

Lesson plan

The following document details the lesson plan for the teacher. The lesson time is based to be around 1 hour, however the teacher can adjust that time by lengthening or shortening the group work time.

Learning objectives:

- Students should develop an understanding about biomass and how it affects them.
- Students should be able to understand the basic science behind at least two biomass processes.
- Students should be able to work in teams to solve problems related to biomass.
- Students should be able to create innovative solutions to biomass problems.

Lesson format

Time (minutes)	Activity
5	Ask students what they know about biomass. If they have no initial ideas then give them hints in regards to biology and what that is. Show video/slideshow which gives an explanation about biomass.
5	Explain the activity and divide the students into groups.
30	Group work activity, the activity is explained in the 'activity work' section of this document.
15	Have the students present their ideas to the class, encourage them to think about its place in the biomass economy.
5	This is for any additional questions.

Equipment

- A3 paper (or larger paper)
- Pens
- Alternatively laptops

Activity work

The activity will be a group work tasked centered around students creating an innovative biomass solution to a industry problem in their neighborhood/city. This could be converting the nearest power plant to biomass energy or making a bridge from bio materials. Students will be given case studies of the biomass industry to help them with their own solution. To further help several categories have been chosen which are as follows:

- Energy
- Fuel

- Cosmetics
- Plastics
- Construction

Each category will be equipped with several case studies to help the students. The students should be divided as evenly as possible. The students should make the plan on A3 paper (or powerpoint in laptops) which can be presented to the class. If the students can have access they can also do their own research on their Bio topic.

Important notes

The teacher should try and discuss with the class how each of the processes are interlinked with each other (for example Biofuels transport biomass to power plants). The students should also think about the effect Biomass could have on their local area.

Video link final version

<https://youtu.be/sA-tJwSWNDc>

Resources

Construction

Biobased bridge. (n.d.). Retrieved from <https://www.coebbe.nl/projecten/biobased-brug/>

Goteo, F. (n.d.). BALA-BOX. Retrieved January 25, 2019, from <https://en.goteo.org/project/bala-box>

Saieh, N. (2010, March 04). Handmade School / Anna Heringer Eike Roswag. Retrieved from <https://www.archdaily.com/51664/handmade-school-anna-heringer-eike-roswag>

Cosmetics and perfume

Organic Beauty Recipes DIY Beauty | DIY Beauty. Retrieved from <https://www.organic-beauty-recipes.com/>

Saieh, N. (2010, March 04). Handmade School / Anna Heringer Eike Roswag. Retrieved from <https://www.archdaily.com/51664/handmade-school-anna-heringer-eike-roswag>

Energy

Biomass power plants. (n.d.). Retrieved from <http://www.bwsc.com/Biomass-power-plants.aspx?ID=1346>

Power. (2010, December 01). Top Plant: Kaukaan Voima Oy Biomass-Fired Power Plant, Lappeenranta, Finland. Retrieved from <https://www.powermag.com/top-plantkaukaan-voima-oy-biomass-fired-power-plant-lappeenranta-finland/>

Plastics

The Problem With Plastic | Biomass Packaging. (n.d.). Retrieved from <http://www.biomasspackaging.com/education/bioplastics/>

Trangbæk, R. R. (2015, June 15). LEGO Group to invest 1 Billion DKK boosting search for sustainable materials. Retrieved from <https://www.lego.com/en-us/aboutus/news-room/2015/june/sustainable-materials-centre>

Virent BioFormPX® Paraxylene Used for World's First PET Plastic Bottle Made Entirely From Plant-Based Material. (n.d.). Retrieved from <http://www.virent.com/news/virent-bioformpx-paraxylene-used-for-worlds-first-pet-plastic-bottle-made-entirely-from-plant-based-material/>

Fuel

Lindemann, G. W. (2019, January 10). Biofuel Examples. Retrieved from <https://sciencing.com/biofuel-examples-5945.html>

Bio construction

Introduction

Bio construction looks at using biologically sourced matter and using them as building materials. The current construction materials such as concrete and steel generate a large carbon footprint due to their manufacturing process. Cheap biomaterials could potentially be cheaper as well as being more environmentally friendly than standard building materials.

Task

With your group think about how you could use bio materials from your local area and use them to design a new building, bridge or other construction. A few things to think about:

- What materials are easily sourced in your local area, recycled wood, hay or organic materials?
- What does your area need that can be fulfilled with a bio construction, footbridge, walls or a new building for your school?
- What will be the environmental impact of your construction, will it have a small carbon footprint and why?

Case studies

BALA-BOX

This project seeks to use prefabricated boxes of wood and straw for a healthy and efficient construction. The straw helps provide insulation whilst the wood supports the structure. The wood and straw are joined together in a box which can be placed as building blocks. Afterwards the structure is coated in mortar.



Advantages:

- It is made with 100% natural materials and is 100% recyclable.
- It has good insulation.
- Like lego the modular design allows the builder to construct many different designs.

- The modules are locked in their placement which gives greater stability to the structure.
- It can be built by two people without little need for construction vehicles.

Hand-Made School Rudrapur, Bangladesh

This project in Bangladesh used an innovative combination of bamboo and hardened mud to construct a new school building. As it was built with earth plastic PVE sheets had to be used to help protect against damping.



The building began with a small masonry foundation which was built on using a mixture of straw and dirt. This was left to harden for a week allowing the lower base to become strong. A ceiling for the ground floor was made with a triple layer of bamboo canes.

Biobased bridge, Eindhoven, The Netherlands

A 14 meter long bridge was built over the Dommel for a period of one year to demonstrate the potential of biocomposites (bio based construction materials). The bridge material was largely made from a combination of fibers of hemp and flax. After some processing a very strong bridge beam could be formed.



Biofuels

Introduction

Biofuels are fuels produced through biological process such as agriculture and anaerobic digestion instead of through petro chemicals from oils. As biological matter can regrow quickly is classified as sustainable. Biofuels also have a lower carbon footprint as the plants the fuel is made from absorbs carbon dioxide from the atmosphere.

Task

With your group think about which biofuel crops could be grown in your area and why.

- What can be grown in your area, would the plants require a lot of space, greenhouses or water?
- What would the advantages and disadvantages of using Biofuel be?

Case studies

Ethanol

Biologically produced alcohols, most commonly ethanol, and less commonly propanol and butanol, are produced by the action of microorganisms and enzymes through the fermentation of sugars or starches (easiest), or cellulose.

It is the most common fuel worldwide with the fuels largely being produced through the fermentation of sugars derived from wheat, corn, sugar beets, sugar cane, molasses and any sugar or starch. This is the same process from which alcoholic beverages are made. The distillation process requires significant energy input for heat sometimes using unsustainable natural gas fossil fuel.



Biodiesel

Biodiesel is a diesel fuel that is made by reacting vegetable oil (cooking oil) with other common chemicals. Biodiesel may be used in any diesel automotive engine in its pure form or blended with petroleum-based diesel. No modifications are required, and the result is a less-expensive, renewable, clean-burning fuel.

It is the most common biofuel in Europe and can be used in a diesel engine when mixed with mineral diesel. Biodiesel is also an oxygenated fuel, meaning it contains a reduced amount of carbon and higher hydrogen and oxygen content than fossil diesel. This improves the combustion of biodiesel and reduces the particulate emissions from unburnt carbon. [

Biodiesel is also safe to handle and transport because it is non-toxic and biodegradable, and has a high flash point of about 300 °F (148 °C) compared to petroleum diesel fuel, which has a flash point of 125 °F (52 °C).



Biofuel crops:

- Corn, used to make ethanol.
- Sugarcane
- Palm Oil
- Jatropha, can grow quickly and with scarce water
- Soybeans
- Cottonseed
- Sunflowers
- Wheat
- Switchgrass

Bio plastics

Introduction

Bio plastics are plastics made from renewable biomass sources such as vegetable fats and oils, corn starch, straw, woodchips and food waste. This makes them renewable and allow plastics to be made without the need for oil and natural gas.

Task

With your group think about the different plastics you could make and their uses

- What new products could be made from bioplastics?
- Could any of your local shops use bioplastics for their products?
- What will be the environmental impact of making bioplastics be? Could the process of making bioplastics damage the environment?

Case studies

Virent plastic bottles

This company makes plastic bottles entirely from plant based materials. It uses a chemical known as BioFormPX that converts plant based sugars into molecules found in oil. This allows for these molecules to form plastics. Virent Partnered with Coca-Cola to display plastic bottles at its pavilion in the EXPO Milan 2015. This could mean one of the world's largest drink manufactures will use biomass plastics.



Lego invests into Bio plastics

The Lego group has announced a new investment into the research, development and implementation of new sustainable raw materials to make Lego elements and packaging. It is part of the company's goal of achieving sustainable materials. This will help reduce the company's carbon footprint and reduce packing sizes. In 2014 60 Billion Lego elements were made, replacing them with Bio plastic would significantly reduce the Lego company's impact on the planet.



Facts about the Lego sustainable materials centre:

- The Lego group dedicates 1 billion DKK and sets up Lego Sustainable Materials Centre to find and implement new sustainable alternatives to current raw materials.
- More than 100 employees are expected to be recruited predominantly in the Lego Group headquarters in Billund Denmark, to work on the task in the coming years.
- The Lego group will continuously report on the progress and learnings gained towards the 2030 ambition.

Biomass packaging

This company seeks to reduce the impact of plastic packaging on the environment by making the plastics Bio based.



Examples include:

Cellophane:

Plastic made from wood. Composed from cellulose, a tree and plant component, cellophane is one of the first plastics ever made. It can be obtained through sustainable growing practices or as byproducts of wood harvest.

PLA (Polylactic Acid):

Plastic made from vegetable starch. A clear alternative for food packaging, it resembles common petrochemical-based plastic, such as PET (polyethylene terephthalate) and PS (polystyrene).

PSM (Plastarch material):

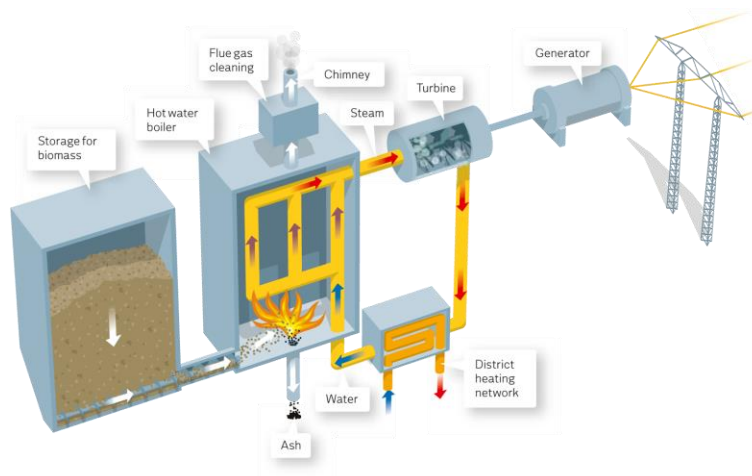
A high heat resistant bioplastic made from plant starch and polypropylene, with natural modifying agents added, for a range of applications.

Biomass energy

Introduction

Biomass energy allows for old coal power plants to be converted from burning coal to bioproducts. Although these products still release carbon dioxide into the atmosphere new ways to reduce this are being implemented and biomass is renewable. This means that with shortages of fossil fuels Biomass can keep the power grid on.

The process



Biomass works in the same way as coal, making it an easy replacement. The biomass is used to heat water to boiling point and the steam will turn the turbine. Often the fuel takes the form of wood pellets. This process involves compressing the wood (or other organic matter) into a dough like pulp. This pulp can then be hardened and used in power stations.

Task

With your group find your nearest power station and decide how you would supply it with biomass

- What materials are easily sourced in your local area, recycled wood, plants or organic materials?
- How would you transport the biomass, trains, trucks or boats? Remember to try and keep the carbon footprint low.
- What types of crops or wood are best to grow in the area to fuel the power station?
- How important is cost when taking into account biomass fueled power stations?
- What should be considered if building a new Biomass power plant?

Case studies

Kent biomass power plant

This plant will have a capacity of 27.8 MW of power (below average) and will be fueled by fresh UK wood. It will power 50,000 households and will deliver CO₂ savings of approximately 100,000 tonnes every year. It is still being built and the cost so far is estimated to amount to £160 million



Straw-fired biomass plant in Sleaford

This power plant will be fueled by straw, a practice which is common in Denmark amongst biomass power plants. It will be the second straw fired power plant in the UK. The capacity will be 38.5 MW and will have a cost of around £130 million pound. It will supply 65,000 homes and reduce CO₂ fumes by 250,000 tonnes a year.



Kaukaan Voima Oy Biomass-Fired Power Plant, Lappeenranta, Finland

Located in a heavily forested part of Finland this power plant will produce energy for nearby pulp and paper mills. Its wood fired boilers will allow it to have a capacity of 125MW of electricity. The new plant replaces an old gas fired power plant and will also help provide 85% of the total district heating consumed by residents and businesses in the city of Lappeenranta.



Cosmetics

Introduction

Bio cosmetics are skin care cosmetics made from natural products such as organic and biological crops. For a cosmetic product to be bio it has to meet the following characteristics:

- 99% ingredients are of plant origin and organic.
- All ingredients are natural so preservatives, dyes, silicones and other artificial are not part of the process.
- The product is not tested on animals
- The containers are recycled or recyclable.

Task

With your group think about how you could use bio materials to start a new cosmetics line. Read through the case studies and determine how your product can be classified as bio and still be effective.

- Can any of the ingredients for your new line be sourced locally?
- How would you market your new line demonstrating the advantages of Bio cosmetics?
- Read through the case studies, do you think all the claims can be scientifically proven and how can you ensure your product works?

Case studies

MADARA Nourish & Repair Shampoo

This shampoo contains Baltic herbal extracts, rose water, quince and nettle. With:

- Ingredients from Organic Farming
- Natural essential oils -
- 99% of the total ingredients are from natural origin
- 8% of the total ingredients are from Organic Farming



The packaging of this product is also made from recycled past consumer products to reduce plastic production.

Apricot kernel face scrub

This DIY cosmetic makes use of Apricot kernel powder which is formed from grinding dried apricot kernels. This powder is often used in beauty products due to its effect gentle abrasion to help clean the skin.



Deodorant Cream

This DIY cream is made using natural materials, reducing the environmental strain on the environment.

Ingredients:

- 30 g shea butter
- 10 g grape seed oil
- 3 tsp corn starch
- 3 tsp alum stone powder
- 5 drops tea tree essential oil
- 5 drops lavender essential oil

Process:

Melt the shea butter and grape seed oil by placing the two ingredients in a bowl and setting the bowl in warm water. Use a food processor to mix the alum stone powder and corn starch. Once the shea butter and grape seed oil have melted, add this liquid mixture to the corn starch and alum stone powder blend. Mix well. Leave the mixture to cool. Add the essential oils and mix once cooled.

All Natural Homemade Foundation Powder

Ingredients:

For the base:

Arrowroot Powder

Add one or a combination of:

Cocoa Powder

Ground Cinnamon

Nutmeg

Olive, or Almond Oil (optional)

Process:

1. Start with a base of arrowroot powder (1 tsp. for dark skin – 1 Tbs. for light skin)
2. Slowly add in one or combination of the cocoa powder, cinnamon, or nutmeg until you reach your desired tone.
3. If you want more of a “compact” foundation, add some jojoba/olive/almond oil to the mixture and press down into a compact. (Start with 5 drops and keep adding until it reaches your desired texture).

Use a brush to apply this homemade foundation. Make sure to tap off excess before swiping face.