into account key habitats and other environments that require special considerations and protection
- ✓ Leave standing and fallen deadwood to provide a basis for biological diversity
- ✓ Letting old trees with woodpecker holes remain standing. Take into account value of anthills, woodlouse, creatures that are recycling deadwood, etc.
- ✓ Creating protection zones with trees along watercourses (buffer zones)
- ✓ Leaving areas of old forest standing and left alone from human interference and management
- ✓ Increased awareness about the role that plants such as fungi (mushrooms) and lichens play in forest ecology

Certification of Sustainable Forestry Products:

How can you tell if the timber or wood products you are buying are coming from a sustainable source? There are two international forest certification schemes currently operating in Ireland:

- **Forest Stewardship Council (FSC)** scheme
- **Programme for the Endorsement of Forest Certification schemes (PEFC)**

Both schemes work throughout the entire forest supply chain. They promote good practice in the forest and ensure that timber and non-timber forest products are produced with respect for the highest ecological, social and ethical standards.

Through their eco-labels and symbols, customers and consumers can identify products from sustainably managed forests.

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8. How much forest is there in the world?

Forests cover 30 percent of the earth's surface. The total land area covered by forests in 2005 was just less than 4 billion hectares.

$$\mathbf{1 \text{ hectare} = 100 \text{ m} \times 100 \text{ m} = 10,000 \text{ m}^2}$$

This area is about a third less than before agriculture emerged 10-12,000 years ago. Forests are unevenly distributed around the world. The top 10 most forested countries, which include 2/3 of all forests in the world, are *Russia, Brazil, Canada, USA, China, Australia, Democratic Republic of Congo, Indonesia, Peru and India.*

Find out about the Irish Government's plans to plant 400 million trees by 2040 as part of their current Climate Action Plan:

<https://www.irishtimes.com/news/environment/climate-change-ireland-plans-to-plant-440m-trees-by-2040-1.4003940>

9. How do forest protect the planet?

Trees create the basis for many natural ecosystems. Some of the invisible and amazing work they do is that they:

- ✓ Create a stable climate
- ✓ Help stabilise the ground and soil
- ✓ Prevent erosion of soil
- ✓ Protect coasts from waves and ocean swells (eg. Mangroves)
- ✓ Stabilise sand dunes
- ✓ Protect the groundwater and prevent the spreading of desert

Forests are very important for biological diversity:

- They are a habitat for up to 90% of all terrestrial (land based) species of animals and plants we know about
- Trees and shrubs play a central role for rural people throughout the world. Forests provide us with timber, firewood, food, feed for livestock, oils, rubber, medicine and new materials for new technologies, and much more....
- The world's forests only cover about 10 percent of the Earth's surface, but they account for 42% of the total photosynthesis of both land and sea

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10. What can we do?

To meet climate change with the forest as a starting point we must do several things:

- We must protect the forests we have and manage them sustainably
- We must reduce deforestation globally
- We need to replant the forest area we have lost and plant even more forests
- We must plan reforestation so as the new forests can be adapted to the climatic changes that will come
- We must use wood as a material and for bio-energy –and replace concrete, steel, etc. with wood

BE PART OF THE SOLUTION!

There are so many other things we can all do in our daily lives to help protect our climate and biodiversity

Save Energy and Consume Less Stuff!

**Here are some simple ideas.
Figure out more on your own....**

- Use your bike instead of the car
- Use the train and bus instead of your car
- Travel without flying (Slow Travel)
- Switch to energy-saving light bulbs – they last 6 to 15 times longer
- Turn off lights and electrical appliances when not in use. Avoid standby mode
- Take short showers
- Hang-dry your clothes instead of using the tumble dryer
- Insulate your house
- Use new forms of energy –solar, wind and bioenergy
- Eat less meat – eat meat that has been locally produced and buy direct from the farmer and they get a fair wage for their work
- Buy locally produced food and products – be willing to pay a higher price as this is the real cost of sustainable production
- Grow some of your own crops
- Grow bio-diverse and habitat rich gardens or window boxes!
- Plant fruit trees and bushes in your lawn
- Turn green spaces into places for wildlife and you to sit and enjoy it
- When buying stuff, ask yourself – do you really need it? This includes clothes, makeup, the next techie product.
- Have clothes swops, shop in charity or 2nd hand shops....

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Explore and invent new solutions:

'With climate change, humanity is facing a great challenge but also with an exciting time when many people at the same time are aiming to develop new technological and social solutions. To this, both children and adults can contribute. We need curiosity and smartness, and for many people to study and get more knowledge. We need creativity to use our knowledge in new ways. Moreover, we need compassion, so that everyone will be included in the progress. It could be a turning point for us all. So, it is just to get started.'

*Adapted from Malene Bendix, Forest in Schools, Denmark
(Translated from Danish to English by Snorre Synnestvedt, Forest Society of Oslo and Akershus)*

Mitigation and Adaptation - Difference and Examples

Source: <https://climate.nasa.gov/solutions/adaptation-mitigation/>

Mitigation – reducing climate change – involves reducing the flow of heat-trapping greenhouse gases into the atmosphere, either by reducing [sources of these gases](#) (for example, the burning of fossil fuels for electricity, heat or transport) or enhancing the ["sinks" that accumulate and store these gases](#) (such as the oceans, forests and soil). [The goal of mitigation](#) is to avoid significant [human interference with the climate system](#), and "stabilize greenhouse gas levels in a timeframe sufficient to allow ecosystems to adapt naturally to climate change, ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner" (from the [2014 report on Mitigation of Climate Change](#) from the United Nations Intergovernmental Panel on Climate Change, page 4).

Adaptation – adapting to life in a changing climate – involves adjusting to actual or expected future climate. The goal is to reduce our vulnerability to the harmful effects of climate change (like sea-level encroachment, more intense extreme weather events or food insecurity). It also encompasses making the most of any potential beneficial opportunities associated with climate change (for example, longer growing seasons or increased yields in some regions).