

# Bioeconomy

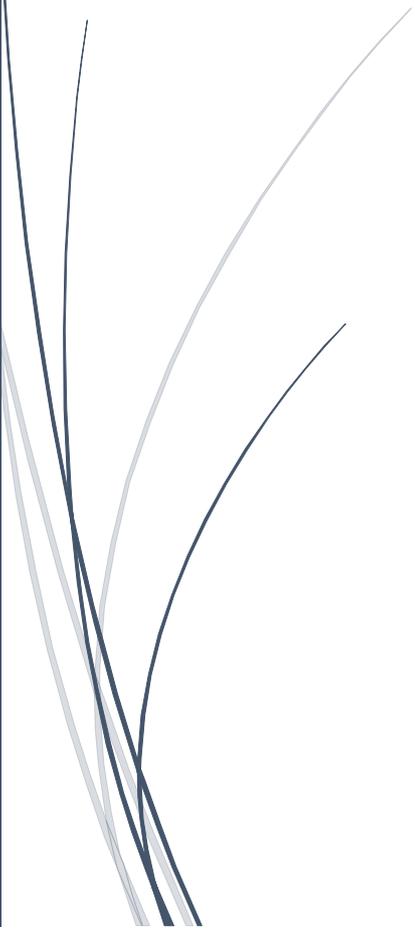
Teaching material



11<sup>th</sup> European Forest Pedagogics Congress 2016

## **BIOECONOMY** and **FOREST PEDAGOGICS**

*– a great chance for education for sustainable development*



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## Bioeconomy

**The EU defines bioeconomy as “sustainable production and processing of biomass for food, health products, fibre products, industry, and energy”.**

Bioeconomy implies a shift from fossil resources (oil) to renewable resources (biomass). This means that development and production of new products from biomass must happen in a sustainable manner. Biomass can be used for anything from food, medicines, cosmetics, chemicals, plastic bottles, lubricants to fuel.

Compared to earlier use of biological resources, today's bioresources from farming, forestry and fishery will be used in technologically advanced productions. This will provide a wider range of products and create new jobs. Finding new uses for biomass from forests requires a good link between knowledge, research, economic insights, and capability for 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. Current research is looking at sustainable utilisation of natural resources, where all products are part of a biological, chemical and physical cycle, and reused time after time. This is how a circular economy works, as opposed to our current economy, which is linear. Circular economy focuses on extensive use of renewable materials, renewable energy, and to avoid wasting resources by exploiting them in the best possible manner. With today's linear economy, growth depends on production and sale. To ensure constant growth, the basis for production is unsustainable exploitation of resources, which produces vast amounts of waste.

In theory, biomass can replace all oil-based products. However, it may not be practically possible. 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 an environmentally friendly production based on biomass.

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

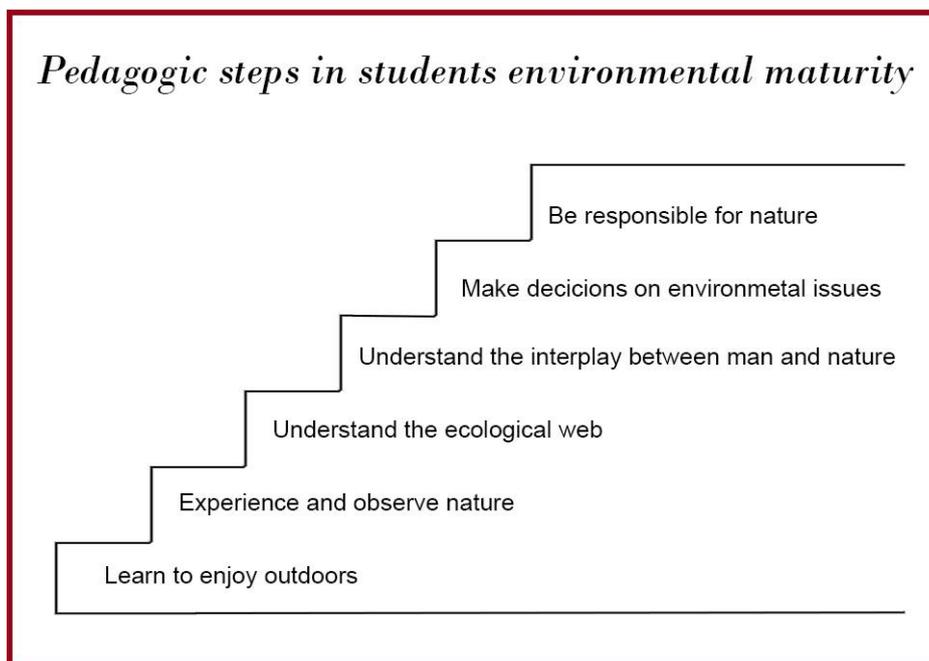
We are facing substantial challenges. However, we live in a time with great trust in science, and in technological and scientific solutions.

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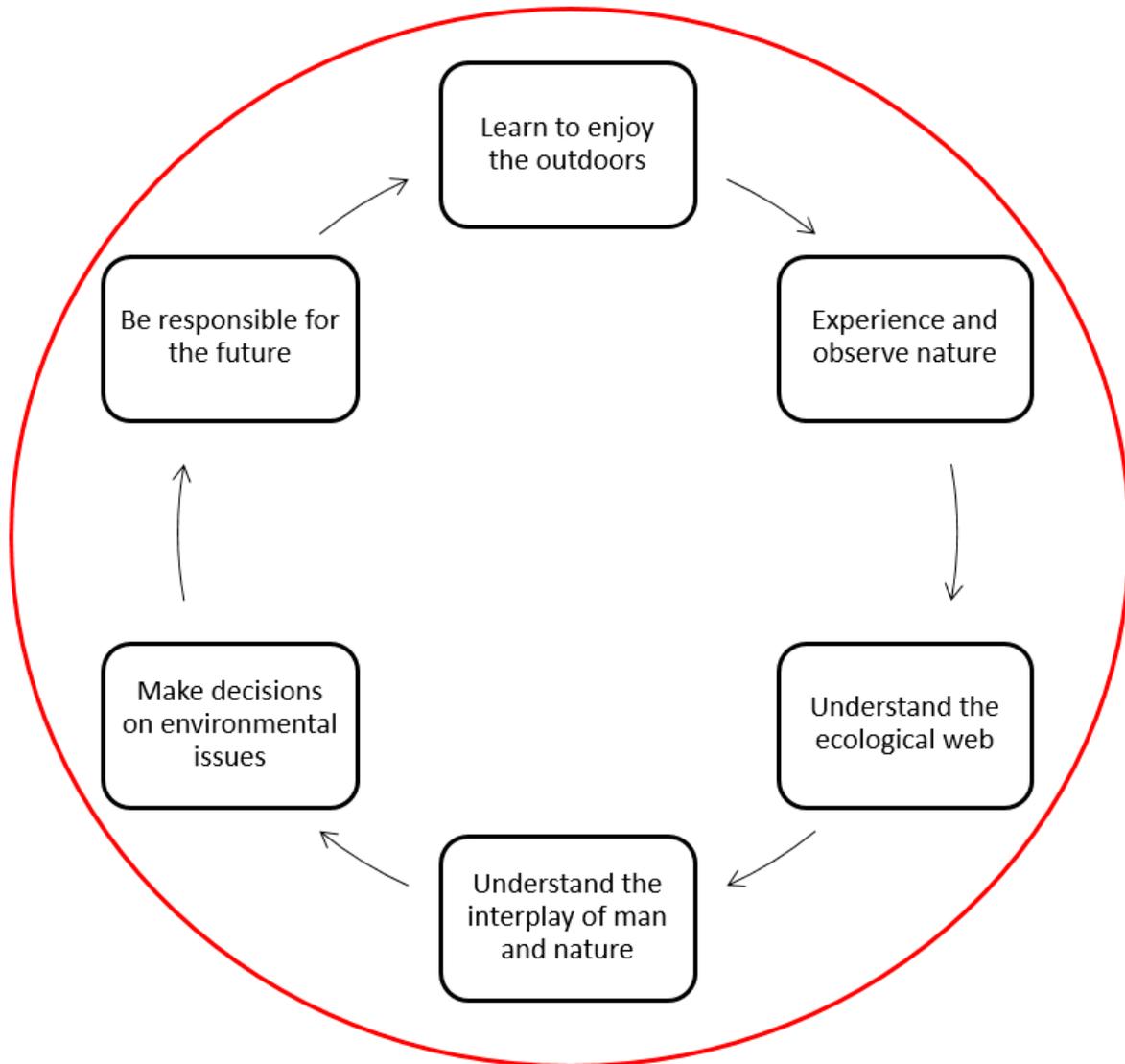
## Quality standards for forest pedagogy, to achieve environmental education for sustainable development (ESD)

To achieve the main principles of forest pedagogy, basic frames of quality standards need to be set up. These standards also describe what is required in order to deliver environmental education for sustainable development (ESD) with real changes in behaviour and attitudes amongst the participants. The standard describes six steps of pedagogical approaches with related activities. The six steps needs repeating at different ages of participants. Relevant activities suitable for all steps must harmonize to age of participants and local forest conditions and relevant issues.

Follow the pedagogical steps for all activities to increase environmental maturity



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



## 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 interaction with forests.**

### Example of activity – being outdoors

#### **Introduction**

Spending time outdoors is the first criteria to learn to enjoy being outdoors. By using all senses: watching, smelling, touching and listening to everything that is different from indoor life will enhance the experience. It is important to make the practice a positive experience based on the children's terms.

#### **Purpose**

Testing climate

#### **Equipment**

None

#### **Preparations**

Find a suitable day. Dress accordingly.

#### **What to do**

Go to a forest and feel the weather. Let the pupils discover the area.

#### **Afterward work**

Discuss with the pupils, example of questions:

- What does this feel like?
- Does the forest look different now, compared to other kind of weather?
- Does the weather stop us in doing certain activities?

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## Step 2: Experience and observe nature

**To experience and observe nature it 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.**

### Example of activity - Land art for children

#### Introduction

Land art is making patterns, sculptures, shapes and more in the landscape, using the elements of nature. Leaves, flowers, pinecones, twigs, pebbles, shells, anything from nature may be used. Integrate the land art in the landscape, or make it as an artistic contribution to the landscape. If you are able to take photos, you can collect them and use as decoration, or for further work. When you are finished, leave the land art to the elements of nature.



Photo: Rainer Schall

#### Purpose

The purpose of this activity is to raise awareness of the diversity around you. The idea is to slow down and examine the surroundings. This is an exercise to make you more conscious of details, constructions, patterns and colours in nature.

#### Equipment

You do not really need anything, apart from the materials in nature. However, it could come in handy to have a basket for collecting items and a pair of scissors (either normal ones or branch scissors). If possible, bring a camera to save your work.

#### Preparations

Find some examples of land art to give the children a better idea of what they are expected to do, and for inspiration. It is easy to find online by typing "land art (for children)" into Google Images. Does any of the pictures catch their interest? Ask them what they think it is made of.

#### What to do

To get the children started, give all of them the same task. Let them work together in groups to collect material; leaves, twigs, seeds, flowers, feathers, pebbles, etc. Thereafter they must cooperate to make a piece of land art. If possible, let the pupils take a photo of their work.

#### Afterward work

Let the pupils reflect on, and make a list of what the land art consist of:

- Number of species
- Which part of the species (leaves, branches etc.)
- Name of species, and parts
- Number of colour used

Adjust the list to age and maturity. They may not be able to complete it, and that is ok. The exercise is to raise awareness and curiosity to our surroundings.

## Step 3: Understand the ecological web

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

### Example of activity - The food web

#### Introduction

This activity emphasises the connection between the species. Removing one species can have dramatic consequences to the entire ecology.

#### Purpose

The purpose of this activity is to learn about the food web and to become more aware of how the different species are interconnected and interdependent.

#### Equipment

Each participant needs a picture. The pictures should display different species, which belong in the local forest and are part of the same food web. Attach a string to the photo so it can hang from the neck of each pupil.

In addition, the group needs a long twine/rope.

#### Preparations

Apart from the pictures and the twine, there is no need for other preparations. However, it could be a good idea to introduce the pupils to the terms food web, producers, consumers and decomposers before doing the task.

#### What to do

You can do this exercise indoors or outdoors. Arrange the pupils in a circle, displaying their picture so everyone can see it. One person will start, holding the twine. She must look at the other images, and decide which of the other species interacts with her own species. For example, if the person who starts has a picture of oak nuts, they may be food for a squirrel. She therefore throws the twine to the person with the image of a squirrel. The pupil with the squirrel then passes the twine to a person with the image of a cone (which the squirrel eats) or to a marten (which could eat the squirrel). This goes on until all the pupils have been included.

Ask the pupils if they realize what they have just made. Hopefully they will see that they represent the food web, and that the twine represents the connection between the species.

Let one of the pupils let go of the rope, hence removing one of the species. What is the effect? Is it an advantage or disadvantage to the other species? Discuss with the pupils. If you would like, remove more species. What happens? Could all species eventually become distinct?



Photo: Anna Lena Albertsen

**Afterward work**

Make a chart starting with the species at the very top of a food chain, and detect what it eats. Write this species below. Then find out what this species eat, and so on, until you reach a microorganism at the bottom of the food chain. You can do this the other way around too, starting at the bottom. You can also do the same with different types of species like animals or fish.

Owl
Mouse
Insect
Plant
Fungi

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## 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 crucial when studying how humans interact with forests.**

### Example of activity – exploring the forest

#### **Introduction**

Humans have always used the forest, and we still do, although the way we use it may have changed over the years. One may be surprised at how many traces one can find.

#### **Purpose**

Be aware of the various activities people have carried out in the forest.

#### **Equipment**

None

#### **Preparation**

Find a suitable area for discovering human interaction in the forest.

#### **What to do**

Go into the forest and ask the pupils to find traces from people. It can be old settlements, telephone poles, signboards, areas of logging, roads and much more. What may look like untouched nature at first glance may still have traces of people.

#### **Afterward work**

Discuss with the pupils the findings, examples of questions to ask:

- What could be the reason for the human interaction?
- Is it relating to business or pleasure?
- Was it necessary?
- Does it have any implications?

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## 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 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.**

### Example of activity - Conflicts of interest

#### Introduction

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.

#### Purpose:

Conflicts of interest trigger democratic processes. It is important to give young people experience in participating in these processes and to see a case from different perspectives.

#### Equipment:

Examples of conflicts of interest.

#### Preparations:

There is a wide variety of ways to address this topic. Below are some suggestions on how to go about it.

#### Conflicts of interests is a very suitable theme for project work

- Making news reports by interviewing different stakeholders
- Make a role play where pupils play out the conflicts
- Arrange a class debate with two or more teams arguing different points of view

#### Conflicts of interests raise many questions

- Which of the stakeholder's interests can possibly trigger a conflict?
- Is one interest more valuable than the other is?
- How do we measure what is valuable?
- Is it possible to find a solution that all parties agree with?

#### What to do

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

Economy: This group have planted the forest and now they want to log it to make money.

Biology: This group wants to protect the forest to preserve its diversity.

Social: This group are neighbours to the forest who wants to keep it for recreational purposes.

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

Let each group do research finding facts about their viewpoint. Next, let them formulate different fact based arguments for their own case. Arguments can also be emotional.

Lastly run a debate where they can argue their points. Who “win” the debate?

**Afterward work**

Let the class discuss the process and reflect on their experience. Could they do anything different?

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## Step 6: Be responsible for the future

**To be a responsible citizen in the future one has to gain enough insight to all perspectives of forests - economic, biologic and social. This knowledge is critical future responsibility. Working on responsibility issues spreads knowledge and attitudes to support future consumers and decision makers to make better choices.**

### Example - Images and objects – class activity

#### **Introduction**

In order to increase environmental awareness it is crucial to have an understanding of what sustainable development means, and what one self can do about it. Each individual are responsible for his or her own actions. Based on education and knowledge one can make well-founded decisions to maintain and improve on a sustainable living.

#### **Purpose**

To make students aware that similar products may have different environmental friendliness.

#### **Equipment**

Pictures or objects of similar kind, where one is considered more environmentally friendly than the other.

#### **Preparations**

Find photos depicting a number of themes (adjust the number to the size of the class). Each theme has two photos, where one is considered more environmentally friendly than the other.

#### **What to do**

Each pupil chooses a picture, and the first task is to find the student who has a corresponding image. They have to look at each other's photo and figure out which images belong together.

Once all students have gathered in pairs, the next task is to figure out which photo's image is more environmentally friendly. They have to discuss the images and come up with a reason for their decision.

Next, divide the students into two groups, one group having the environmentally friendly image and the other group the not so environmentally friendly image.

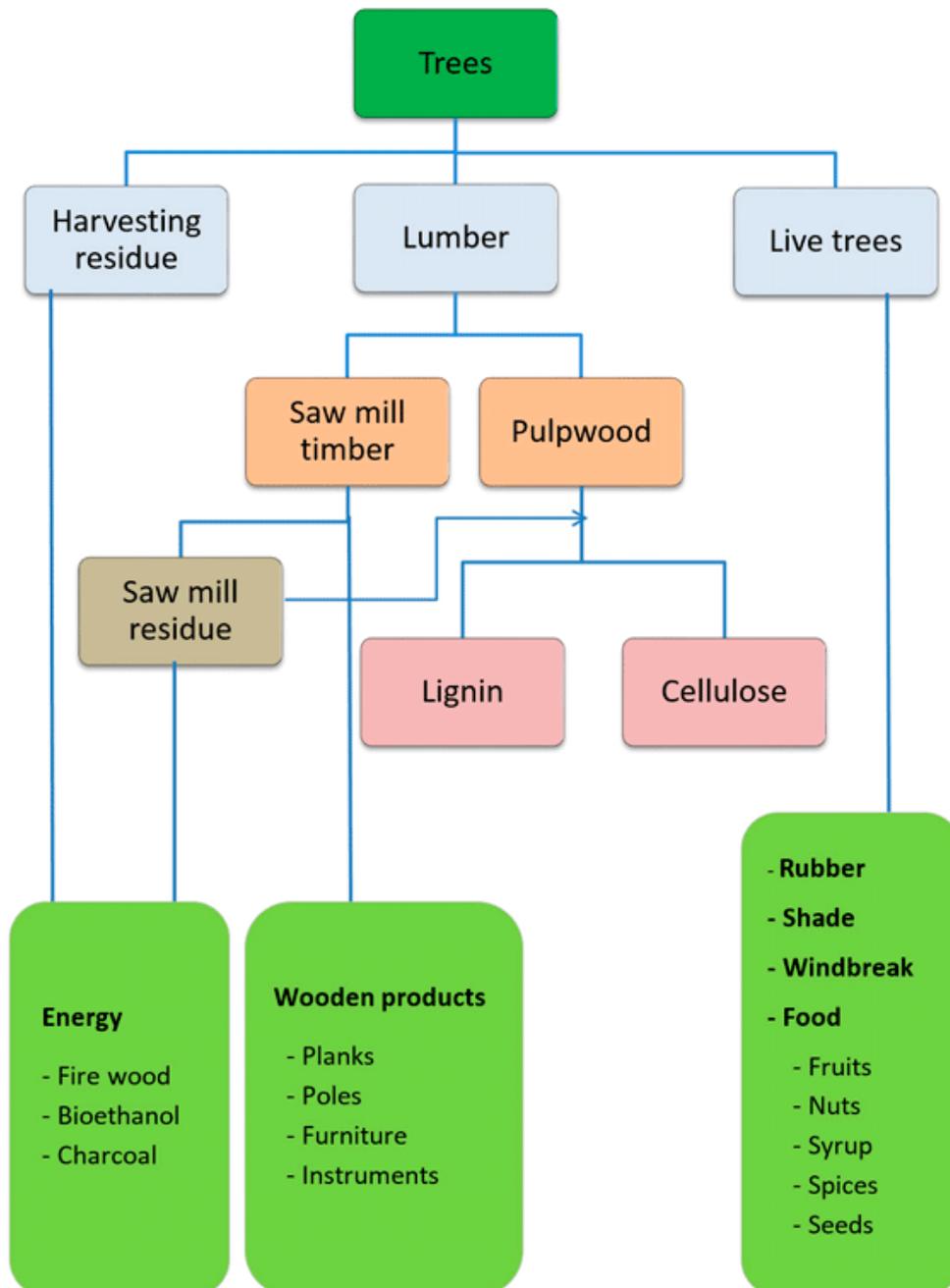
One by one, each student from the environmentally friendly group stands up, shows his /her photo, and describes why it belongs to this group. From the other group the student with the corresponding image stands up and tells the reason for being in that group.

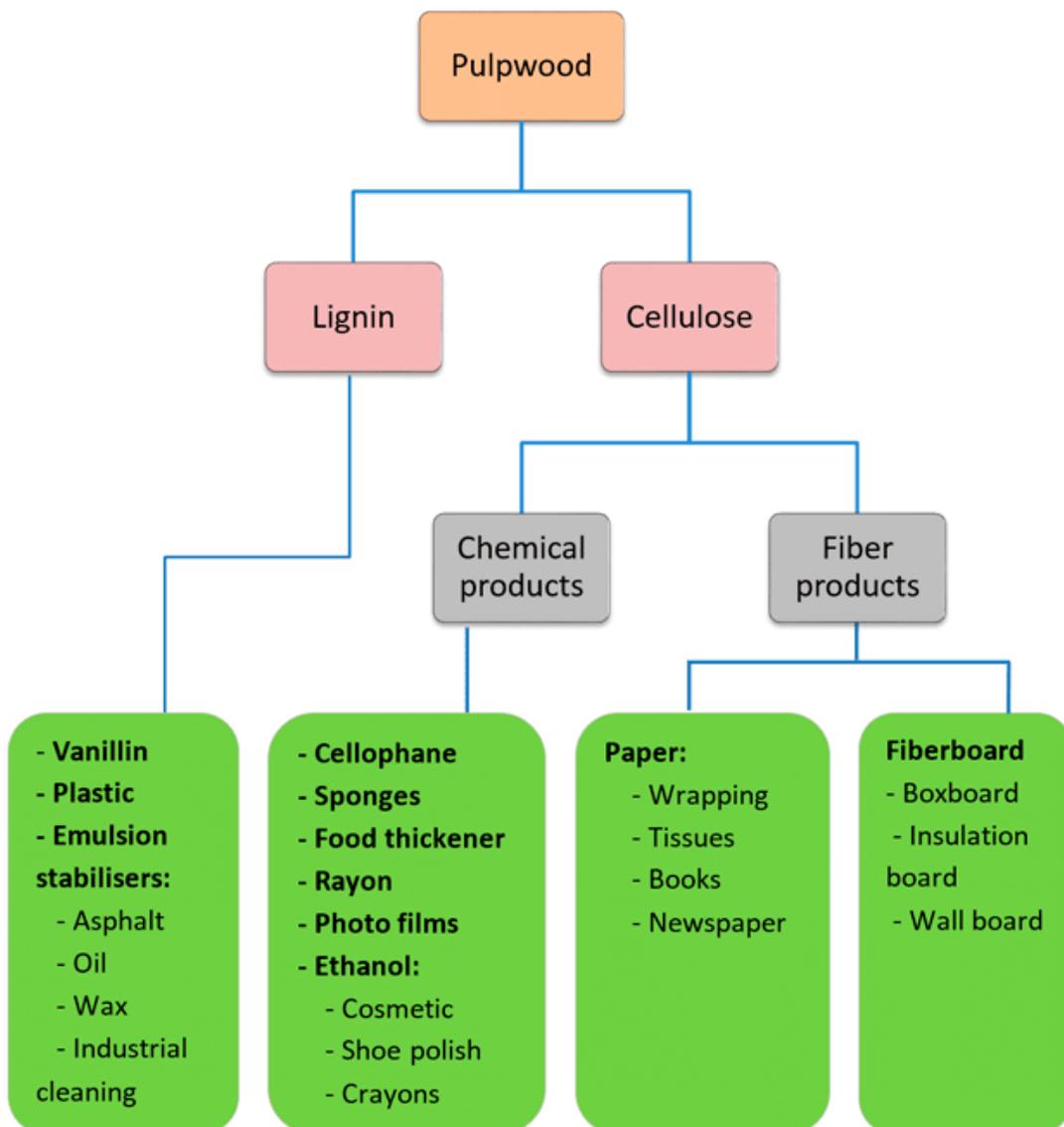
#### **Afterward work**

Do a class discussion and let the class decides whether they have come to the right conclusion or not.

## 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 XXX, and has an enormous numbers of usages. Therefore, we have made a new diagram that starts with pulpwood because there are so many levels of how it is used. You may be amazed to learn how many products you find traces of a tree.





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## Facts about products from the forest

### Introduction

**Forests are crucial to people everywhere in the world. In fact, it is pure magic. Sun, air, water and some nutrients are all it needs, and the photosynthesis do the rest. The trees grow and the forests provide for a range of resources we depend on. It would be impossible 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 making houses, 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, wood has no CO<sub>2</sub> offset during production since it grows naturally. Quite the contrary, trees collect the CO<sub>2</sub> and store the carbon. The storing of carbon continues in wooden products until it decomposes or burn. The extra storing of carbon in wooden products is the reason we consider wooden products as environmentally friendly.

### 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 multipurpose material and has usages 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 to 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 composed 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.



Photo: Anna Lena Albertsen

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## Wood based chemicals

Trees do not only provide us with wood. Many chemicals are extracted for different uses ranging from medicine to industrial 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. The lignin can be extracted and used as both a binding and 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. This is why it you can find it 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 many sugar-containing compounds. 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<sub>2</sub>), 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 animals 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 others 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's 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.

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## 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 in particular, 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

This kind of paper has very different requirements than the ones mentioned above. 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 amount of products that originate from the forest. That is not surprising knowing that more than half of the world's plant species are natives of the tropical forest.

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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. 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 keeps 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<sub>2</sub>. However, it can also be made from cellulose. Toothbrushes and instrument panels in cars are already products from trees, but we can assume the use will increase in the future.

**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 it acts as an excellent binder in frozen food and milk based drinks, to mention a few. Recent research is looking into 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 new 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. WOOD

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## Activities about forest products

### What WOOD I see!

#### Introduction

Wood is surrounding us in our daily life. However, do we actually notice it? Have you ever considered how much wood we actually use? This activity has a version for both the youngest, and the older pupils.

#### Purpose

This exercise lets the pupils investigate what is made of wood, what derives from wood, and where it is used. They can do it at home, in the classroom or anywhere else at the school.

The use of wood as material is beneficial for the environment as it is a renewable material. Wood also holds the carbon it collected during growth and therefore acts as a carbon sink.

#### Preparation

Decide on a suitable area for investigation.

### For the youngest pupils:

#### What to do

Examine what is made of wood in the classroom or at home. Let the pupils wander around to investigate and make notes in the inventory list.

#### Equipment

The inventory list from next page

#### Examples of possible findings

Floor, walls, furniture, window frames, toilet roll holder, ladle, skateboard, musical instruments, toothpicks, pencils.

#### Afterward work

Discuss with the class their findings;

- Were there any surprises?
- What are the pros and cons of using wood as a material?
- Why is choosing products made of wood an environmentally friendly alternative?

### For the older pupils:

#### What to do

Examine what products you use in one day that is made from wood and products that derive from wood. Let the pupils use a camera to document all wood based products and to make a poster or a brochure to illustrate their findings.



## Food

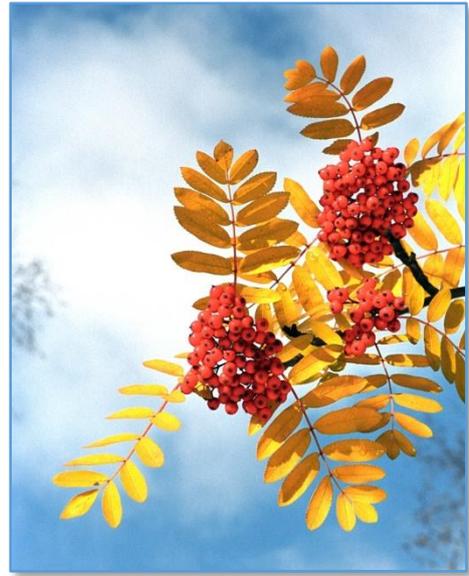
### Which one goes out?

Look at the photos. Can you find any reason why one of them does not fit with the three others?

There is not one correct answer; your arguments decide if it is correct.



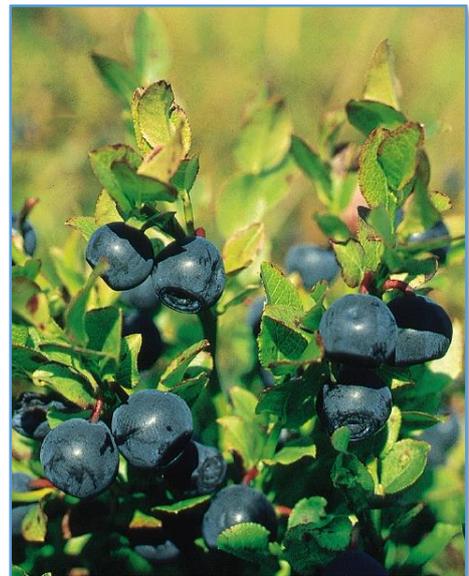
STRAWBERRIES



ROWAN BERRIES



CRANBERRIES



BILBERRIES

Photos: MS Clip art

### Solution:

There can be many solutions to this question, and none is wrong as long as they have logical arguments.

Examples are:

- **Strawberries:** Are not from forests (unless they are wild strawberries)
- **Bilberries:** Are the only ones that are blue
- **Rowan berries:** Are the only ones that grow on trees
- **Strawberries:** It's the only photo definitely taken indoors. (We are not sure about cranberries as it doesn't show)

## Paper

### Making recycled paper

#### Introduction

Paper can be recycled over and over again. In fact, up to six times. Making recycled paper requires less energy and water and thus is more environmentally friendly. However, most important, making recycled paper is fun, and in the end, you have a nice product you can use for many purposes.

#### Preparations

Before you can make paper, you need to gather the equipment needed. Below is a detailed list with instructions.

It is your choice how much of the preparation you would like the pupils to take part in.

#### Equipment for making frames

- Wooden lists 3x3 cm (see the table below for measurements)
- Ruler
- Saw
- Wood glue
- Stainless steel screws
- Screwdriver
- Electric drill (optionally)
- A stapler, and stainless steel staples
- A mesh of nylon or steel, with a mesh opening of 24 pr. cm<sup>2</sup>

#### How to make frames

Cut the lists to the correct length corresponding to the paper size you like. Screw four pieces together as a picture frame and use glue in the joints. Make two identical frames and staple the mesh onto one of them.

Size of the paper	The number of lists you need	The size of the mesh you need	Cut the lists this length
21 x 29 cm	2 each of 1,12 m	37 x 45 cm	4 each of 24 cm 4 each of 32 cm
15 x 21 cm	2 each of 84 cm	31 x 37 cm	4 each of 18 cm 4 each of 24 cm
30 x 30 cm	2 each of 1,4 m	46 x 46 cm	8 each of 35 cm

#### Equipment for making pulp

- Used white paper such as print waste, egg cartons, newspaper (but not too much as it makes the paper grey), old wrapping paper. Do not use glossy paper such as from magazines, as the way it is treated makes it unusable for recycling.
- Bucket for soaking paper
- Electric whisk

### **How to make pulp**

- Tear the paper into small pieces and put it in a bucket. Add boiling water until it just covers the paper. Leave it for some hours, preferably overnight.
- When the papers have dissolved, use the whisk and whip the pulp. If it goes thick, add more water. It should be thin as slurry. The thinner the pulp is the thinner paper you can make

### **Equipment for paper making**

- Large bowl (larger than the frames)
- 2 frames - one with mesh (see description)
- Sponge
- Dry towels
- If possible, an iron to dry paper quickly
- Paper pulp (see description)

### **How to make paper**

1. Take two wooden frames, one with mesh and one without. Hold them towards each other, so that the mesh is in the middle. Lay them flat and make sure the frame with the mesh is the bottom one.
2. Dip the framework into the paper pulp until a thin and even layer covers the mesh.
3. Take the framework out of the water, keeping it in a horizontal position. Let the water drain off.
4. Carefully remove the top part of the framework.
5. Flip the frame with the wet paper onto a damp cloth. Sponge the back of the mesh with a sponge.

Gently remove the frame with the mesh. To dry your paper, either hang it on a string, or leave it inside a newspaper with some weight on top.

### **Afterward work**

Use the paper the pupils made. Examples for use can be:

- To draw on
- To write on
- Make a gift card
- Decoration

---

## Bioenergy

### Quiz

Circle the correct answer:

- 1. Bioenergy is energy that comes from:**
  - a. Fossil fuel
  - b. Tidal waves
  - c. Plants and trees
  - d. Wind mills
  
- 2. How is the energy stored in plants?**
  - a. As the green colour
  - b. As sugar, starch and cellulose
  - c. In the roots
  - d. No energy is stored
  
- 3. When will use of bioenergy increase the greenhouse effect?**
  - a. When the volume of trees harvested is less than the annual growth
  - b. When the volume of trees harvested is more than the annual growth
  - c. When the volume of trees harvested is equal to the annual growth
  
- 4. Bioenergy can be used for:**
  - a. Heating
  - b. As fuel for transportation
  - c. Producing electricity
  - d. All of the above
  
- 5. Where does most of the energy in the world come from?**
  - a. Sun
  - b. Inside the earth
  - c. Fossil fuel
  - d. The ocean

- 6. Forest bioenergy development can provide socioeconomic benefits such as:**
- Creating and maintaining jobs in local communities
  - Generating additional income to landowners
  - Increasing tax revenues to local governments
  - All of the above
- 7. Calorific value is the amount of heat wood provides when burned. Which statement is correct?**
- All wood has the same calorific value per kilo
  - 5,97 cmAll wood has the same calorific value per volume
- 8. Why is it important to dry firewood properly?**
- It makes it easier to carry
  - It is difficult to burn wet wood
  - Wet wood uses lots of energy to evaporate the moist when burning, which means less energy for heat
- 9. Biomass will decompose if we don't use it and the stored carbon will return to the atmosphere as CO<sub>2</sub>. If we use biomass for heating the stored carbon will also return to the atmosphere as CO<sub>2</sub>, but is the amount:**
- Larger
  - Smaller
  - The same
- 10. What are the benefits of bioenergy?**
- Its available all over the world
  - It's a renewable resource
  - It can be made from waste, such as harvesting residue or animal faeces
  - All of the above

---

## Solution

1. Bioenergy is energy that comes from:
  - a. Fossil fuel
  - b. Inside the earth
  - c. Plants and animals**
  - d. Wind mills
  
2. How is the energy stored in plants?
  - a. As the green colour
  - b. As sugar, starch and cellulose**
  - c. In the roots
  - d. No energy is stored
  
3. When will use of bioenergy increase the greenhouse effect?
  - a. When the volume of trees harvested is less than the annual growth
  - b. When the volume of trees harvested is more than the annual growth**
  - c. When the volume of trees harvested is equal to annual growth
  
4. Bioenergy can be used for:
  - a. Heating
  - b. As fuel for transportation
  - c. Producing electricity
  - d. All of the above**
  
5. Where does most of the energy in the world come from?
  - a. Sun**
  - b. Inside the earth
  - c. Fossil fuel
  - d. The ocean

6. Forest bioenergy development can provide socioeconomic benefits such as :
- Creating and maintaining jobs in local communities
  - Generating additional income to landowners
  - Increasing tax revenues to local governments
  - d. All of the above**
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  - All wood has the same calorific value per volume
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  - It is difficult to burn wet wood
  - c. Wet wood uses lots of energy to evaporate the moist when burning, which means less energy for heat**
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- Larger
  - Smaller
  - c. The same**
10. What are the benefits of bioenergy?
- Its available all over the world
  - It's a renewable resource
  - It can be made from waste, such as harvesting residue or animal faeces
  - d. All of the above**

## Energy from biomass

### Introduction

An exciting experiment for the oldest primary school pupils is to compare how much energy they can obtain from various types of biofuels. Exciting in two ways; the combustion device must be installed, and later to see the results obtained in the experiment.

### Purpose

The purpose of this experiment is to learn about different types of biofuels, and to see that biofuels of same.

### Equipment

- Various kinds of biofuels
- Scale to weigh the biofuel
- Methylated spirits to ignite the fire
- Crucible (or some other heat resistant container)
- Beaker that can hold 2 dl (or some other heat resistant water container)
- Tripod or ring stand with iron ring, and wire gauze
- Water for testing and extinguishing
- Thermometer

#### Note:

If you don't have the equipment listed, you can simplify the method to heat the water.

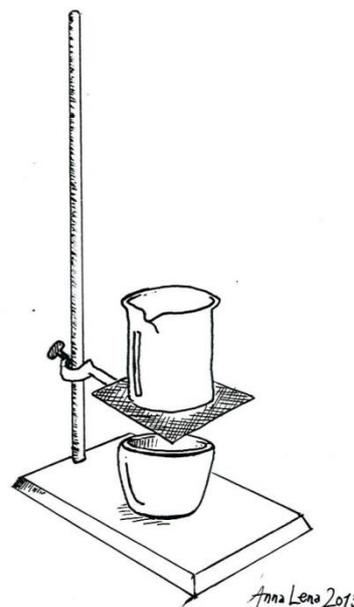


Illustration: Anna Lena Albertsen

### Preparation

Prepare the same amount of different types of biofuel (e.g. 10 g). Examples of biofuels to investigate: Dry sticks from spruce, pine or from different broadleaved trees. Other items to try may be core wood, bark, sawdust, shavings, straw, grain and peat. Try also using methanol and ethanol if obtainable.

Prepare 10 cl of water for each type of biofuel you want to investigate. It is very important that the water temperature is the exact same for each biofuel you test. To ensure that all the pupils use water with the same temperature, tap water into jugs one day in advance. Measure the temperature just before the experiment begins.

Prepare water for fire extinguishing (only for emergency, the fire should burn-out by itself).

**What to do**

- Make precise measures of the biofuel by placing the crucible on the scale. Reset the scale to zero, and then add the biofuel.
- Fill the beaker with 10 cl of water, and place it on the tripod/ring stand, on top of wire gauze.
- Pour 3 ml of methylated spirit over the biofuel to ignite it. Let the methylated spirit burn exactly one minute before it is placed underneath the beaker with water. It is a matter of making the biofuel burn up completely while heating the water.
- When the fire has burnt-out, stir the water before you measure the temperature. Use the table below to record the values from each type of biofuel.
- Repeat the procedure with various types of biofuel.

**Note**

You may find air supply to the small fire difficult. A solution is to use a metal container and make a few small holes in it. A simpler solution is to try and blow gently. Perhaps pupils (and teachers) can find other creative solutions?

**Results**

Type of biofuel	Temperature

**Afterwards**

- Were there any possible errors that could impact on the results of the experiment? (E.g. biofuel not completely burned out, inaccurate measures)
- What does it mean that biofuels do not add any extra carbon dioxide (CO<sub>2</sub>) to the atmosphere?
- The different types of biofuel are all made of biological material. Where does the energy in for example wood originally come from?

**Additional experiment**

Use fresh and dry sticks from the same species to get a comparison between dry and wet wood using the same methods and procedures.

## Products in general

### What can you find in forests?

Find the missing words in the maze. They appear horizontally, vertically and diagonally.

For help you can use the table below which, contains all the words you are looking for.

P	A	Q	W	N	I	F	K	F	T	L	R	O	A	Z
X	S	D	T	H	Z	I	R	A	N	I	M	A	L	S
B	U	F	O	O	D	R	R	Q	M	M	B	E	I	X
S	P	A	Z	A	B	E	E	S	R	A	V	C	R	I
R	H	Q	E	U	P	W	T	D	P	Q	U	F	W	N
I	E	A	B	A	S	O	R	S	O	I	M	P	O	S
H	R	O	D	C	X	O	Z	I	Y	Q	C	U	H	E
S	B	W	T	E	M	D	U	L	W	H	O	E	S	C
N	S	H	Z	H	G	J	K	E	A	G	N	W	S	T
E	O	J	Y	T	I	L	U	N	X	J	E	Z	Y	S
S	H	K	L	X	T	Q	X	C	T	G	S	Q	L	O
T	W	U	Z	W	I	H	A	E	I	H	J	Y	G	X
S	S	H	E	L	T	E	R	Z	T	W	P	Z	L	H
J	P	L	A	M	E	D	I	C	I	N	E	U	D	A
I	X	J	H	Q	I	A	W	T	H	U	L	A	Q	P

FOOD	SHADE	MEDICINE	CONES
SILENCE	ANIMALS	HERBS	INSECTS
SHELTER	FIREWOOD	SPICE	NESTS

---

**Solution**

	A	Q	W	N	I	F	K	F	T	L	R	O	A	Z
X	S	D	T	H	Z	I	R	A	N	I	M	A	L	S
B	U	F	O	O	D	R	R	Q	M	M	B	E	I	X
S	P	A	Z	A	B	E	E	S	R	A	V	C	R	I
R	H	Q	E	U	P	W	T	D	P	Q	U	F	W	N
I	E	A	B	A	S	O	R	S	O	I	M	P	O	S
H	R	O	D	C	X	O	Z	I	Y	Q	C	U	H	E
S	B	W	T	E	M	D	U	L	W	H	O	E	S	C
N	S	H	Z	H	G	J	K	E	A	G	N	W	S	T
E	O	J	Y	T	I	L	U	N	X	J	E	Z	Y	S
S	H	K	L	X	T	Q	X	C	T	G	S	Q	L	O
T	W	U	Z	W	I	H	A	E	I	H	J	Y	G	X
S	S	H	E	L	T	E	R	Z	T	W	P	Z	L	H
J	P	L	A	M	E	D	I	C	I	N	E	U	D	A
I	X	J	H	Q	I	A	W	T	H	U	L	A	Q	P

## Which products are not from forests?

### Introduction

It is amazing how many products contain something that derives from trees. Not all are obvious. Trees have many more qualities than just to provide us with wood. Wood consists of many substances that can be extracted and used in other products.

Can you figure out which ones that definitely have nothing to do with trees?

Magazine	Internet
Syrup	Cardboard
Egg	Firewood
Skateboard	Glass
Toothpaste	Roses
Ice cream	Toilet paper
Pencils	Medicine
Paint	Charcoal
Rubber	Nuts
Cinnamon	Wine cork
Cabinet	Canoe paddle
Cones	Weetabix
Staples	Shoe polish
Chewing gum	Napkins
Sponges	Photo films
Cellophane	Crayons
Chair	Guitar

## Solution

X = products that definitely has nothing to do with trees

	Magazine	X	Internet
	Syrup		Cardboard
X	Eggs		Firewood
	Skateboard	X	Glass
	Toothpaste	X	Roses
	Ice cream		Toilet paper
	Pencils		Medicine
	Paint		Charcoal
	Rubber		Nuts
	Cinnamon		Wine cork
	Cabinet		Canoe paddle
	Cones	X	Weetabix
X	Staples		Shoe polish
	Chewing gum		Napkins
	Sponges		Photo films
	Cellophane		Crayons
	Chair		Guitar

---

## 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 provide.**

### Ecology

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

### Water

Forests interact 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. On a daily basis 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 as some of our biggest challenges today. One of the main reasons for global warming is too much CO<sub>2</sub> in the atmosphere – caused by human activities. CO<sub>2</sub> 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<sub>2</sub> from the air, and it is forests.

Through the photosynthesis, trees capture CO<sub>2</sub> 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 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.

## 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 is showing that visiting a forest has real, quantifiable health benefits, both mental and physical.

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.

### Food and medicine

Forests provide a great source for food. Many cultures has 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.

## Activities about benefits and services from the forest

### 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 measure 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

#### What to do

Find two different ecosystems to do the investigations. It could be two different types of forests, or it could be a forest and for example a meadow. Divide the class in two, so that each half can study a different ecosystem. In that way, it is possible to compare two ecosystems afterwards. For each ecosystem, the pupils cooperate in pairs or a group of three. When they reach the area for their studying, toss the stick in an arbitrary direction. Wherever the stick lands, stick it to the ground with the twine on top. With the stick in centre, pull the twine around, in this way deciding the borders 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  $A = \pi r^2$ , 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  $1 \text{ m}^2$ . In this way, the pupils may easily find the biodiversity of species per square meter.

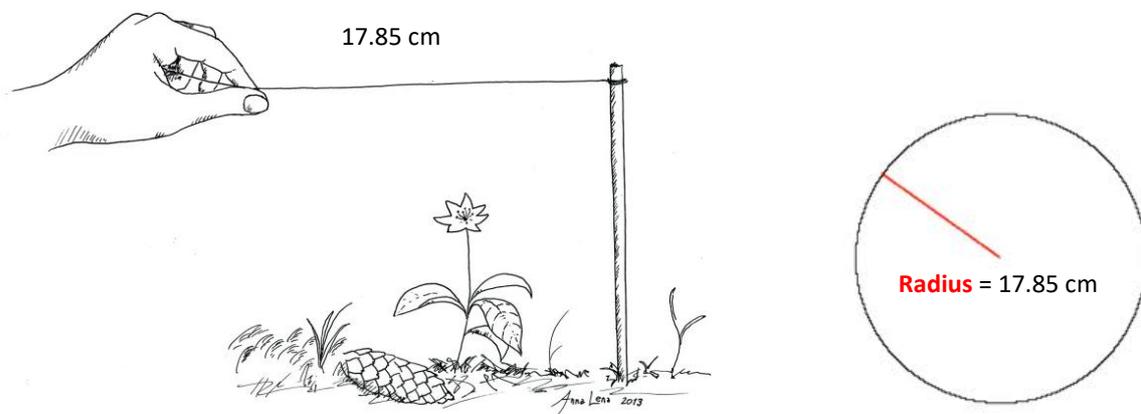


Illustration: Anna Lena Albertsen

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.

Now all the groups in the same ecosystem need to find out the average number of species per m<sup>2</sup> for the specific ecosystem.

	Number of species per m <sup>2</sup>					Average no. of species/m <sup>2</sup> 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<sup>2</sup>)? What may be the reasons for the variation in diversity of species?

### Afterward 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?

## Ecology – experiment with water

### Forest floors and water quality

#### Introduction

One of the many benefits of the forest is that it works like a giant sponge, retaining water and thus preventing floods and erosion. Slow running water also means that there will be less sediment in lakes and rivers. In addition, the forest floor acts like a filter. Water in the forest will percolate into the ground. Healthy forest soils filter and trap pollutants, in this way helping to purify water on its way to the ground water system. The result is clean drinking water.

#### Purpose

In this experiment, pupils will learn about the forest floor, what it consists of, and the effect it has on water quality. They will observe and learn how forest floors can clean and filter running water.

#### Equipment

- Forest floor material (soil, sand, gravel, humus, mosses, leaves, needles, twigs, branches, bark)
- Three screen boxes (cylinders, such as two 1.5 litre plastic bottles attached)
- Drainage catch basin for each box
- Water jug with muddy water

#### Preparations

Assemble three screen boxes (photo next page) before class begins.

- Fill one box with stones and pebbles.
- Fill one box mostly with sand and less organic matter.
- Fill one box with layers of sand, soil and organic matter on top. Predominantly with organic matter. This may include residues of dead organic matter such as leaves, needles, pine cones, twigs, branches, plants, mosses and lichens) and decomposed organic matter (humus).

To be able to observe the filtration effect, you need muddy water.

#### What to do

1. Begin with a discussion of what a forest floor is and what its components are. Before pouring the water into the boxes, ask the pupils what they expect will happen. In which box will the filtration process be most efficient?
2. Pour the same amount of water on to each box. Allow time for water to filter through materials. This will take some time, so the pupils could do a different task while waiting. Return to boxes to observe and discuss the water quality in the catch basin for each system.



Photo: Anna Lena Albertsen

**Note**

Involve the pupils when learning what a forest floor consists of by letting them participate in filling the boxes. If possible, let the pupils be involved in collecting the material needed from the forest.

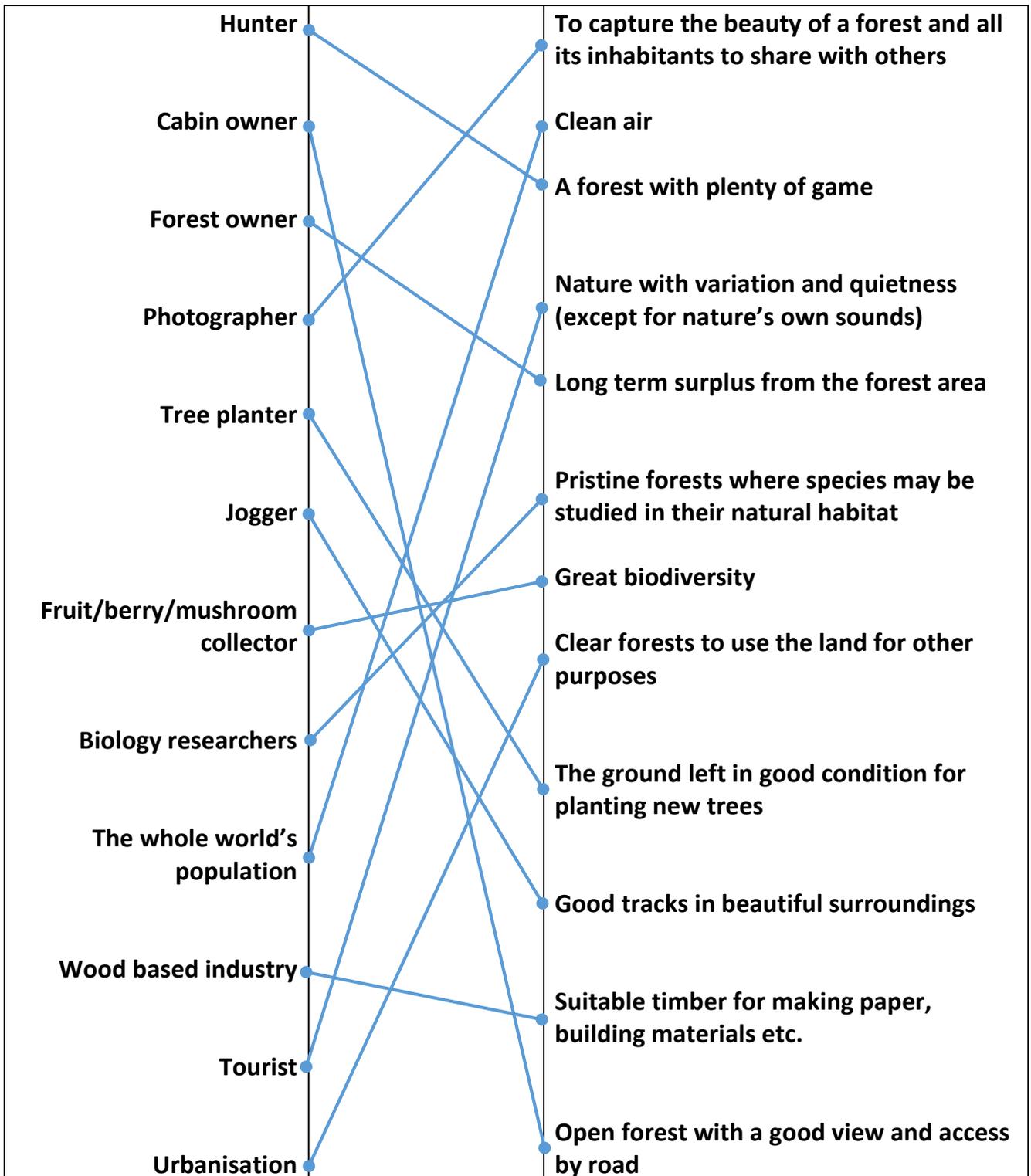
## Socio cultural servicers

### Who wants what from the forest?

Draw lines connecting the forest user to what they want or need. There may be more than one possible alternative, but one fits better when you do them all correctly.

<b>Hunter</b>	<b>To capture the beauty of a forest and all its inhabitants to share with others</b>
<b>Cabin owner</b>	<b>Clean air</b>
<b>Forest owner</b>	<b>A forest with plenty of game</b>
<b>Photographer</b>	<b>Nature with variation and quietness (except for nature's own sounds)</b>
<b>Tree planter</b>	<b>Long term surplus from the forest area</b>
<b>Jogger</b>	<b>Pristine forests where species may be studied in their natural habitat</b>
<b>Fruit/berry/mushroom collector</b>	<b>Great biodiversity</b>
<b>Biology researchers</b>	<b>Clear forests to use the land for other purposes</b>
<b>The whole world's population</b>	<b>The ground left in good condition for planting new trees</b>
<b>Wood based industry</b>	<b>Good tracks in beautiful surroundings</b>
<b>Tourist</b>	<b>Suitable timber for making paper, building materials etc.</b>
<b>Urbanisation</b>	<b>Open forest with a good view and access by road</b>

Solution



## What can you do in the forest?

Find the missing words in the maze. They appear horizontally, vertically and diagonally.

For help you can use the table below containing all the words you are looking for.

Q	F	Y	K	W	S	T	G	H	A	R	V	E	S	T
R	W	D	H	O	Q	G	P	W	I	Y	X	E	H	I
C	O	R	I	E	N	T	E	E	R	I	N	G	M	W
W	R	H	A	T	H	R	G	S	E	H	T	S	E	R
O	K	Y	P	C	E	P	G	T	Q	G	U	F	X	A
F	T	B	K	Y	F	U	L	O	G	W	N	Y	E	X
C	E	U	M	C	Q	G	A	A	J	T	X	E	R	Q
A	Q	R	B	L	E	U	P	D	Y	E	D	I	C	Y
M	R	E	S	E	A	R	C	H	I	B	W	Y	I	R
P	L	N	Y	U	V	Q	H	F	S	H	T	K	S	P
Z	O	W	P	E	F	H	O	J	A	U	P	H	E	W
G	K	D	J	A	W	E	Y	M	I	N	K	G	Q	X
B	H	Q	R	S	F	A	U	Z	O	T	R	Y	D	O
R	E	L	A	X	P	F	L	E	Q	P	U	J	T	W
W	I	T	Y	E	L	W	F	K	S	L	E	A	R	N

WALK	PLAY	WORK	CAMP
HUNT	RESEARCH	HARVEST	ORIENTEERING
RELAX	EXERCISE	LEARN	CYCLE

Solution

Q	F	Y	K	W	S	T	G	H	A	R	V	E	S	T
R	W	D	H	O	Q	G	P	W	I	Y	X	E	H	I
C	O	R	I	E	N	T	E	E	R	I	N	G	M	W
W	R	H	A	T	H	R	G	S	E	H	T	S	E	R
O	K	Y	P	C	E	P	G	T	Q	G	U	F	X	A
F	T	B	K	Y	F	U	L	O	G	W	N	Y	E	X
C	E	U	M	C	Q	G	A	A	J	T	X	E	R	Q
A	Q	R	B	L	E	U	P	D	Y	E	D	I	C	Y
M	R	E	S	E	A	R	C	H	I	B	W	Y	I	R
P	L	N	Y	U	V	Q	H	F	S	H	T	K	S	P
Z	O	W	P	E	F	H	O	J	A	U	P	H	E	W
G	K	D	J	A	W	E	Y	M	I	N	K	G	Q	X
B	H	Q	R	S	F	A	U	Z	O	T	R	Y	D	O
R	E	L	A	X	P	F	L	E	Q	P	U	J	T	W
W	I	T	Y	E	L	W	F	K	S	L	E	A	R	N

## Modern citizens towards a sustainable future

**How can we prepare young children of today to become responsible citizens of tomorrow?**

**The aims of the following teaching material are to make pupils aware of the effect consumers have on global warming, and to make them reflect on their role as consumers. Further learning goal is the use of tree as a carbon sink and the importance of forests to combat global warming.**

### Introduction

One of humankind's greatest challenges is to ensure sustainable development. Such a complex matter is of no doubt a challenge to teach. In order to increase environmental awareness, knowledge is crucial. However, perhaps more important is the understanding of the role every one of us play.

Images and objects is a teaching method, which emphasizes active learning and critical thinking. The aim of using different images and objects is to create reflection and discussions. The following activities make use this method, to endeavour critical assessment of the options we are facing as consumers. Thus, based on education and knowledge, the modern citizen will make well-founded decisions to maintain and improve on a sustainable living.

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.

There are three PowerPoint presentations to accompany the activities, introducing the themes:

- a. CO<sub>2</sub>, global warming and carbon footprint
- b. Trees as a part of the solution to climate changes
- c. Wood as a material and the effects of substituting other materials

The activities varies within these themes. Some, which pupils may do at home, at school or in their local surroundings. Since some of the activities involve actions at home, it may be a good idea to involve the parents in advance. Some of the activities can or need to have a duration for at least a week, whereas others, as little as one hour.

Most of the activities involve using a digital camera. For some this may not be possible, others may not have access to a digital camera. It is therefore an option to gather pictures from the internet or to make drawings. Some of the activities do not require use of photo/illustration.

However, there are several arguments for taking their own photographs. One is the idea about making it personal. *Your* room, *your* clothes, *your* choices. The other reason is to be able to share their findings with the rest of the class. Last, but not least, we also believe that with a camera in their hands, the pupils will become more active and more focused on the task. Sitting in front of the computer will not be the same as looking for the "environmental choices" in their surroundings or in their own home.

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## The PowerPoint presentations

### **CO<sub>2</sub> - a global issue**

This presentation about global warming and carbon footprint gives a very simplified version of the causes and consequences of global warming and climate change. Older children can get a more advanced introduction about the greenhouse gases, the greenhouse effect, and the possible consequences of global warming.

Before introducing the term carbon footprint, there is a slide with the question: “Does your way of living cause emissions of CO<sub>2</sub>”? Please challenge the pupils to answer this question before you go on. Do they see the connection between their lifestyles and the use of fossil fuels? Slides with the title “Your way of living?” and “Does your way of living = CO<sub>2</sub>” is a source for discussion in the classroom.

At this point, it is also perhaps necessary to talk about what actions they may take to reduce their own carbon footprint. What choices can they make? What changes can the school do? Can they introduce changes at home? The pupils will need some knowledge of possible measures before they can do the activities.

### **Why are trees a part of the solution?**

The presentation of the photosynthesis is only a briefly introduced and it is a very simplified version of the truth. For example, it is not the oxygen from the carbon dioxide which is omitted back into the air, but the oxygen from the water molecule (H<sub>2</sub>O).

For most classes, it will be an advantage to explain the whole photosynthesis. However, the main message is that trees store carbon (C), thus reduce the amount of CO<sub>2</sub> in the atmosphere, and release oxygen for our benefit.

### **Wood as a material**

This presentation explains the advantages of choosing wood as a material, as compared to concrete, steel or cement. However, many pupils may not like the idea of cutting down the forest, as they may consider it not to be an environmentally friendly thing to do. It is therefore necessary to explain the importance of sustainable forestry.

## The activities

### **Introduction**

The below you find “Summary of activities” which gives a brief description of the following activities, and explains their purpose. Please note the following:

## Exercises

### What is it made of?

#### Introduction

When we consider how much CO<sub>2</sub> we emit, we need to reflect on what we buy. One of the questions we need to ask ourselves is “what is it made of?” Different types of materials have different production methods, usage and durability. In addition, it varies what happens to the product when discarded. We should therefore be aware of what material the item is made of. Do you know what the items in your home are made of?

#### Purpose

Create awareness of the different types of materials, and discover that the same product can be made of different materials.

#### Equipment

Digital camera

#### Preparations

Present the PowerPoints “Why are trees a part of the solution” and “Wood as a material”

#### What to do

Go to the kitchen. Investigate the items from the list below..

	Product	Which material is it made of?	If not wood, is it possible to replace it with wood?	If yes, do you want to select wood next time?
1	Kitchen bench			
2	Floor			
3	Walls			
4	Table			
5	Cabinets			
6	Curtains/blinds			
7	Plates			

#### Afterward work

Do a class discussion, or let the pupils answer them individually.

- Compare your list with your classmates. Were there any differences?
- What other questions should we ask ourselves when we make purchases?
- Give some good reasons for choosing wood as a material.
- What would be the reason(s) for not choosing wood as material?

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## Wooden products in everyday life

### **Introduction:**

When we consider how much CO<sub>2</sub> emissions our lifestyle causes, we must also consider the production of our purchases. One of the things we have to think about is what kind of material the product is made of. Do you know what the things around you are made of?

### **Purpose:**

To make pupils aware of how many wooden products we see or use in our daily life.

### **Equipment:**

Digital camera, or paper and pen.

### **Preparations:**

Present the PowerPoints “Why are trees a part of the solution” and “Wood as a material”

### **What to do:**

Pupils must use a camera or use pen and paper to record how many wooden products surrounding them on a normal day. That means they must have a camera / paper and pen nearby when they wake up, and start recording all products of wood they see and / or use, until they go to sleep.

### **Afterward work**

Let the pupils answer the following questions

- How many pictures did you take?
- Did you take more or less photos than you expected?
- Do we need wood, or is it possible to replace other materials with wood?
- What are the benefits of wood compared to other materials?
- What are the disadvantages with wood to other materials?

If recordings made with a camera, make a photo story.

If recorded on paper, find photos to illustrate the findings.

Make an exhibition to let the pupils look at each other’s findings, or, let them present their findings to the rest of the class.

The following four exercises connect to the PowerPoint called Carbon dioxide - a global issue.

## My carbon footprint

### Introduction

The knowledge of carbon footprint is good for becoming aware of one owns habits. When we don't think about it, our carbon footprint can be very high. Nevertheless, with knowledge we can make small adjustments to reduce our carbon footprint.

### Purpose

The purpose of this exercise is to give the pupils an indication of their own carbon footprint. However, this is not a precise method, and some elements, such as food, are not included. Further, the idea is that the higher they score, the bigger is their carbon footprint.

### Equipment

The list

### Preparations

Present the photos PowerPoint called Carbon dioxide - a global issue.

### What to do

In this exercise, pupils shall record what they have at home and what actions they perform at home. Emphasise honesty and to do the registration as precisely as possible. Let them fill in "My recording".

Investigating their personal consumption (how many shoes and clothes they have at home), and what actions the family takes for the environment.

### Afterward work

The students' form has a column for points. You as a teacher have a form with the points listed. Go through the form and let the students fill in their score. The one with the lowest points has the lowest carbon footprint.

Questions 1 – 3 is your personal consumption	My recording	Points
<b>1) What do you have of the following clothing and shoes? Register the number per item.</b>		
Number of pairs of shoes (including boots, sandals, sports shoes, etc.)		
Pants (including jeans, sweat pants, etc.)		
Outer wear (including coats, raincoats, jackets, etc.)		
<b>2) How many items of clothing and shoes have you purchased the last 2 months? Mark an x at one of the alternatives below.</b>		
0		
1-3		
4-7		
More than 8		
<b>3) Do you reuse?</b>		
Do you sometimes buy second hand clothes?	Yes /No	
Do you sometimes use a shopping net rather than a plastic bag?	Yes /No	
<b>Sum question 1-3</b>		=
<b>Questions 4 – 7 involves the rest of the family Add up the numbers below and divide it by the number of people living in the home.</b>		
<b>4) What is in your home? Write the correct number of each item</b>		
Number of televisions		
Number of DVD players (or Blue Ray, VHS etc)		
Number of game consoles		
Number of computers (included laptops)		
Number of mobile phones		
Number of iPads or similar e-readers		
<b>5) Check the following items at home. Does any have energy efficient labels? Yes or no</b>		
Stove	Yes /No	
Washing machine	Yes /No	
Freezer	Yes /No	
Refrigerator	Yes /No	
Dish washing machine	Yes /No	

6) Others		
Number of power saving light bulbs		
Number of other light bulbs and fluorescent tubes		
Do you have water saving showerhead?	Yes /No	
How do you travel to school?	Walk/bicycle/bus/tram/car	
7) What kind of waste do you separate		
Plastic	Yes /No	
Paper	Yes /No	
Batteries	Yes /No	
Drinking cartons	Yes /No	
Light bulbs	Yes /No	
Bio-waste	Yes /No	
Glass and metal	Yes /No	
Do you recycle bottles	Yes /No	
<b>Sum question 4-7</b>		=
Divided on the number of <b>people</b> living in the home		/
New sum		
+ sum from question 1-3		+
<b>Sum for me (my carbon footprint)</b>		=

**Teachers form with the point system.**

Questions 1 – 3 is your personal consumption	My recording	Points
<b>1) What do you have of the following clothing and shoes? Register the number per item.</b>		
Number of pairs of shoes (including boots, sandals, sports shoes, etc.)		1 point per item
Pants (including jeans, sweat pants, etc.)		1 point per item
Outer wear (including coats, raincoats, jackets, etc.)		1 point per item
<b>2) How many items of clothing and shoes have you purchased the last 2 months? Mark an x at one of the alternatives below.</b>		
0		-1 point
1-3		1 point per item
4-7		2 points per item
More than 8		3 points per item
<b>3) Do you reuse?</b>		
Do you sometimes buy second hand clothes?	Yes /No	No = 1 p, Yes = -1 p
Do you sometimes use a shopping net rather than a plastic bag?	Yes /No	No = 1 p, Yes = -1 p
<b>Sum question 1-3</b>		=
<b>Questions 4 – 7 involves the rest of the family Add up the numbers below and divide it by the number of people living in the home.</b>		
<b>4) What is in your home? Write the correct number of each item</b>		
Number of televisions		2 points per item
Number of DVD players (or Blue Ray, VHS etc)		2 points per item
Number of game consoles		2 points per item
Number of computers (included laptops)		2 points per item
Number of mobile phones		2 points per item
Number of iPads or similar e-readers		2 points per item
<b>5) Check the following items at home. Does any have energy efficient labels? Yes or no</b>		
Stove	Yes /No	-1 point per item
Washing machine	Yes /No	-1 point per item
Freezer	Yes /No	-1 point per item
Refrigerator	Yes /No	-1 point per item

Dish washing machine	Yes /No	-1 point per item
<b>6) Others</b>		
Number of power saving light bulbs		-1 point per item
Number of other light bulbs and fluorescent tubes		1 point per item
Do you have water saving showerhead?	Yes /No	No = 1 p, Yes = -1 p
How do you travel to school?	Walk/bicycle/bus/tram/car	Walk = -1 p Bicycle = 0 p Bus/tram = 2 p Car/taxi = 4 p
<b>7) What kind of waste do you separate</b>		
Plastic	Yes /No	No = 1 p, Yes = -1 p
Paper	Yes /No	No = 1 p, Yes = -1 p
Batteries	Yes /No	No = 1 p, Yes = -1 p
Drinking cartons	Yes /No	No = 1 p, Yes = -1 p
Light bulbs	Yes /No	No = 1 p, Yes = -1 p
Bio-waste	Yes /No	No = 1 p, Yes = -1 p
Glass and metal	Yes /No	No = 1 p, Yes = -1 p
Do you recycle bottles	Yes /No	No = 1 p, Yes = -1 p
<b>Sum question 4-7</b>		=
Divided on the number of persons living in the home		/
New sum		
+ sum from question 1-3		+
<b>Sum for me (my carbon footprint)</b>		=

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## Inspire your family

### Introduction

Our lifestyles contribute to CO<sub>2</sub> emissions. If we want to reduce emissions of CO<sub>2</sub>, we need to make changes in the way we live. It does not necessarily have to be big changes, and they do not need to reduce our quality of life. However, it is important that we do it together. We must all contribute. In that way, even small changes can make big differences.

### Purpose

Create awareness of what one already does and what one can do, involving the family. To discover possibilities of environmental friendly actions at home. We must all be ambassadors and everyone must contribute.

### Equipment

Digital camera

### Preparations

Present the PowerPoint called Carbon dioxide - a global issue.

### What to do

Let the pupils request a family meeting where they discuss their way of lifestyle and what the family can do for the environment. It is the pupils' task to chair the meeting and to explain the reason for the meeting to the rest of the family. The pupil must also make sure that someone writes down all the suggestions, and what the family agrees on. They can use the form below for notes.

The family should carry out a brainstorming session to answer the two questions:

- What do you do at home, which is good for the environment?
- Find suggestions for what more you can do.

The pupil choose one of the suggestions and make sure the whole family agrees on it, and complete the action within one week. Use a camera to document the process.

Next week the pupil choose one of the other proposals, and implement it in one week. It is important that the whole family agree. Remember to take photographs to document what the family does for the environment.

### Afterward work

Let the pupil select the task they (and the family) were most pleased with, and to present it to the class. They should justify why they think it was a good initiative. Will the family continue to do this? Why / why not?

### Questions:

1. Did the whole family understand why it is important to do something?
2. Was it easy for the whole family to agree?
3. Did everyone in the family manage to carry out what they had agreed?
4. If not, what can the pupil do to make everyone contribute?
5. In order to create a global reduction of CO<sub>2</sub> emissions must all countries in the world agree to contribute. Do they this is possible? Let them explain their answer.

## Good and bad choice

### Introduction

At home, at school or at work, we always make choices. Some of these choices will lead to unnecessary emissions of carbon dioxide (CO<sub>2</sub>), while other choices may help to reduce emissions. We often make these choices without much thought of it. This means that in many cases, we can easily make a smarter environmental choice, once we are aware of it.

### Purpose

Give the pupils an opportunity to reflect on good and poor environmental decisions, and to make them aware that we have a choice.

### Equipment

Digital camera

### Preparations

Present the PowerPoint called Carbon dioxide - a global issue.

### What to do

Go out and take two photos. One shall depict an object or activity you think is a bad environmental choice. The other shall depict a smarter environmental choice. This can be photos of for example, transport, energy, products or trash, but remember to link it to CO<sub>2</sub> emissions.

### Afterward work

For each photo, pupils must explain the reason for the particular pictures. Why is this a good example of a smart /poor environmental choice? How does this lead to reduced / increased emissions of CO<sub>2</sub>? In addition, for the photo depicting a bad environmental choice, they should suggest what one ought to do as a better solution.

Let the pupils share their photos and explanations with the rest of the class.

**Location:** At home, at school or nearby.

Environmentally friendly things we already do	These are suggestions on what more we can do

These are the proposals we have decided to implement:

Week	Description of what the family will do for the environment this week
1	
2	
3	
4	

## How far did your T-shirt travel?

### Introduction

To assess the amount of CO<sub>2</sub> we emit, we need to consider our purchases. One of the things to study is the origin of the products. Generally, one can say that the further away the production of goods take place, the more CO<sub>2</sub> will escape on its way to you.

### Purpose

Make pupils aware that transportation is an important contribution to our carbon footprint. Not only our own use of transportation, but also the transportation of the products we buy.

### Equipment

Clothes, food in its original packaging, digital camera

### Preparations

Present the PowerPoint called Carbon dioxide - a global issue.

### What to do

Choose four different pieces of clothing; the pupils may use what they are wearing. Find the tab inside the garment describing fabrics, etc. Usually you will find the production country. Register the country of origin. Find out which of these countries that is furthest away and which one is the closest. Take a photo of the garment which is produced furthest away. Do the same for five randomly selected foods from your refrigerator or food cabinet.

### Afterward work

Let the pupils share with their class the products they found that was produced furthest away. What are the alternatives to buying this item? Let them answer or do a group discussion on the following questions:

- What is the reason why the production of our products takes place so far away? What does it mean for CO<sub>2</sub> emissions and which country is producing the clothes or food we buy?
- What other questions should we ask ourselves when we buy something?

	Product	Country of production	Rank from closest to furthest from you
1			
2			
3			
4			
1			
2			
3			
4			

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## Using Images and objects as a teaching material

This is an example of using images as a teaching tool, and the subject is wood as a material and sustainability.

There are 30 photos available for this task, depicting 15 themes. Each theme has two photos similar to each other, but where one is considered more environmentally friendly than the other.

*Each student chooses a picture, and the first task is to find the student who has a corresponding image. They have to look at each other's photo and figure out which images belong together.*

*Once all students have gathered in pairs, the next task is to figure out which photo's image is more environmentally friendly. They have to discuss the images and come up with one or more reasons for their decision.*

*Next, the students are divided into two groups, one group having the environmentally friendly image and the other group the not so environmentally friendly image.*

*One by one, each student from the environmentally friendly group stands up and shows his/her photo and describes why it belongs to this group. From the other group the student 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.*

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 and that one is almost always better than the other.

Please note that there aren't necessarily any "right or wrong" answers. The purpose is rather to create a discussion and use reflection to enhanced the learning process.

### 30 images, depicting 15 themes

No.	Title	Photographer	Comment
1	Downhill skiing area	Trygve Øvergård	Downhill skiing requires the use of a lift, and is therefore more energy consuming than cross country skiing
	Cross country skiing	Terje Johannesen	
2	Bus		The bus takes more passengers, and is therefore a better choice than a car. However, a full car is better than an empty bus!
	Car		
3	Brick house	Nina Ree-Lindstad	Releases CO <sub>2</sub> in the production process
	Wooden house	Nina Ree-Lindstad	Stores carbon, and is therefore a better choice
4	Plastic bag	Nina Ree-Lindstad	Plastic is made of petroleum, which is not a renewable resource. In addition, plastic bags are not durable and often tossed away
	Shopping net	Nina Ree-Lindstad	May be used many times.  Made of cotton, renewable resource (but in many cases the production of cotton is problematic, due to use of pesticides).
5	Cement pier	Nina Ree-Lindstad	Releases CO <sub>2</sub> in the production process
	Wooden pier	Nina Ree-Lindstad	Stores carbon, and is therefore a better choice
6	Bottled water	Nina Ree-Lindstad	Where tap water is drinkable, use of bottled water is not necessary and hence it is an environmental problem because of production and transportation
	Tap water	Anna Lena Albertsen	
7	Bananas	Anna Lena Albertsen	The idea is that bananas have a longer transportation. This will of course vary, depending on the country. Apples and bananas may therefore be substituted by other fruits/vegetables.
	Apples	Anna Lena Albertsen	
8	Wooden floor birch	Anna Lena Albertsen	In Norway, birch is a local species. The use of merbau implies transportation.
	Wooden floor merbau	Nina Ree-Lindstad	In addition merbau is considered a threatened species.
9	Metal stool	Anna Lena Albertsen	Releases CO <sub>2</sub> in the production process
	Wooden stool	Nina Ree-Lindstad	Stores carbon, and is therefore a better choice

10	Soles made of old car tires	Anna Lena Albertsen	Is a better choice because the material is reused
	Soles made of rubber	Anna Lena Albertsen	Rubber is also a natural and renewable resource, so the choice is not obvious!
11	Paper cup	Anna Lena Albertsen	Made of wood, a renewable resource
	Plastic cup	Anna Lena Albertsen	Made of petroleum, not a renewable resource
12	Sweater made of fleece	Anna Lena Albertsen	Made of petroleum, not a renewable resource. However, the fleece may also have been made by used plastic bottles, and would then be a good example of reuse of material.
	Sweater made of wool	Anna Lena Albertsen	Wool is a renewable resource
13	Petroleum base heater	Nina Ree-Lindstad	Both heaters will emit the same amount of CO <sub>2</sub> . However, wood will not release more CO <sub>2</sub> than it gathered as a live tree, and wood is also a renewable resource.
	Wood based heater	Anna Lena Albertsen	
14	Concrete bridge	Nina Ree-Lindstad	Releases CO <sub>2</sub> in the production process
	Wooden bridge	Nina Ree-Lindstad	Stores carbon, and is therefore a better choice
15	Glass fiber boat	Nina Ree-Lindstad	Releases CO <sub>2</sub> in the production process
	Wooden boat	Nina Ree-Lindstad	Stores carbon, and is therefore a better choice

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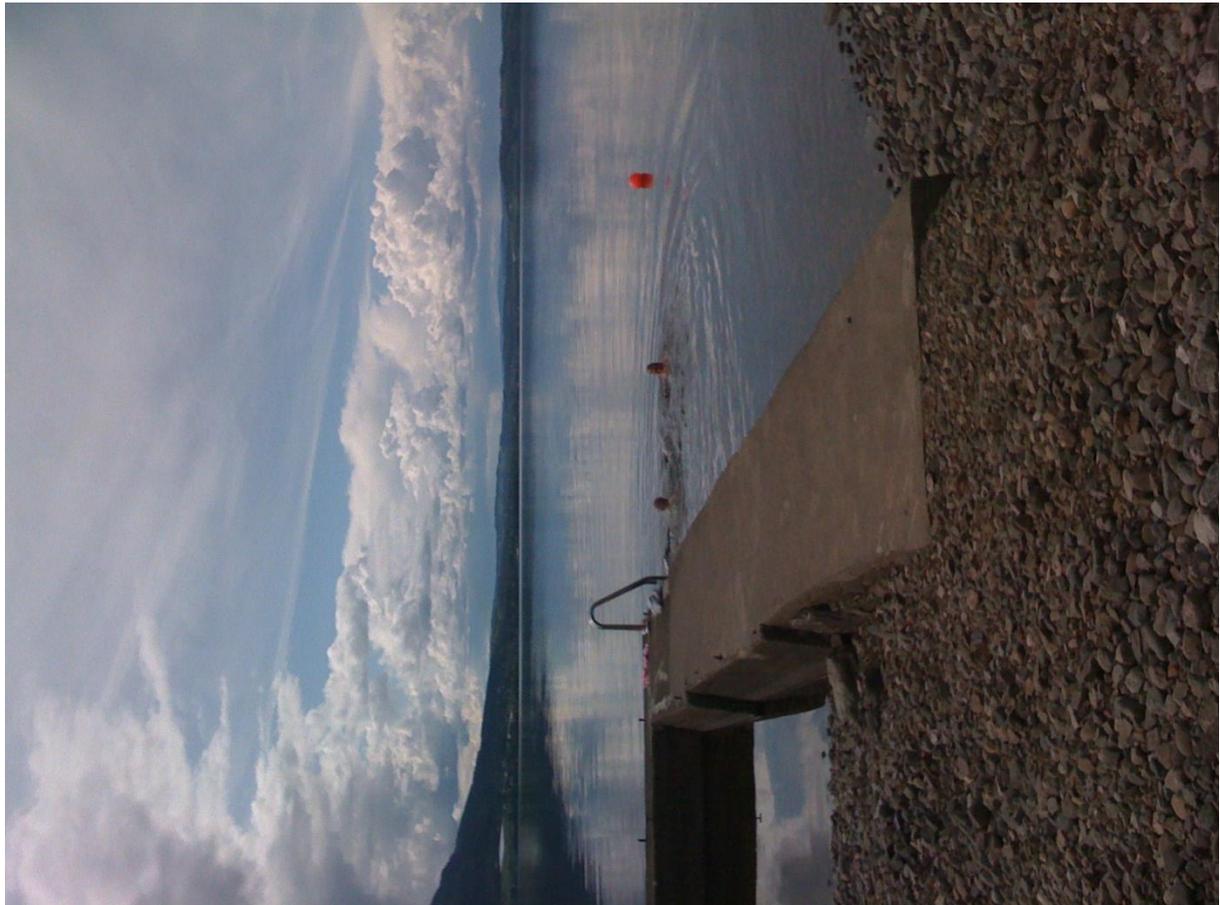
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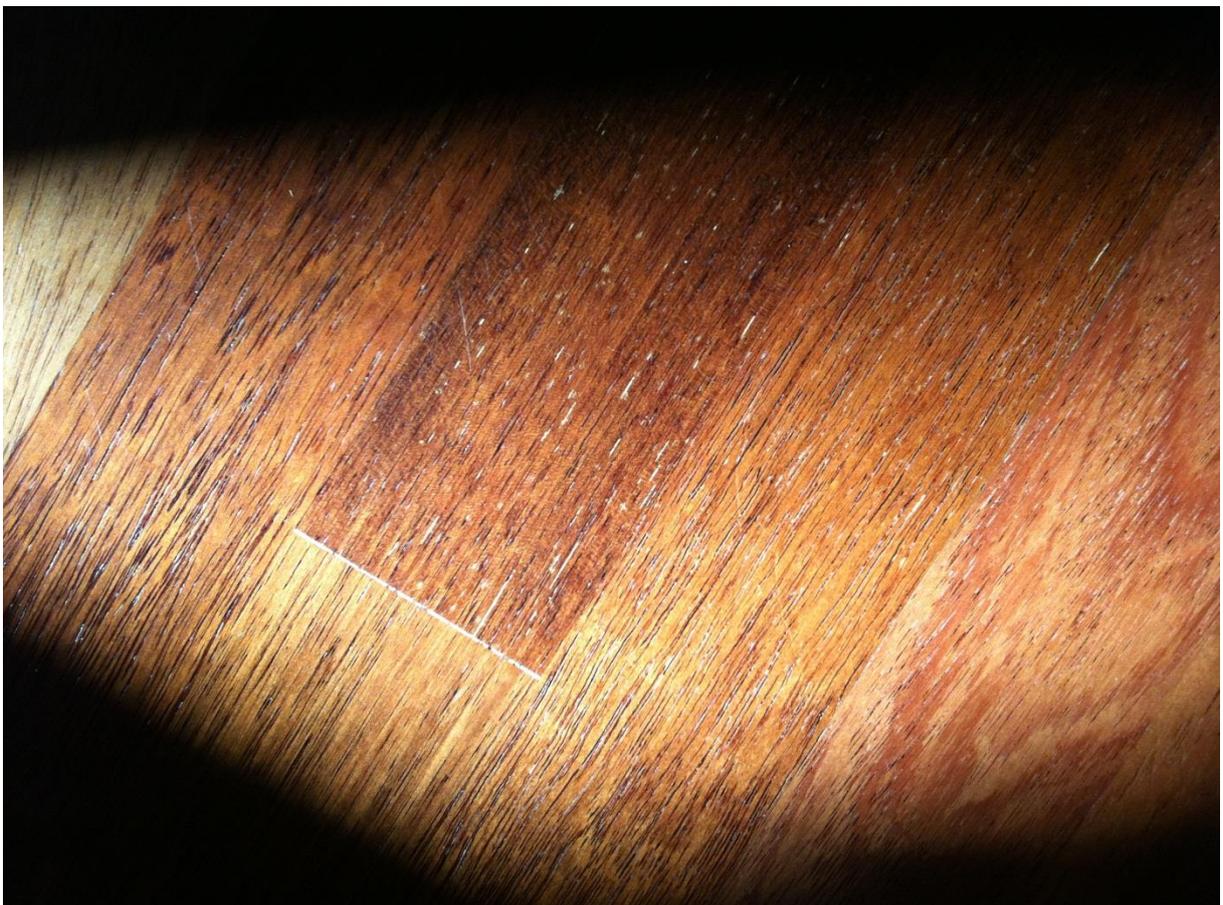


























## GLOSSARY

**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 different 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 surface 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 production 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 opportunities for present and future generations

**Wood Chemicals:** Chemicals found naturally in the various parts of a tree