BIOECONOMY
and
EUROPEAN FOREST WEEK
2017

A GREAT CHANCE TO SEE THE ROLE OF OUR FORESTS IN EDUCATION FOR SUSTAINABLE DEVELOPMENT

European Forest Week

Warsaw 2017

Forest Europe growing life

CONTENTS

Click on the photo to play the video, it opens in your web brower.

The main aim of the movie is to show economic, environmental and social importance of forests. The video is based on infographics used in State of Europe´s Forest 2015, supplemented by pictures from European forests.

BIOECONOMY

The EU's definition of bioeconomy is "sustainable production and processing of biomass for food, health products, fibre products, industry, and energy".

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Bioeconomy implies a shift from fossil resources (oil, coal and gas) to renewable resources (biomass). This means that development and production of new products from biomass must take place in a sustainable manner. In theory, biomass can replace all oil-based products. It can be used for many products such as food, medicines, cosmetics, chemicals, plastic, lubricants and fuel.

Earlier use of biological resources was limited to the main usage of the resource, such as for trees where for instance only the stem was the resource and the rest of it was considered waste. This has changed, and with today's knowledge we are able utilize the entire tree. All of today's bio-resources from farming, forestry and fishery are used in technologically advanced productions of new resources in addition to the primary product. The result is a wider range of products, new jobs and maybe even new types of professions. Finding new uses for biomass requires a good link between knowledge, research, economic insights, and innovation.

Just as important as finding new uses for biomass, is to ensure that the product stays in the cycle to transform into a new product rather than waste after its initial use.

Current research is looking at sustainable utilization of natural resources, where all products are part of a biological, chemical and physical cycle, and re-used time after time. This is how a circular economy works, as opposed to our current economy, which is linear. With today's linear economy many products are made from non-renewable resources and end up as waste as soon as it is broken, no longer used, when a newer model is on the market, and similar reasons.

Without doubt, a change is necessary to secure a sustainable future. There are huge expectations for bioeconomy and its impact on business and society. It is anticipated to be a driving force for a shift to environmentally friendly productions based on renewable resources.

For bioeconomy to succeed, new products must replace non-renewable products. Production must be steady without wreaks havoc on the resource basis. Bioeconomy must be adaptable for future changes, for instance climate change.

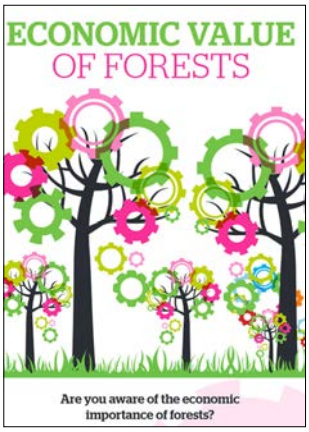
We are facing substantial challenges. However, we live in a time with great trust in science, and in technological and scientific solutions.

HOW IS BIOECONOMY RELATED TO FORESTRY?

Circular economy

Lack of resources on our planet is the reason why there is a shift towards circular economy which focuses on renewable resources. Today we extract resources, create a product which we use and later throw away.

Fact sheet



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Take for instance a wooden chair. When it is broken, we can fix it, but at one point it ends up as waste. It is quite likely that the chair can't be used as firewood because it has been treated with chemicals. There is no current system which allows the owner to make it reusable except for delivering it to special waste, which may send it to specialized energy producers. Hence, the chair's life cycle was: resource extraction, production, purchasing, using and throwing away. The best use of the chair then is still to be burned for energy, but in a complicated manner. This is a linear economy which always starts with using a resource and ending up as waste.

However, by planning how a product can be made from a renewable source and how it can be reused or upcycled into a new product after its initial use, the resource will stay within the economy for a longer time. This will reduce the enormous quantity of waste we produce today.

A wooden product will always reach an end. But rather than making waste, it may end in a permanent state like a building or end its days as biofuel. Today, some biofuels are made from resources that just as well could be food. It is a product made directly from a resource which ends up as combustion waste. However, if it is made from waste, the original resource will have had many usages before it ends up as biofuel which then will be the last new product.

Sustainable forestry

It is essential that annual growth in a forest is higher than what is logged, and that a new tree is planted for every one taken out. Certified timber is a proof that the logging process has taken environmental considerations. This means protecting rare species, special animal habitats, biological diversity and to leave trees of special value for people or animals. It also means protection of water resources and areas of important social value.

CO_2 and climate change

Forests act as a carbon sink, which means they store the carbon from the CO_2 which they collect during the photosynthesis. Nevertheless, this is only the case if the annual growth is bigger than what is logged. A change from fossil to biological resources will also reduce the amount of CO_2 emitted to the atmosphere. This is because all biological resources are renewable and have their own carbon cycles. Fossil fuels are also made from biological material, but have been stored in the ground for millions of years and are hence not part of a carbon cycle. The release of CO_2 from fossil fuels is added to the existing carbon cycle, which imbalance it. We need alternative resources for all products made from hydrocarbons, but most of all there is a need to r eplace fossil based energy which is the greatest emitter of CO_2.

Products of wood

When using wood as a material, the carbon is still stored in the wood and it won't emit CO_2 before it is burned or decomposed. In addition, wood has a great substitution effect. Production of materials such as steel and concrete are very energy intensive and the energy is mostly made from fossil resources, whereas wood only uses the sun. WFor each ton of wood used instead of non-wood products, there is an average emissions reduction of approximately 2 tons of carbon.

Renewable resources

All organic resources are renewable, such as plants, wood, fish, animal manure to mention a few. Forest is a good example of a renewable resource. But keep in mind that all resources must be well managed to allow a greater growth than what we extract. All the above-mentioned resources can be used as energy, in addition we can use other renewable resources such as wind, water, waves and geothermal energy.

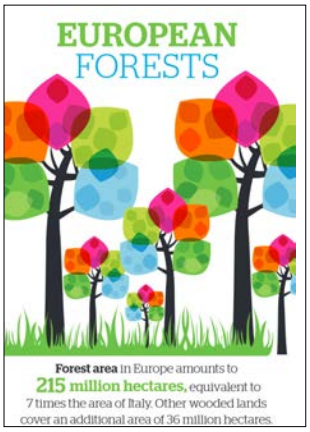
Biodiversity

A rich biodiversity is of greatest importance to our planet for numerous reasons, and the forests have the richest biodiversity on land. A rich biodiversity maintains stable ecosystems, which otherwise can be fragile if there are loss of species. Ecosystems serve humans by providing natural functions, such as the microbes which decompose dead plants and animals and thereby recycle nutrients. Further they provide services like pollination of food plants, they help cleaning the air, soil, and water. They can also protect us from extreme weather like wind, and limit erosion. A rich biodiversity provides numerous resources, and the forest is regarded as a considerable source for products such as food, herbs and wood, moreover it is fundamentally important in medicine. Different species bring different skills, so the more the merrier. Nature is the foundation of our existence.

Technology and innovation

Technology has taken wood to a greater level. Today, wood is a component in anything from toothpaste to asphalt, and now we can create plastic from it too. Anything made from hydrocarbons can also be made from wood. Scientists have already managed to make a car entirely from wood based plastic. Technology has demonstrated the possibility. And the research goes on.

Fact sheet



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FURTHER READING

[The Role of European Forests in a global context]

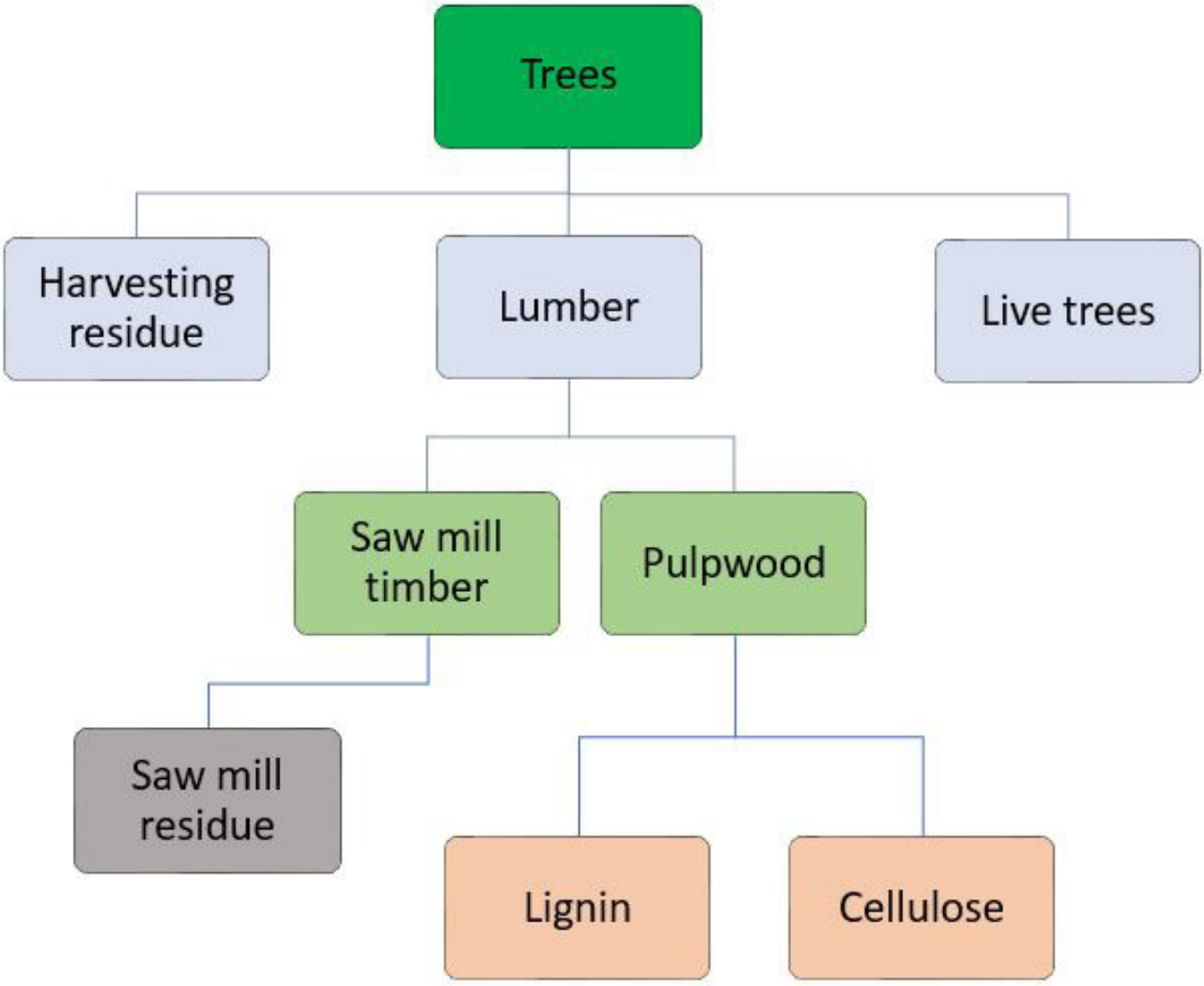
[European forests resources]

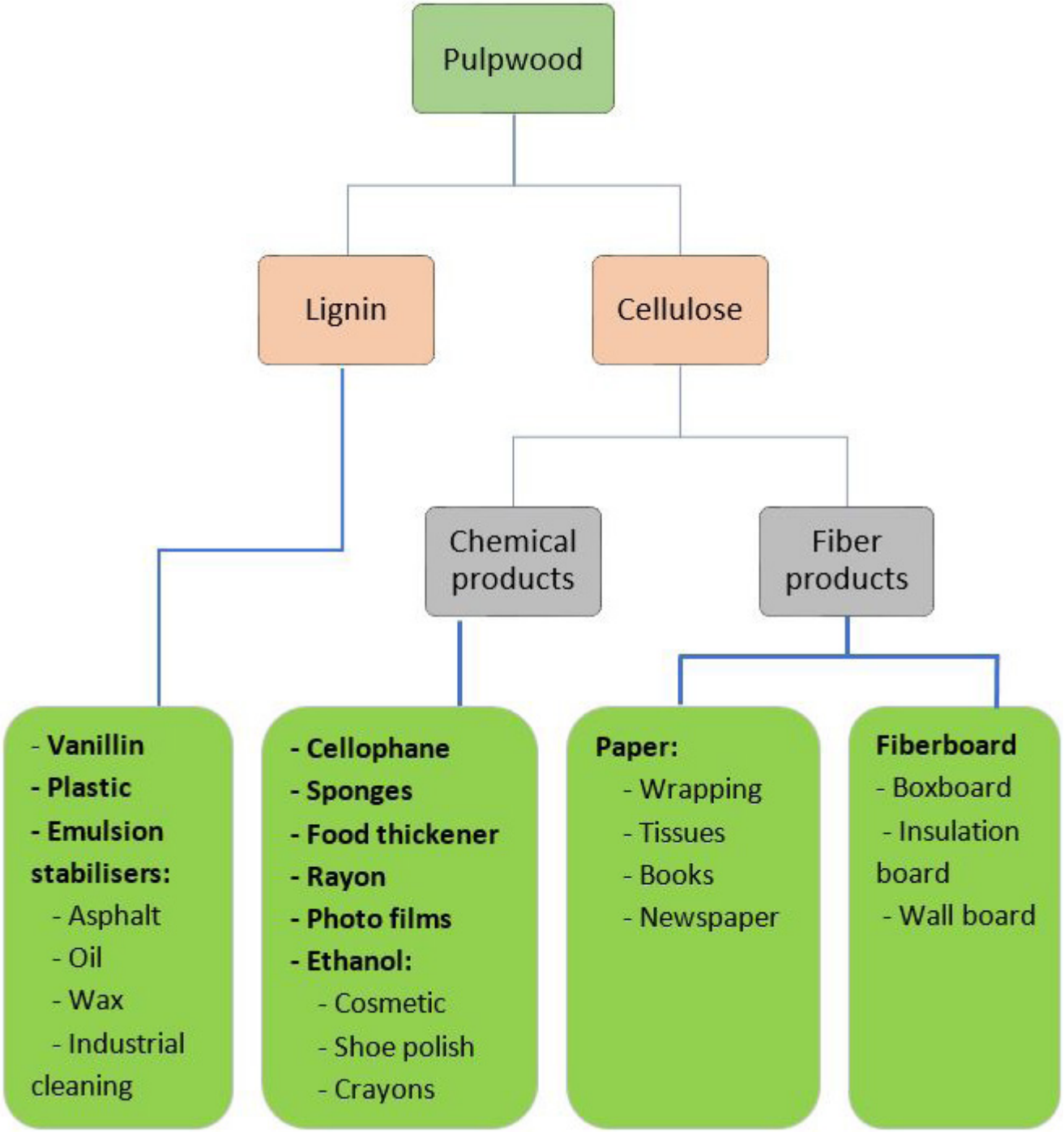
[The forest sector in the centre of green economy]

[Sustainable forest management and policy tools]

WHAT CAN WE GET FROM A TREE?

This diagram shows the different levels of everything one can make from a tree. As you can see, there is nothing left of the tree once it has been separated into different areas of application. Pulpwood is a product from lumber, and has enormous numbers of usages. Therefore, we have made a new diagram that starts with pulpwood. You may be amazed to learn how many products you can find traces of a tree.




Pulpwood
Lignin
Cellulose
Chemical products
Fiber products
- Vanillin
- Plastic
- Emulsion stabilisers:
- Asphalt
- Oil
- Wax
- Industrial cleaning
- Cellophane
- Sponges
- Food thickener
- Rayon
- Photo films
- Ethanol:
- Cosmetic
- Shoe polish
- Crayons
Paper:
- Wrapping
- Tissues
- Books
- Newspaper
Fiberboard
- Boxboard
- Insulation board
- Wall board

FACTS ABOUT PRODUCTS FROM THE FOREST

Introduction

Forest products are important for people around the World. In fact, it is pure magic. Sun, air, water and some nutrients is allall they need, and the photo-synthesis does the rest. The trees grow and the for-ests provide for a range of resources we depend on. It would be difficult to get through a day without using something that derives from forest. It could be firewood, newspaper, furniture, medicines or food. These are all products we can directly relate to forests, and there are many more.

Wood

We can use wood for buliding houses, making furniture, boats, and bridges. The list is almost endless as there are very few things you can't make from wood. The great thing about using wood as building material is that it is very environmentally friendly. Compared to other materials like steel or concrete, production of wood require less energy and produce less wastes. It is estimated that for each ton of wood used instead of non-wood products, there is an average emissions reduction of approximately 2 tons of carbon. Moreover, wood products store the carbon over their entire lifetime, so the longer products are used, the higher environmental benefits. At the end of lifetime wood products could be recycled and used for the new products or energy.

Building material

Wood is historically one of the greatest resource for constructions. Wood has excellent qualities like durability, usability and strength.

Even today, wood is a number one choice in many countries for construction purposes.

Wood is a multi-purpose material and has usag-es ranging from construction, planking, panelling, roofs and floors, window frames and doors, and a wide range of decorative purposes. One can use it for anything from small house or 100 metres long glulam bridges. Compared to its own weight, it is extremely strong. This applies to everything from big logs to the smallest particles of fibres.

The technique of glulam makes it possible to build huge buildings like airports or sports stadiums. Glulam is a type of structural timber product com-posed of several layers of dimensioned timber bonded together with durable, moisture-resistant adhesives.

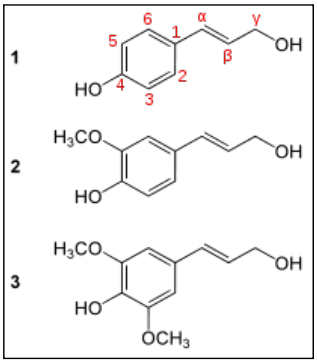
Wooden products

Inside a house, you will always find products made from wood. Wooden furniture is one of the earliest, and most important, inventions intended strictly for human comfort and pleasure.

The making of the very first musical instruments used wood. It is still an important material for many instruments. Table, chairs, kitchen benches and cabinets are just some of the products made from wood often found in homes.

Outside the house, you can see fences made from wood, or a child on a skateboard. Perhaps you take a trip in a wooden boat, departing from a jetty made from wood. Wood is surrounding us in our daily life in one way or another.

Wood based chemicals



Trees do not only pro-vide us with wood. Many chemicals are extracted for different uses ranging from medicine to indus-trial purposes. The great benefit is that "green chemistry" can replace or reduce chemical products that have a negative environmental impact. The two major sources for green chemistry are lignin and cellulose.

Lignin

A tree is made of wood fibres. A substance called lignin keeps the fibres together. T he lignin can be extracted and used as either a binding or a

dispersing agent in products like paint and concrete.

From lignin, it is possible to extract the delicious vanillin. It tastes almost exactly as vanilla, but is much cheaper. Most food with vanilla flavour is made from vanillin – consequently trees!

Cellulose

Cellulose is perhaps best known as the raw material for paper. However, it has many other purposes as well. Recent technology has made it possible to make plastic from cellulose. That is far more environmentally friendly than the plastic we are familiar with, made from oil.

You can also use cellulose for food. Cellulose powder serves as an excellent thickener that makes water and other liquids viscous/thick and sticky. Therefore, you can find it in for instance toothpaste. Pills consists mostly of cellulose, as the actual amount of medicine is so tiny it would be impossible to eat without some sort of filling that increases the size to something we can pick up and eat. Viscose (rayon) is a fabric for clothing also made from cellulose.

Sugar

Wood contains sugars. By adding yeast, one can produce alcohol, which further usage can be methylated spirits and window washer fluid. The fermentation process produces carbon dioxide (CO_2), which is captured and used in carbonated soft drinks.

Food

The forest is a great provider of food. Many animals live in the forests and most cultures have a long history of hunting game for food, not only mammals but also, birds, fish, reptiles, and insects. In many parts of the world, like Europe and North America is hunting today mostly for recreational purposes as you can buy all the food you need in shops, and there is no real need for hunting one's own food.

However, the forest can provide more than meat. You can find fruits, berries, mushrooms, herbs and eatable plants in all forests to some extent. In some countries, gathering food is part of daily life, - whereas in other countries it is part of recreational habits.

Paper

Paper is a product from nature, and the raw material comes from trees and other plants. Today it is hard to imagine a world without paper. We have books, money, packaging and even filters in cars to mention a few. It comes in different shapes and qualities depending on what we use it for. Paper can be recycled and used over and over again, which is good for the environment. There are three major categories for the different uses of paper. For print, packaging and hygienic use.

Paper for print

One of the most important purposes of paper is to distribute information. Paper is the carrier of information and culture through books and magazines. Historically, paper has played an important part in distributing news and freedom of speech. Today, paper has many competitors for these tasks, but despite digital technology and Internet paper has not disappeared. Newspapers are still printed on paper; even though they can be read on the Internet. Concert posters are still posted on walls, and surveys show that most people prefer a birthday card of paper instead of a digital card.

Paper for packaging

Packaging is for protection, information and sale. It is the second largest range of use for paper and carton. Packaging is for protection of goods, all the way from the factory to the shop and from there to the home of the buyer. It should be informative and let consumers learn about the product without opening it. Packaging is also important for sale. They use lots of effort in designing the packaging to make the products most appealing to target groups. There is continuous research on paper and paper products to improve and create new products.

Paper for hygienic use

Household paper like napkins or toilet paper should be soft and absorptive. It is made from a different type of pulp and is not as strong as paper for print or packaging, but it makes use of the natural absorbance power of cellulose fibres.

Energy

Bioenergy is renewable energy from nature – plants and trees. The energy from the biomass is the solar energy, which the trees and plants collected when they were growing. Bioenergy is an environmentally friendly alternative to fossil fuel. In modern forestry, every part of the tree is used. The bottom part of the tree trunk is used for building material, the upper part for paper, and what is left over will be used for energy.

Bioheat from forests

Bioenergy comes in many shapes. Residues from logging timber can be chopped into chips, sawdust can be compressed into pellets, but it can also be regular logs for firewood.

Biofuel from forests

The forest is also about to become a competitor to fossil fuel. Ethanol and biodiesel have been criticised as source for fuel as they are made from food plants such as corn, sugar canes and rapeseeds. Research on second-generation biofuel suggests that forests can be a contributor, and they are currently studying how to make fuel from harvesting residues.

Medicines

A great amount of the products in grocery stores is from the tropical forests: coffee, cocoa, coconut, vanilla, bananas, pineapples and pepper, just to mention a few.

A drug store has an equally impressive number of products that originate from the forest. That is not surprising knowing that more than half of the world's plant species are native to the tropical forest.

In an environment with great competition from other species and the threat from myriads of insects, bacteria and fungi, tropical plants have developed a wide range of chemical compounds to protect themselves. These chemicals have given us drugs to treat cancer, malaria, heart disease, bronchitis, dysentery and tuberculosis to mention a few. In addition, there are common drugstore products like headache pills and cortisone ointment. In fact, over 120 pharmaceutical products are plant derived, with a large portion originating from tropical species.

However, medicinal plants are not only from tropical forests. To natives all over the world, the forest has been a great source for natural medicines. Trees live longer and grow larger than annual plants, and will therefore contain greater amounts of chemical defence.

Recent research has shown that the Nordic spruce contains large amounts of compounds that may have preventive effects on common and wide spread diseases like diabetes, cancer and cardiovascular disease.

Innovation from the forest

Research and development keep pushing the limits for how we can make use of wood, and new products and usages emerge.

Nano technology has made researchers in Sweden able to make the world's strongest paper. It is water resistant and seven times stronger than normal paper. As it is solid as iron it is impossible to hit a nail through it.

New technology has made it possible to make drink cartons for milk and juice that do not need refrigerated truck for transportation, yet it keeps the products fresh until it reaches its consumers.

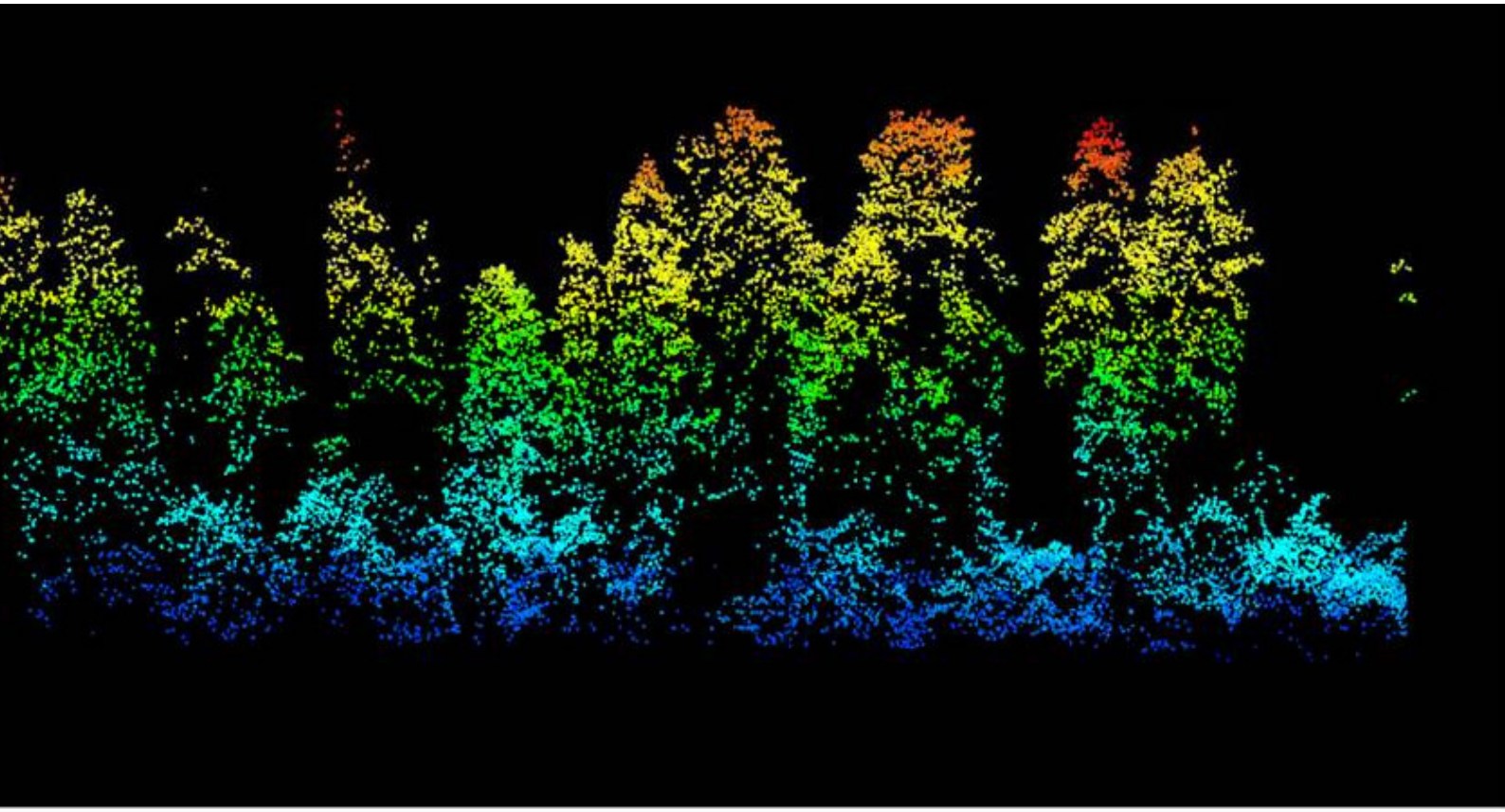
Plastic is usually made from oil or natural gas, which cause emissions of CO_2. However, it can also be made from cellulose. Toothbrushes and instrument panels in cars are already products from trees, but we can assume the usage will increase in the future.

This plastic pen is made of wood in Finland.

Wood for food is already a reality, but the range of products keeps increasing. Food additives are often synthetic; however, natural ingredients can replace many. One can make sausage skin from cellulose, and cellulose acts as an excellent binder in frozen food and milk based drinks, to mention a few. Recent research is considering possibilities to make animal food from trees to replace other biological sources like beans and rapeseeds.

Paper and technology can create new exciting products. Intelligent medicine wrapping can help a patient knowing when to take a pill, and it can communicate directly to the doctor and pharmacy when they need more pills. Intelligent wrapping can also prevent piracy of products. Research and development in wood-based technology makes it possible to build even taller, stronger and more durable buildings from wood. They are also fire resistant, and since the building material is wood, it is far more environmentally friendly than other building materials.

Airborne laser scanning provides forest parameters such as volume, height and number of trees.



FACTS ABOUT BENEFITS AND SERVICES FROM THE FOREST

Human survival depends unconditionally on forests. They are called the "lungs of the earth" and for a good reason. Through the photosynthesis, trees create the air we breathe and they are the reason why life outside of water became possible in the first place. Besides the air we breathe, we depend on numerous other functions the forest provides.

Ecology

Ecology is the scientific study of the relations between living organism and their environment.

Water

The forest interacts closely with the water cycle - it acts as the storehouse of water. Like a giant sponge, it soaks up rainfall during wet seasons and helps water percolate into the soil. During dry seasons, it pumps the water back into the atmosphere through evaporation and plant transpiration. In this way, the forest regulates the groundwater level, which is the biggest water resource for people on earth. Forests also contribute to the maintenance of good water quality. They significantly reduce soil erosion, which in turn reduces the level of sediments in rivers and lakes. Forests also filter and trap some pollutants. Without forests, rainfall would cause floods and soil erosion, which would wash away most of the nutrients and the elements needed to maintain life.

Biodiversity

Only about 1.2 million species on earth are identified. Yet scientists estimate the planet could be home to as many as 8.7 million different species of animals, plants, fungi and microorganisms. All these species and their habitats represent the world's biological diversity – biodiversity. Daily humans use more than 40 000 species for food, shelter, medicines and clothes.

We greatly value the biodiversity, yet only fractions of known species have been examined for its values for humans. However, the more we learn the more we understand how much the world depends on it. Forests are the most diverse ecosystem on land, and provide perfect habitat for life. We have tropical, temperate and boreal forests, each offer unique and diverse habitats for plants, animals, fungi and microorganisms. In fact, forests contain more than 80 % of the world's terrestrial species. Tropical forests are home to as much as 50 % of the species living on our planet yet it covers less than 5 % of the Earth's land surface.

Fighting global warming

Climate change and global warming are some of our biggest challenges today. One of the main reasons for global warming is too much CO_2 in the atmosphere – caused by human activities. CO_2 is naturally present in the atmosphere, which is good because it traps warm air and provides a temperature on earth, which makes it possible to live here. However, when there is too much, the temperature will increase and the impact on earth can have devastating effects.

Today we have only one means of reducing the amount of CO_2 from the air, and it is forests.

Through the photosynthesis, trees capture CO_2 from the air. The trees store the carbon, and release the oxygen back to the air. So not only do the trees clean the air and provide us with oxygen. They also store the carbon throughout its life cycle. Hence, the forests act as a carbon sink. If the tree dies and decomposes naturally, it is releasing its carbon back into the air. This is a carbon neutral cycle. However, when the wood is used for building a house, the house will continue to store the carbon. If the source for wood-based products is from sustainably managed forests, the products are environmentally friendly.

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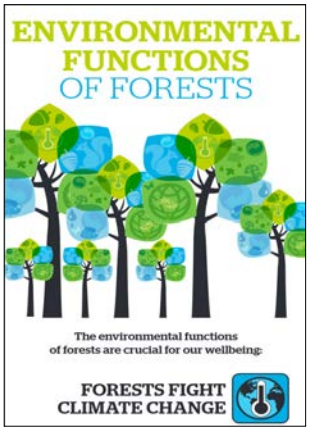

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Sociocultural services

People who live in or near a forest have a relationship to it in one way or another.

Recreation

Some people enjoy a quiet peaceful walk in the forest. Recent studies show that visiting a forest has real, quantifiable health benefits, both mentally and physically.

A walk in the forest can trigger all your senses. Sight, hearing, smell, touch and taste. Touching various species can be thrilling, and there is a lot to taste. Listening carefully, one can hear sounds different from any other place. It may even let you see some of the animals in their natural habitat. Many cultures have long traditions for hunting, and harvesting berries, mushrooms and other species for food and medicine.

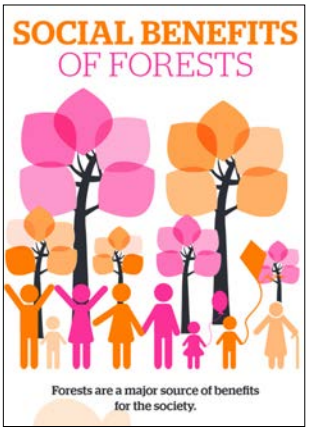
Religious and spiritual

Many religions are tightly linked to nature. Some, like Hinduism, consider trees and plants as equal individuals to humans. In any case, nature can provide silence and scenery for meditation and spiritual or religious activities. Sacred forests are often protected or untouched.

Scenic and landscape services and values

Imagine living on a planet without trees. Think of how a property can increase in value if there are old beautiful trees on the land. Many people value beautiful scenery, particularly when on holiday. Many hotels and resorts are built in or near a forest to provide pleasant surroundings.

Fact sheet



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Further reading

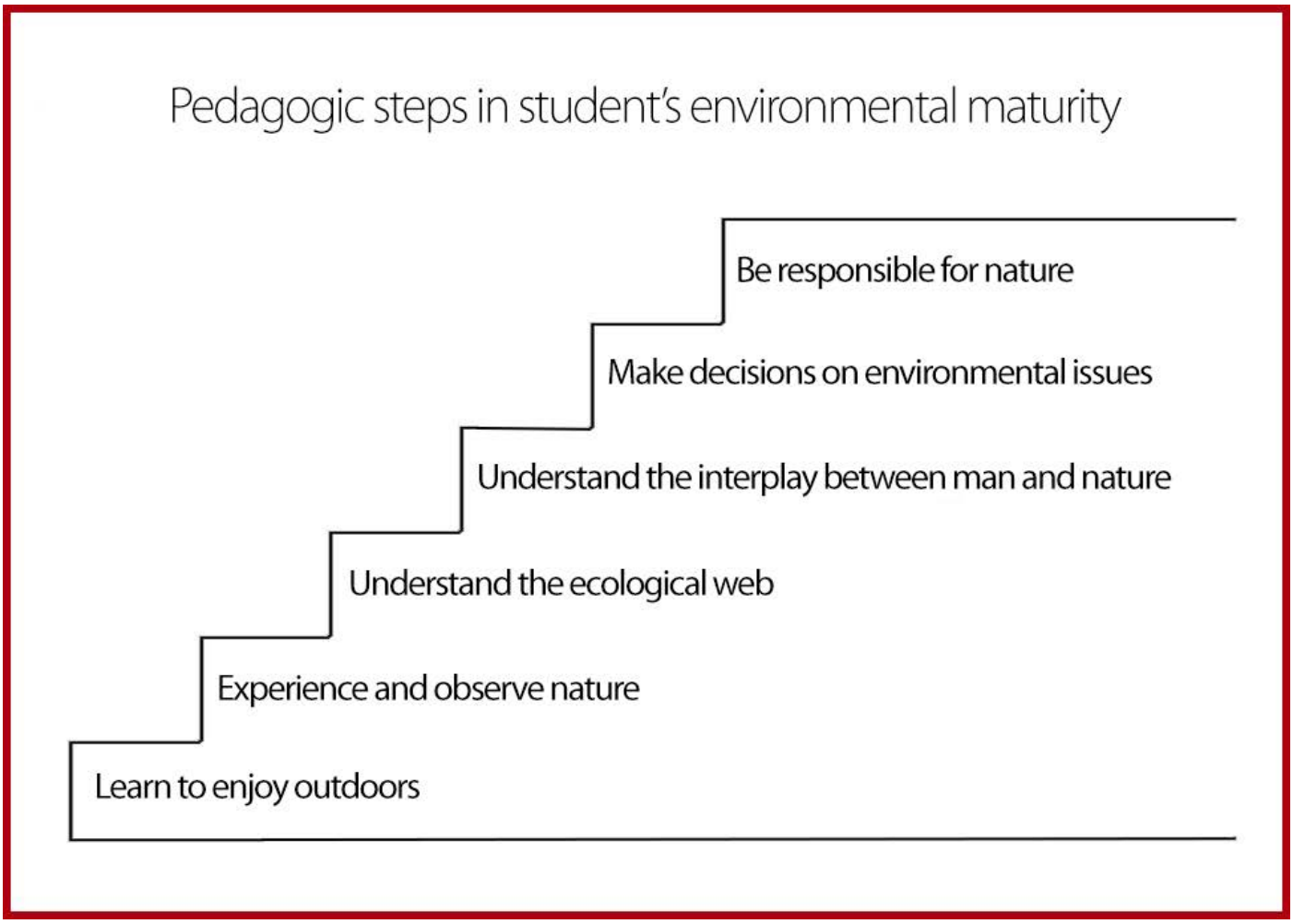
- European Forests Contribute to Mitigating Climate Change and Protecting Biodiversity
- Protecting forests in a changing environment
- Mitigating Climate Change and Protecting Biodiversity

QUALITY STANDARDS FOR FOREST PEDAGOGY, TO ACHIEVE EDUCATION FOR SUSTAINABLE DEVELOPMENT (ESD)

Follow the pedagogical steps for all activities to increase environmental maturity.

The pedagogical steps is a way to describe what is required to deliver education for sustainable development (ESD), which goal is to make real changes in behaviour and attitudes amongst the participants.

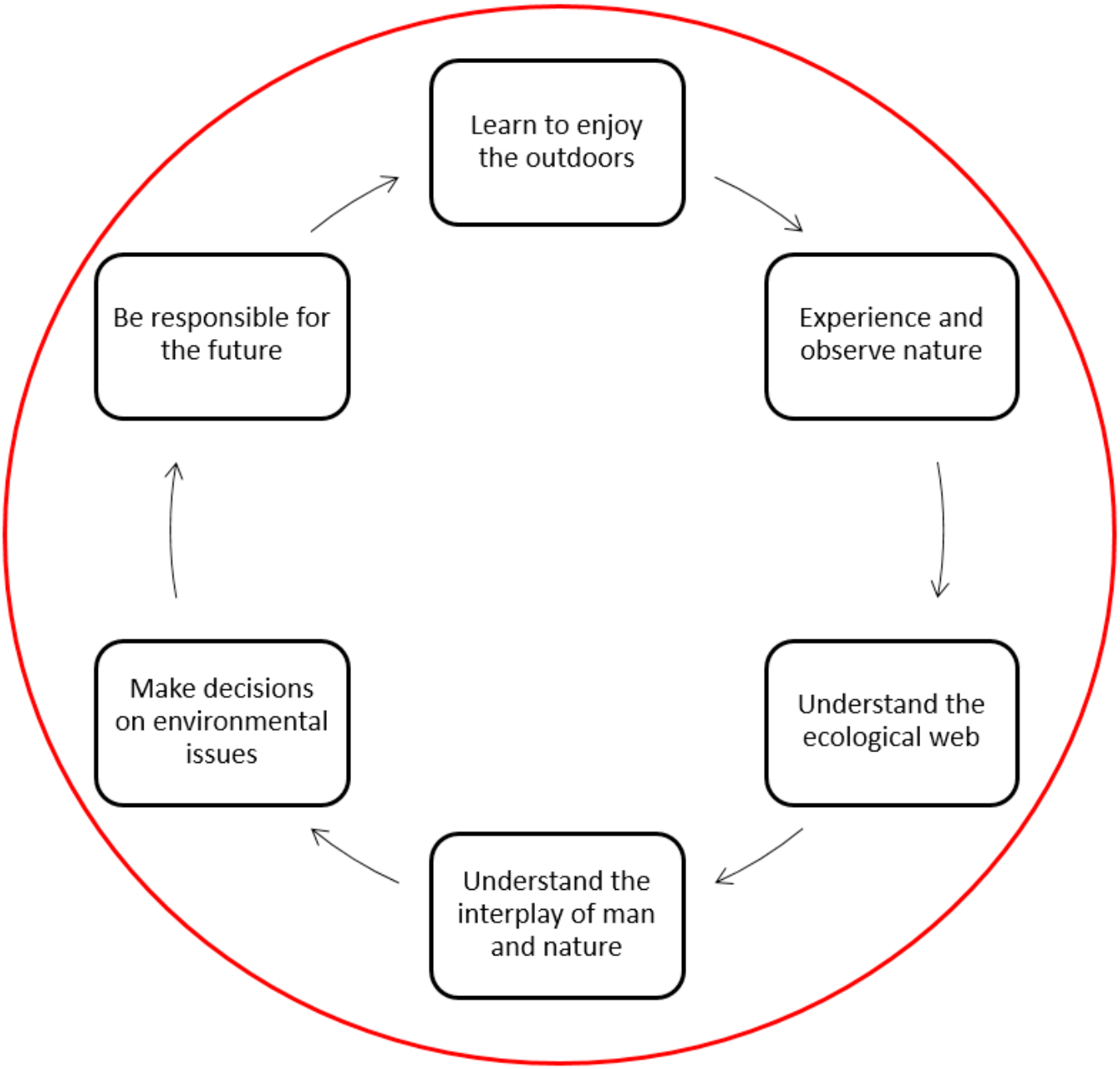
The standard describes these six steps of pedagogical approaches. The six steps need repetition at different ages of the participants and the activities for each step must harmonize with the age of participants, local forest conditions and relevant issues.



Repeating the steps several times will enhance the experience, increase the knowledge and expand the horizon.

The pedagogical steps is not a fixed direction to achieve the goal. Rather they must be repeated with more knowledge each time. For instance, learn to enjoy outdoors is not a one-time step, it can evolve with age. As an example, you can take children from kindergarten to the forest, simply to make them realise what it is. Then you can take first grade children to the forest to eat their lunch. At secondary school, you may want to take them to the forest for a sleep over in tents. Each of these tree activities reinforce the joy of being outdoors in accordance to age group.

So, in short you start with the most basic understanding and as the children's understanding increases, you can add more complexity.



Step 1: Learn to enjoy the outdoors

To learn to enjoy outdoor activity is a practical sensitivity training. This means to have positive experiences and to develop a positive attitude towards the environment. This step is the most important level to start tuning your heart and feelings towards outdoor activities and to gain a general curiosity about nature, nature processes and human interactions with forests.

Step 2: Experience and observe nature

To experience and observe nature is important to become familiar with nature's systems and different species. When doing observation activities in forests you will also get experience and personal relations to these issues. This knowledge does not change behaviour, but provides us with a better basis for reflections and personal adaption of behaviour.

Step 3: Understand the ecological web

Learning about the ecological web is of importance to understand the interplay between species in forest. The knowledge and understanding of ecological interplay between species, within different ecosystems and within bigger areas with many specific structures, leads to a better understanding of nature's processes.

Step 4: Understand the interplay of man and nature

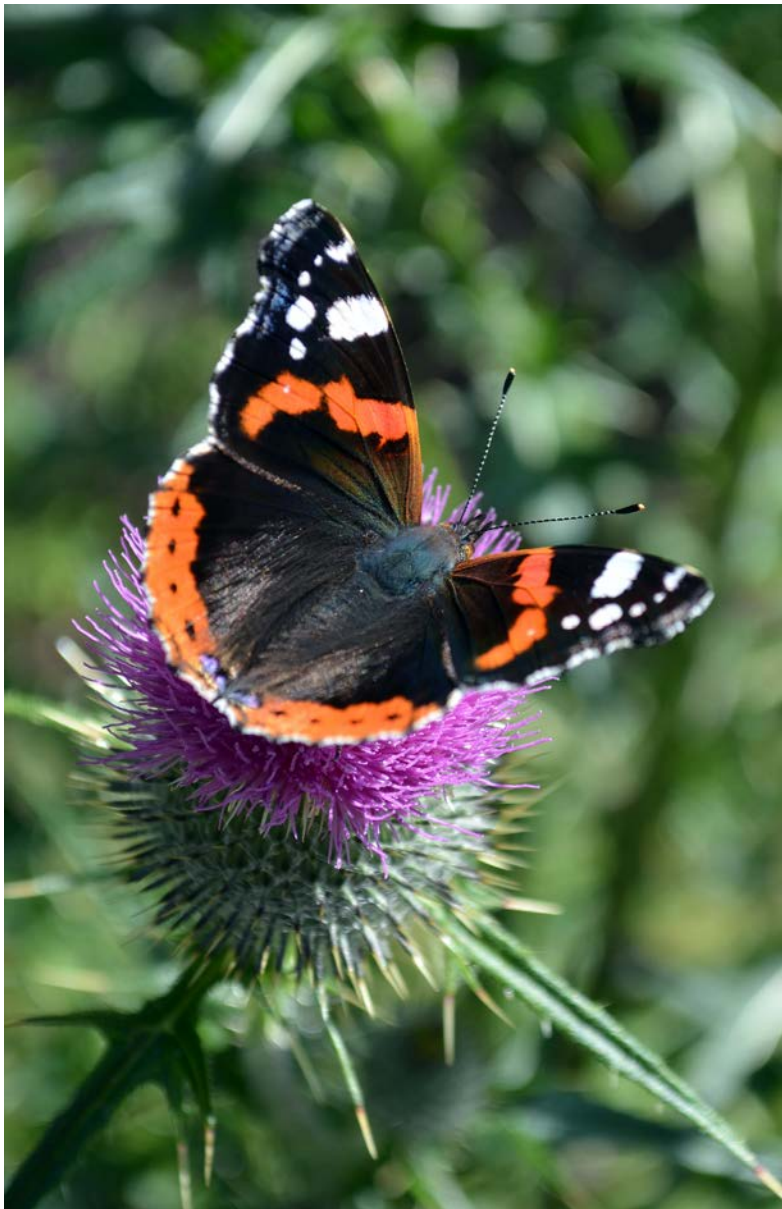
Understanding the interplay between humans and forests is crucial for understanding the potential conflict of interests that exist between different stakeholders. Learning about forest should reflect all the functions forests fulfil for people; cultural, ecological, economic and social. Understanding the balance between these perspectives is central when studying how humans interact with forests.

Step 5: Make decisions on environmental issues

When understanding the interplay between forests and humans we will identify topics where there are conflicts of interest. When understanding the reason for different opinions, it is possible to make better decisions and take alternative actions. Skills for asking good questions are crucial to collect knowledge and reliable information. With a wide range of knowledge covering dissimilar perspectives, it is possible to work seriously with the conflict of interest between different opinions and to make up one's own opinion based on facts and reliable information.

Step 6: Be responsible for the future

To become a responsible citizen, we must gain enough insight to all perspectives of forests - economic, biologic and social. Working on responsibility issues spreads knowledge and attitudes to support future consumers and decision makers to make better choices.



TEACHING MATERIAL

CONSUMER POWER AND RENEWABLE RESOURCES

Introduction

One of humankind's greatest challenges is to ensure sustainable development. Knowledge is crucial to increase environmental awareness, and perhaps more important is the understanding that we all play a role in making a change towards a sustainable development. As consumers, we have the power to push development of products and services towards a sustainable development, but we need to know what our options are. Images and objects is a teaching method, which emphasizes active learning and critical thinking.

Purpose

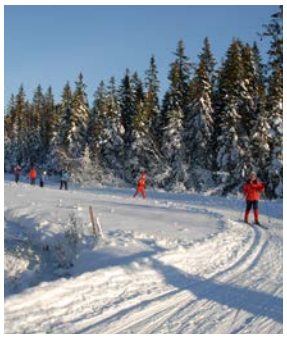
The aim of using images and objects is to create reflection and discussions about the products and services we use, and to raise awareness of the options we face as consumers.

Preparations

Find relevant objects or images representing various themes (see examples on the next page). Each theme should have two objects or photos similar to each other, but where one is considered more environmentally friendly than the other. The teaching material is easy to adjust to different age groups. However, the recommended use is for pupils from the age ten to sixteen years.

Implementation

- Each pupil chooses an object or a picture, and the first task is to find the pupil who has a corresponding image. They must look at each other's photo and figure out which images belong together.
- Once all pupils have gathered in pairs, the next task is to figure out which photo's image is more environmentally friendly. They must discuss the images and come up with one or more reasons for their decision.
- Next step is to divide the pupils into two groups, one group having the environmentally friendly image and the other group the not so environmentally friendly image.
- One by one, each pupil from the environmentally friendly group stands up and shows his/her photo or object and describes why it belongs to this group. From the other group, the pupil with the corresponding image stands up and tells the reason for being in that group. The whole class decides whether they have come to the right conclusion.

		Downhill skiing, slalom vs. Cross country skiing	Downhill skiing requires the use of a lift, and is therefore more energy consuming than cross country skiing. However, making the tracks require snowmobiles.
		Petroleum based heater vs. Wood based heater	Both heaters will emit the same amount of CO2. However, wood will not release more CO2 than it gathered as a live tree, and wood is also a renewable resource.
		Concrete vs. Wood	Concrete bridge releases vast amounts of CO2 in the production process. Wooden bridge stores carbon, and is likely to be a better choice.
		Paper vs. Plastic	Paper cup is made of wood, a renewable resource. Plastic cup is made of petroleum, not a renewable resource.

This is one basic way to teach using images and objects. The main purpose of this activity is to understand that we always have a choice. Among the choices we make, one is likely to be more environmentally friendly than the other. Two choices may seem similar, and yet they're not. Please note that there aren't necessarily any "right or wrong" answers. This is an exercise to ask critical questions, and reflect upon the consequences of the choices we make

For the youngest pupils, you may want to leave it to a simple good or bad. For older pupils, you can make it more complex by asking "what if …". By adding more information to the themes, the pupils need to dig deeper into the subject to get a broader understanding of today's challenges. In this way, they will experience that there isn't necessarily an easy yes or no solutions.

As an example, take the two photos of the boats. One is made from wood, and the other from plastic. The immediate response is that the boat made from wood is the better option. But what if this boat has a large fuel consuming engine and the plastic boat has a small engine using very little fuel. Which is then the most environmentally friendly? Another aspect is to investigate consumer power. If everyone started using shopping nets rather than plastic bags, can this stop production of plastic bags? There are numerous examples of how consumers can force changes by simply not buying it, and social media reinforce the power. Think about animal tested products in cosmetics. The production has had a shift in how the products are tested towards other options based on new technology and innovation. Palm oil is another example. Palm oil causes loss of rainforest which are cleared to give room to palm plantation. Equally important is the fact that it is unhealthy to eat. Several food production companies have replaced palm oil with better alternatives simply because consumers stop buying the products and demand options. Loss in sales speaks a language producers understand very well. But as in most cases there is still a long way to go until palm oil is completely effaced from our food.

We have the power to make it happen and by thinking critically about what our options are, we can force changes toward a sustainable consumption and development.

CONFLICTS OF INTERESTS IN USE OF FORESTS

Introduction

When understanding the interplay between forests and humans, we will identify topics where there are conflicts of interest. When understanding the reason for different points of views, it is possible to make better decisions and take alternative actions. Skills for asking good questions are crucial to collect knowledge and reliable information. With a wide range of knowledge covering dissimilar perspectives, it is possible to work seriously with the conflict of interest between different opinions, and to make up one's own opinion based on facts and reliable information.

Forests serve many purposes for people. Some have economic interests, some care about forests for its social and cultural values, yet others are concerned about the biological values of forests. All perspectives are equally important, and its stakeholders care specifically for their own perspective. With more than one stakeholder, conflicts of interest can occur.

This activity triggers democratic processes. It is important to give young people experience in these processes and to see a case from different perspectives.

There are many ways to do this exercise, from a few hours indoors in a theoretical manner, or a as a big project including thorough preparations, outdoor activities and after work. The following is an example of how it can be used as a big project.

Preparations

You need at least three perspectives of one specific case. Preferably use local examples of existing or potential conflicts of interests, or you can use the examples below.

Divide the class into three groups representing one interest each. A possible case can look like this:

Economy

A forest owner wants to log his forest to earn money. The forest will be replanted, but it takes time for it to reach a stage where we can call it a forest again.

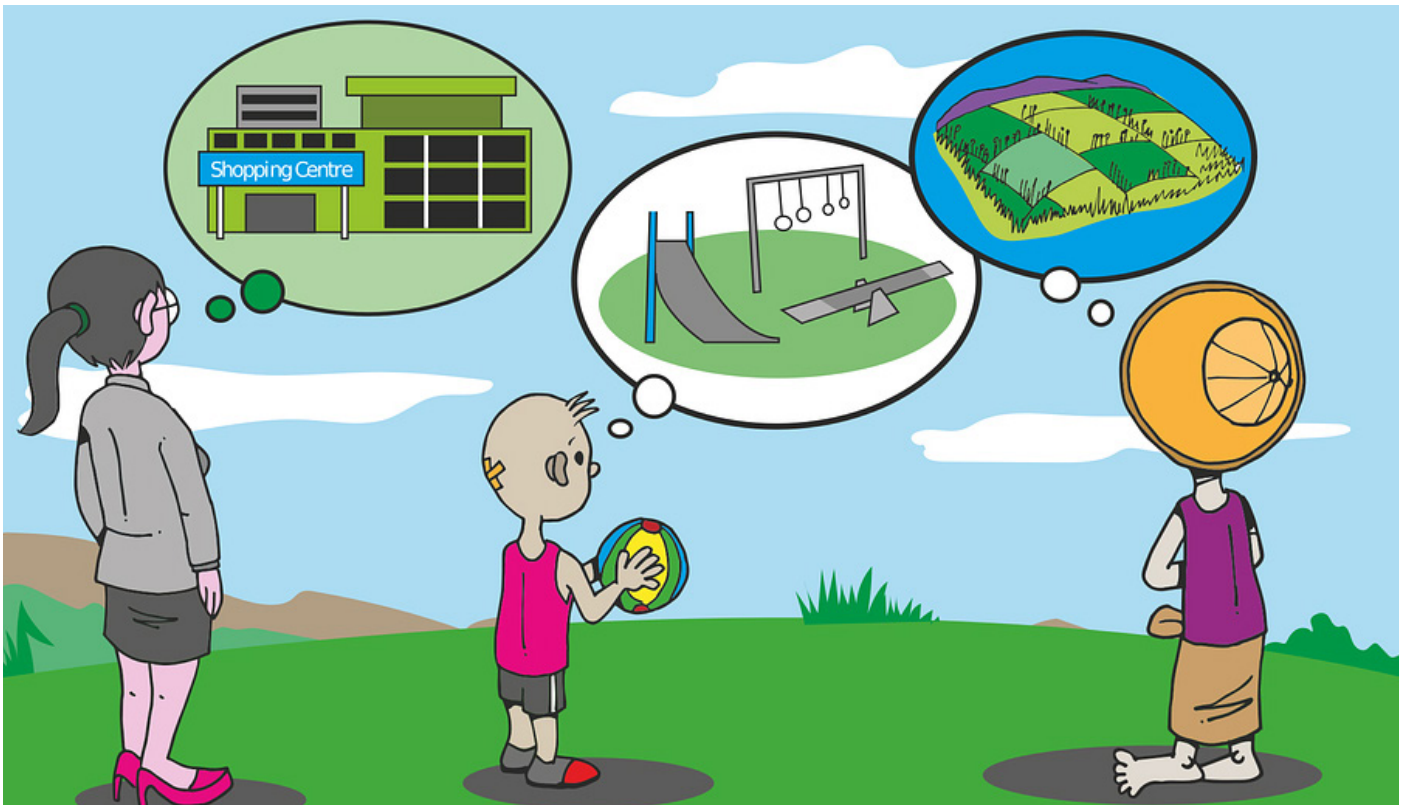
Biology

A biologist is concerned that removal of the forest will destroy the biodiversity in the area and that the area will no longer be available for recreation purposes This group wants to protect the forest to preserve its diversity.

Social

An investor wants to use the land for creating a golf course. This will create jobs and new options for social recreation.

All perspectives are equally valid, but there is a conflict of interest. How can they solve this?



Implementation

Stage 1

Let each group do research to find facts about their viewpoint. They can start indoors doing research and then go out to do fieldwork.

The group representing the forest owner, should calculate the value of the forest. To do this, they need to find the number of trees in the forest, and estimate the volume of these trees. This requires use of mathematics and a method to estimate the number of trees, and their average height and width. With this information and the price for the wood you can give a good estimate of the value of the forest.

The group of biologists can go to the forest to map the number of species. They can try to determine how many species depend on the forest and the potential loss of species. Further they check with the local authorities and their point of view about biodiversity and use of land. They can also try to map the social value by for instance doing a survey among the locals.

The investor group should argue why the location should be used for creating a new business. They can check with the local authorities about their point of view for creating new businesses. Further they can make a business plan and argue in an economic perspective as well as the benefits for locals and the new social opportunities in use of the area.

Stage 2

Let the pupils formulate different fact based arguments for their own perspective. Arguments can also be emotional. One or two pupils must be chosen to represent the group in a panel debate.

Stage 3

Debate. Each stakeholder will introduce their perspective and point of view. After all three's introduction, the debate can start. The rest of the class is audience. The debate team must argue in a proper manner, using facts and avoiding personal attacks. The audience can respond by clapping, but should avoid booing. The teacher's role is to challenge the pupils by asking good questions. The teacher must help the pupils stick to the point, help them express their main arguments, and if necessary moderate the debate.

Stage 4

Let the class discuss the debate.

- Could they do anything different?
- Which of the stakeholder's interests can possibly trigger a conflict?
- Is one interest more valuable than the other?
- How do we measure what is valuable?
- Is it possible to find a solution which all parties can agree on?
- Write a report about the work done and the possible solutions to solve the conflict.

Useful tools to find data about forests

Measure tree height

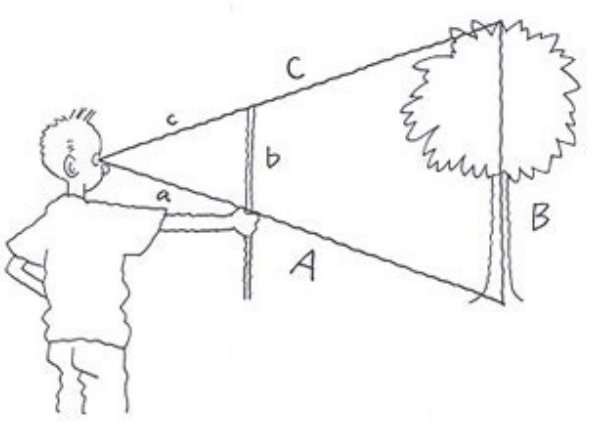
This is a description of how to measure the height of a tree, using a stick, a measure band, and simple mathematics. Find a stick that is at least the length of your arm. While keeping a straight arm, hold the stick so that the distance from your hand to the top of the stick, is equal to the distance from your hand to your eye. You can check this by placing the stick along your arm. If the end reaches your shoulder, then the distance is correct.

Place yourself in front of the tree you would like to measure. The distance between you and the tree, should correspond to the height of the tree.

Now, while keeping a straight arm, hold the stick vertically. Place the stick in front of the tree, so that it covers the tree. It should fit perfectly; it should not be longer nor shorter. Move closer or farther away until you find the distance. At the position where the whole stick covers the tree from the bottom to the top, make a stop. You have now found the position that will help you measure the height of the tree. From this position, use the measure band to find the distance to the tree. The distance you have just measured, equals the height of the tree!

Wondering why? Take a look at the figure.

When holding the stick vertically in front of you like this, two triangles are formed. The small triangle abc and the big triangle ABC have pairs of equal angles. Equal angles means that the triangles are similar. They have different sizes, but have the same shape.



Consequently, if a equals b in the small triangle, then A must equal B in the big triangle. To begin with, we made sure that the distance between the eye and the hand (a) was equal to the distance from the hand to the top of the stick (b).

Thus, a = b. And hence A = B. By measuring A (distance from us to the tree), we find B (height of the tree).

Measure tree volume

This is a description of how to measure the volume of a tree, using a measure band and simple mathematics. (To be able to find the volume, you need to find the height of the tree first.)

The three-dimensional geometric shape which corresponds to a tree, is a cone. The formula to calculate the volume (V) of a cone, is

$$V = \frac{\pi \times r^2 \times h}{3}$$

In this formula, h is the height of the tree, π = 3,14, and r is the tree's radius at the bottom of its stem. The radius (r) is unknown, and must be measured. Use the measure band to find the circumference. Once we know the circumference (C), we can calculate the radius by using this formula:

$$r = \frac{C}{2\pi}$$

This formula has been derived from the circumference of a circle:

$$C = 2\pi r$$

Estimate the number of trees in the forest

This is a description how to estimate the number of trees in the forest, using a **four meter long** rope and simple mathematics.

To find the number of trees in a forest, we don't count all the trees. We count all the trees within a restricted area, and repeat this in several places within the forest. This gives an average of the density of trees. To find the total number of trees in the forest, the average density is multiplied with the area of the forest. The pupils will count the number of trees within a circle, and the rope represents the radius of this circle.

Knowing that the radius (r) is 4 meters, the area (A) of the circle can be calculated using this formula:

$$A = \pi r^2$$

Which gives:

$$A = 3{,}14 \times 4m \times 4m$$

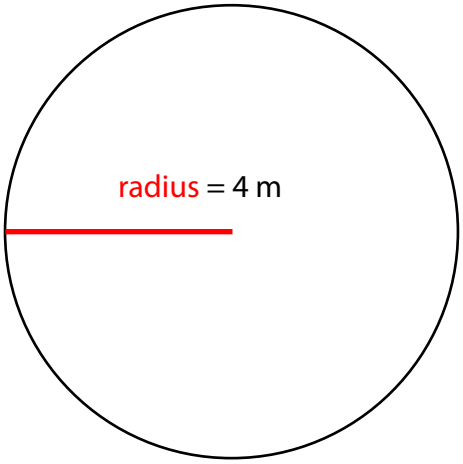
$$A \approx 50{,}24\ m^2$$

At least two pupils need to cooperate. One of the pupils must place his-/herself at the centre of the circle whilst holding the rope. The other pupil holds the rope at the other end, keeping it at a straight line, and then moves along the circumference of the circle. Now comes the important part: While making this circle, the pupils must count all the trees that are within the circle.

By repeating this exercise in several places, the pupils will find the average density of trees in the forest (no. trees/50 m^2).

Please note: The area of a forest is often measured in hectares. A hectare is 10,000 m^2. This means that if the pupils prefer to find the no. trees/hectare, all they need to do, is multiply the number of trees within the circle by 200.

Why? Because the area of the circle is approximately 50 m^2, and multiplied with 200, this gives 10,000 m^2, - a hectare.



BIODIVERSITY - INVESTIGATE YOUR LOCAL FOREST

Introduction

One of the world's greatest concerns is to protect and maintain the diversity of biomes, species and genes. To do so, we need knowledge about where we find specific species. It is necessary to map the biodiversity. There are many methods and measures to do this, but one of the basic criteria is to discover and count how many species there are within a certain area.

Purpose

In this experiment, the pupils will investigate the biodiversity in their local forests, and they will learn how to work scientifically. They will learn a method to measure the diversity of species, and to discuss any differences between ecosystems. It will also apply mathematics in practice.

Equipment

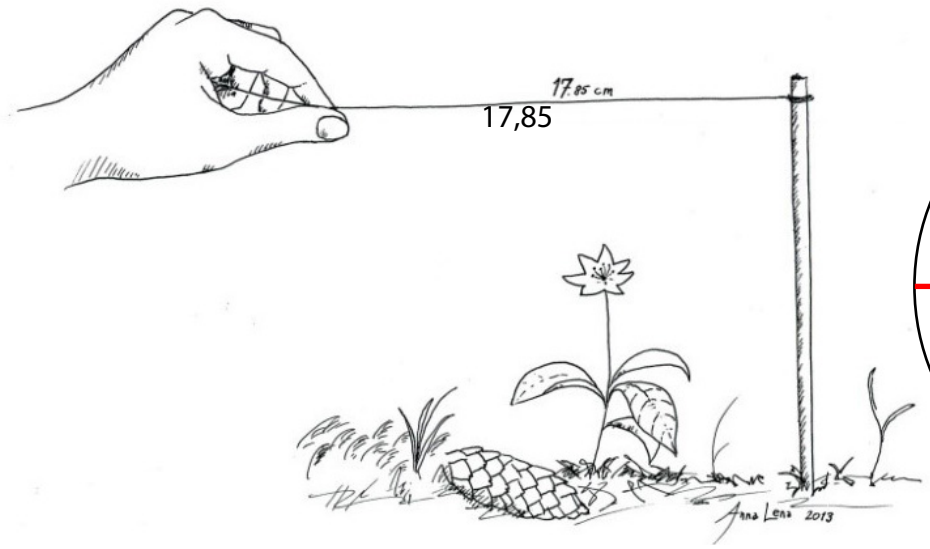
- Stick with 17.85 cm long twine
- Flora and fauna books
- Pencil and paper for taking notes

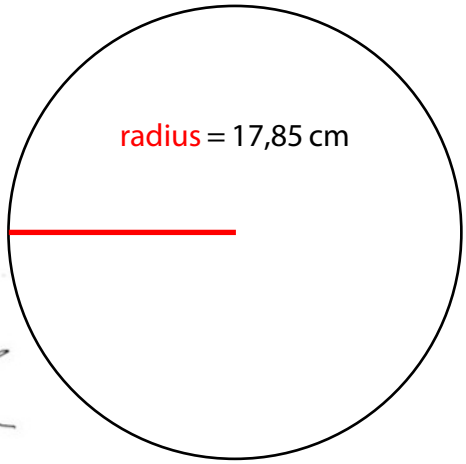
Implementation

Find two different ecosystems to do the investigations. It can be two different types of forests, or it could be a forest and for example a meadow. Divide the class in two groups, one for each ecosystem. In this way, it is possible to compare two ecosystems afterwards. For each ecosystem, the pupils cooperate in pairs or a group of three. First thing to do, is to toss the stick in an arbitrary direction. Wherever the stick lands, it must be placed in the ground with the twine on top. With the stick in centre, pull the twine around it. This will determine the border of a circle with the radius 17.85 cm. While turning the twine slowly around the stick, register each new species within the radius. After having studied all the plants and animals within this radius, the pupils have mapped the biodiversity of an area of the size:

$$A = \pi r^2 \text{ giving } A = 3.14 \times 17.85^2 \approx 1000 \text{ cm}^2 = 0.1 \text{ m}^2$$

Consequently, ten analyses will add up to a total area of 1 m^2. In this way, the pupils may easily find the biodiversity of species per square meter.





Name of pupils: _____

Circle	Species	Number of species
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
Average number of species per square meter		

Conclusion for the group:

In this ecosystem, there are _____different species per square meter.

With the above information, each group can find the average number of species per m^2 for the specific ecosystem.

	Number of species per m^2					average no. of species/ m^2 in ecosystem
	Group 1	Group 2	Group 3	Group 4	Group 5	
Ecosystem 1						
Ecosystem 2						

Which ecosystem has the greatest biodiversity (number of species per m^2)? What may be the reasons for the variation in diversity of species?

Supplementary work

- Discuss with the pupils, or let each answer these questions:
- How are the abiotic (non-living) factors in the two different ecosystems?
- Why is it important to maintain a great biodiversity?
- Why is there a greater diversity in the tropical forests than in the boreal forests?

GLOSSARY

Afforestation:	Planting of trees on land which was never forested
Biodiversity:	The variation of life forms within a given species, ecosystem, biome, or an entire planet
Bioenergy:	Energy that derives from biological material
Carbon sink:	A reservoir that absorbs or takes up atmospheric carbon; for example a forest or an ocean
Cellulose:	The scientific name for wood fibre
Decomposition:	The process by which organic material such as leaves and branches, are broken down by bacteria, fungi, protozoans, and the many kinds of animals that live in the soil
Deforestation:	Removing the tree cover below the threshold value that defines a forest and converting the land to another use
Ecology:	The science or study of the interaction between living organisms and their natural environment
Ecosystem:	An interdependent and dynamic system of living organisms and their physical and geographical environment
Erosion:	The process by which soil and rock are removed from the Earth's sur face by the action of wind, water, ice or gravity
Lignin:	A complex chemical compound derived from wood
Pulpwood:	Refers to timber with the principal use of making pulp for paper pro duction and chemical products, or for extracting lignin
Reforestation:	Planting of trees on land which was forested before
Sustainable forest management:	Management of forests that maintains and enhances the long-term health of forest ecosystem for the benefits of all living things while providing environmental, economic, social and cultural opportuni ties for present and future generations
Wood Chemicals:	Chemicals found naturally in the various parts of a tree

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