BIOECONOMY TEACHING PACKAGE
TEACHER'S MANUAL WITH LESSON PREPARATIONS

BioBeo

Innovative education for the bioeconomy

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Background

What is Bioeconomy?

"In the bioeconomy, fossil fuels are replaced in a sustainable way by renewable biological sources – such as forests, plants, animals, fish, microorganisms, organic waste and agricultural by-products – to produce food for humans and animals, products of biological origin and energy in a sustainable and circular way. This means that, in principle, there is no waste. Waste materials are raw materials for new products. In principle, nothing goes to waste.

In order to achieve a sustainable and circular bioeconomy, attention must be paid to this in primary and secondary education, in higher education and scientific research, in technological and innovative industry with the aim of not only making the economy run, but also allowing ecosystems and biodiversity to flourish and improving the health and well-being of society. By changing the current economy and addressing the environment and society, the bioeconomy contributes to achieving a better and more sustainable future for all."

Themes of this teaching package: Sustainable circular bioeconomy, interconnectedness, outdoor learning, food loop, forestry, life below water

The storyline:

- The basic idea of the bioeconomy is to move away from an economy based primarily on fossil resources to an economy based on renewable biological resources.
- In the production (cultivation) of biological raw materials from plants, CO_2 is converted during photosynthesis into other carbon compounds that are stored in plants. Many organic raw materials can be produced and harvested within a year. Which is a huge advantage over fossil fuels, which have taken millions of years to form.
- In current production systems, stems, leaves and roots are often residual waste that is not of economic value. But this residual waste acquires economic value when it is composted or used as fuel in a biogas plant. The use of the material as a raw material for a biogas plant is called the "energy use" of biological raw materials.
- Forestry is part of the bioeconomy at several levels. Forests provide the air we breathe and are not only of recreational interest, but they are also the supplier of many biological materials in the bioeconomy. In addition, they are ideal locations to connect natural and urban environments. While forest products are becoming increasingly attractive from a sustainability perspective and are an important part of the circular economy, there are huge differences in the management of forestry activities around the world.
- The use of fossil raw materials is harmful because the total amount of greenhouse gas that is released cannot be removed from the atmosphere within a reasonable period of time, but remains in the atmosphere, leading to negative effects, such as climate change.

The way in which the bioeconomy is told can contribute, positively or negatively, to the changes needed to achieve a circular and sustainable bioeconomy.

The aim of this teaching package is to show students how the transition to a sustainable bioeconomy can best take place and which social actors play a role in this transition.

The subject matter is in line with the following Sustainable Development Goals (SDGs): 2, 3, 12, 13, 14, 15

This teaching package can be used for the age group: 12-15 years

This teaching package contributes to: acquiring the key competences in the field of sustainable development

The following themes are addressed in the bioeconomy:

	Interconnectedness ☒	**Interconnectedness** is about the influence that the natural environment (*biosphere*) has on human well-being and the ecological interconnectedness of all living things.
	Outdoor learning ☒	**Outdoor learning** is active outdoor learning where students learn by what they do, by what they encounter, and by what they discover.
	Food loop ☒	The **food loop** includes the agriculture, hospitality, retail and energy production sectors. The circular economy is all about reusing residual waste and reducing food waste.
	Forestry ☒	**Forest products** play a major role in a sustainable circular economy. Yet, there are huge differences in the management of forestry activities around the world.
	Life below water ☒	**Life below water** refers to the conservation and sustainable use of resources from oceans, seas, rivers, and lakes.

In this lesson package, these 5 themes of the bioeconomy are discussed. These themes can be covered in any order. The themes can also be taught as stand-alone lessons.

In this teacher's manual you will find 6 lesson preparations. In addition, a powerpoint presentation and worksheets are available for students with each lesson.

Have fun with this lesson package on the bioeconomy!

Learning objectives lesson: Sustainable circular bioeconomy

1. Students can define the sustainable circular bioeconomy.
2. Students can identify the benefits of the bioeconomy.
3. Students can discuss the challenges of the bioeconomy.

Learning objectives lesson: Interconnectedness

1. Students can define interconnectedness.
2. Students can provide examples of interconnectedness in the world around them.
3. Students will be able to define biotic and abiotic factors.
4. Students discuss the consequences of interconnectedness between organisms and their environment.

Learning objectives lesson: Outdoor learning

1. Students can measure abiotic factors in an environment.
2. Students can determine whether an environment has a lot of biodiversity.
3. Students get to know the different plants and animals in their environment.
4. Students are introduced to the idea that the natural world can be a source of inspiration for designing a product.
5. Students develop a sense of appreciation for nature.

Learning objectives lesson: Food loop

1. Students will be able to define the food loop and its different components.
2. Students can explain how a food loop works.
3. Students can determine their food print.
4. Students learn to reduce food waste.

Learning objectives lesson: Forestry

1. Students will be able to demonstrate the importance of forests to our planet and articulate our dependence on forest products in our technologically advanced society.
2. Students can discuss the challenges facing forests and the importance of sustainable forestry.
3. Students can make informed choices between products from certified forestry and non-certified forestry.

Learning objectives lesson: Life below water

1. Students can explain what the blue bioeconomy means.
2. Students can give examples of blue bioeconomy products.
3. Students can discuss the importance of protecting life below water and get to know seaweed as food.

Introductory lesson: Sustainable circular bioeconomy

Topic: Bioeconomy	Lesson title: Sustainable circular bioeconomy No. of lesson 1 of 6	
Date:	Class:	Duration: 50 minutes
BioBeo Theme: All	Key words: Circular economy	

Learning Outcomes:

1. Students can define the sustainable circular bioeconomy.
2. Students can identify the benefits of the bioeconomy.
3. Students can discuss the challenges of the bioeconomy.

Resources/Materials/Equipment:

- Prerequisites: Students have heard of terms such as "raw materials", waste and waste disposal by incineration, recycling.
- Whiteboard or projector
- Pens, markers
- Paper
- PowerPoint presentation on the sustainable circular bioeconomy (see Annex 01)
- Worksheet on the sustainable circular bioeconomy (see Annex 02)
- Internet access, to show the YouTube video (in English, subtitles can be set):
  - Circular economy: a new perspective on progress
  - Blue Hero
- If possible, use an online quiz platform (such as kahoot) so that students can answer via their mobile phones and the lesson becomes more interactive.

Start of the lesson:

1. Ask students to take something out of their pencil case. Ask them to answer the following questions:
   - What are the products made of?
   - What is the lifespan of a product?
   - What happens to the product after use?

   (Assignment 1, Appendix 02)

Continuation of the lesson:

2. Show the video Sustainable circular bioeconomy: rethinking progress. This film is about circular consumption (this is about circular systems, no raw material is lost). Let students write down in their own words what they mean by a sustainable circular bioeconomy (assignment 2, appendix 02).
3. Project the definition and explain that the sustainable circular bioeconomy is an alternative to the traditional linear economy, which is based on the 'take, make and dispose' model. In a circular economy, raw materials are kept in use for as long as possible and waste is minimised.
4. Show the second video Blue hero which is about making new products from recycled materials. Let students answer a few viewing questions (assignment 3, appendix 02).
5. Discuss the task done and ask students to think about ways to apply the principles of circular economy to their own lives. For example, they can:
   - Buy products made from recycled materials
   - Repair broken items instead of replacing them
   - Compost food scraps

Conclusion:

6. End the lesson with a quiz via the PowerPoint (or convert it into a kahoot).
7. Discuss (a selection of) quiz questions and check whether everyone has understood what the correct answer is. Explain that sustainable circular bioeconomy focuses on the use of biological raw materials and that waste is used as a reusable raw material. The bioeconomy guarantees a sustainable and healthy future for the planet and all life on it. Each of us must choose and use food, energy and products wisely and prudently for the sake of our planet.

Means of evaluation:

- Students can be assessed on their ability to define sustainable circular bioeconomy, identify its benefits and think of ways to apply the principles of the circular bioeconomy to their own lives.

Variations of the lesson:

Differentiation:

- Offer students who need extra support more photos and information about sustainable circular bioeconomy.
- Let students who need a challenge explore a specific example of sustainable circular bioeconomy and present their findings to the class.

Expansion activities:

- Play the game "Resources don't go".
- Let students create a poster or presentation about the benefits of sustainable circular bioeconomy.
- Let students write a letter to a local government about the need to support sustainable circular bioeconomy.

Quiz questions

Below are the quiz questions, the correct answer is in bold and below the question is an explanation of the correct answer.

1. What does the word 'organic' mean when we talk about an organic product?
   A. That the product is easy to recycle
   B. That the product can be composted
   C. That the product is made from fossil raw materials
   D. **That the product is made from renewable raw materials**

The term biobased refers to the fact that a product consists entirely or partly of renewable materials from nature such as trees, plants or animals.

2. What is the best description of a biobased economy?
   A. An economy that is no longer completely dependent on fossil raw materials
   B. **An economy that runs on biomass as a raw material**
   C. An economy that is fully circular
   D. An economy in which we only generate energy through solar panels and wind turbines

A biobased economy is an economy in which biomass is the raw material. Biomass is a raw material that is renewable and ensures that we no longer need fossil raw materials.

3. What are some examples of biomass?
   A. Sand, water and lime
   B. Stone, steel and magnesium
   C. Trees, fruit and petroleum
   D. **Wood, manure, grass**

Wood, manure, and grass are all forms of biomass. These raw materials are renewable and will continue to be available on earth for the foreseeable future.

4. Are biobased products biodegradable?
   A. **No, not all biobased products are biodegradable by definition**
   B. No, biobased products are never biodegradable
   C. Yes, biobased products are always biodegradable
   D. Yes, but only bio-based products made from plants are biodegradable

Biobased products are not always biodegradable. Although they are made from biomass, it does not always mean that they can also be broken down in nature. Depending on the biobased product, this may or may not be biodegradable.

5. What is a circular economy?
   A. An economy in which we only use biobased raw materials
   B. An economy in which only wind turbines are used to generate energy
   C. An economy in which we no longer use fossil raw materials
   D. **An economy of closed cycles in which raw materials, components and products lose their value as little as possible.**

In a circular economy, raw materials are recovered and reused as much as possible after use. This is in contrast to a linear economy in which many raw materials are still lost because they are burned.

6. Why do we want to reduce CO_2 emissions in particular?
   A. Because CO_2 is bad for human health
   B. **Because CO_2 emissions cause an enhanced greenhouse effect**
   C. Because CO_2 emissions cause biomass to grow less quickly
   D. Because CO_2 emissions cause pollution of industrial sites

We want to limit CO_2 emissions mainly because it stimulates the increased greenhouse effect. Without global warming, humans would not be able to live here, but the amplified effect causes climate problems with all the consequences that entails.

7. Which cycle doesn't exist?
   A. The water cycle
   B. The carbon cycle
   C. The nitrogen cycle
   D. **The metal cycle**

The metal cycle is a non-existent cycle. Of course, metal can be recycled, but this is not what we mean by recycling. The earth system does have the water cycle, the carbon cycle and the nitrogen cycle.

8. How should we deal with discarded electronics in a circular economy?
   A. We have to take discarded electronics to the recycling centre
   B. **We need to recycle end-of-life electronics where the raw materials can be used in new products**
   C. We need to throw away discarded electronics and buy a new replaced product
   D. We don't need to use electronics anymore

By returning discarded electronics to the right delivery points, this can also be the recycling park, the electronics can be recycled in the right way so that as many raw materials as possible can be recovered to be reused in other products.

9. How do we achieve a circular economy?
   A. By a number of producers who ensure that their product is circular
   B. **Through collaboration between all the connected companies and institutions that together shape our infrastructure and economy**
   C. By making transport more sustainable worldwide
   D. By ensuring that all the energy required is generated sustainably

In order to achieve a circular economy, it is necessary for large-scale cooperation between all kinds of parties, raw material suppliers, producers, transporters, recycling companies, et cetera.

Literature and links

European Environment Agency, "The Circular Economy and the Bioeconomy. Partners in Sustainability", EEA (2018) Report No. 8. https:// www.eea.europa.eu/publications/circular-economie and bioeconomy

Centre of Expertise for the Biobased Economy (CoE BBE). https://www.coebbe.nl/

Flanders Circular. https://vlaanderen-circulair.be/nl/kennis/publicaties/download-2/educatieve-brochure-materials-cycles-close

Lesson: Interconnectedness

Topic: Interconnectedness	Lesson Title: Interconnectedness No. of lesson 2 of 6	
Date:	Class:	Duration: 50 minutes
BioBeo Theme: Interconnectedness	Key words: Interconnectedness	

Learning Outcomes:

1. Students can define interconnectedness.

2. Students can provide examples of interconnectedness in the world around them.

3. Students will be able to define biotic and abiotic factors.

4. Students discuss the consequences of interconnectedness between organisms and their environment.

Resources/Materials/Equipment:

- Whiteboard or projector
- Pens, markers
- Paper
- PowerPoint presentation on interconnectedness (Annex 03)
- Worksheet on interconnectedness (Annex 04)
- Internet access to show YouTube movies:
  - "Observing a tree (= observing a tree)": https://www.youtube.com/watch?v=VTAh8RpKXmI (or if you're outside: observe a real tree).
  - "Woodlice" (in English, subtitles can be set): https://www.youtube.com/watch?v=kKKxKK1fq90 (or when outside: observe real woodlice).

Start of the lesson:

1. We are going to do a mindfulness exercise with students. This is an exercise in which students pay attention to everything that is happening in and around them at that moment. These can be emotions, sensory experiences, or certain thoughts.
   Ask students to stand up and move very slowly from heel to toe, without moving, while they watch the movie "Observing a tree" (or if you're outside, observe a real tree).

2. Students silently observe what the tree looks like. Look at the trunk, the branches, and leaves. Observe if the tree is stationary or moving. Can you hear it? Just be still and observe these things.

3. While observing, take a few deep breaths and be aware of how you feel.

4. What struck you and what did you experience? By being still and calm, we can perceive what is going on inside us (what we feel, smell, see, whether it is cold or hot, how the wind feels on our skin, how the ground feels under our feet..).

5. We can also observe what is going on inside us (what we think at that moment: it strikes me that this lesson is a bit different from other lessons, it strikes me that I don't get it, it strikes me that I think this is a fun exercise, it strikes me that I have thoughts, it strikes me that I can perceive my thoughts).

   Explain that students have now practiced a little mindfulness. By being mindful, we can connect well with the world around us.

Continuation of the lesson:

6. Observe the drawing of the river. Let students describe what "interconnectedness" they can see (Assignment 1, Appendix 04). They can e.g. Note that the tree gnawed by the beaver is a resting place for birds. Interconnectedness is not only about the interconnectedness of all living beings, but also about the influence that nature has on humans (and vice versa).

7. Give some examples of interconnectedness, such as the way nature can calm people or how human activity affects the earth's climate or the way one country's economy can affect another country's economy. Let students give examples, too.

8. The river landscape is an ecosystem, a natural system consisting of the biological interactions between all organisms that occur in a given area, and the interaction between these organisms and their non-living (= abiotic) environment. Biotic factors are the living organisms in an ecosystem and their interactions with each other and with the environment. This includes plants, animals, fungi, bacteria, and other microorganisms.
   Abiotic factors are the non-living components of an ecosystem that affect the life processes of organisms. These factors include things like temperature, light, humidity, soil composition, air quality, water availability, and geographic features such as elevation and soil conditions. Let students define biotic and abiotic factors in their own words and write down some examples of them (Assignment 2, Appendix 04).

9. Now go outside to establish interconnectedness in nature. Search the school environment for a stone to move, a dead branch of a tree, etc. Try to push the stone or a piece of bark away from the branch. Do you see animals? How do they react when you take their "protection"? What changes do you cause when you remove the bark?
   Instead of going outside, you can also show the YouTube video about "woodlice". Let students complete assignment 3 (Appendix 04).

10. Go back inside and try to find more examples of interconnectedness:
    - Divide students into small groups and have them brainstorm about examples of interconnectedness (Assignment 4, Appendix 04).
    - After a few minutes, invite each group to share their examples with the class.
    - As students share their examples, write them on the board.
11. Consequences of interconnectedness. Once students have generated a list of examples, discuss the "bigger" consequences of interconnectedness, such as:
    - The way interconnectedness can lead to problems, such as climate change.
    - The way in which this interconnectedness can also lead to solutions, such as international cooperation to tackle climate change.
    - The way in which this interconnectedness can make us more aware of our impact on the world around us.
    - Let students individually think about the consequences of interconnectedness for themselves, their immediate environment, and for the planet. Let them write down the answers (Assignment 5, Appendix 04).

Conclusion:

12. Humans are part of the natural world, and connecting to it is important – for our own well-being, our understanding, and to inspire us to protect nature. Humans have an impact on the natural world around them on a small scale (disrupting woodlice) and on a large scale (climate change). Ask students to think about the implications of interconnectedness for themselves, for their immediate environment, and for the planet. As inspiration, use the five key ways to improve our relationship with nature: contact, emotion, beauty, meaning, and compassion. Examples of the five ways to improve our relationship with nature are:
    - Seeking sensory contact with nature: By spending time in natural environments and using our senses, we can experience a deeper connection with nature. This can range from feeling the wind on our skin, smelling flowers, listening to birdsongs, to tasting fresh fruit straight from the tree.
    - Perceiving emotions that nature arouses in us: Nature can evoke various emotions in us, such as peace, hope, and awe. By consciously reflecting on these feelings, we can deepen our appreciation for the natural world and feel more connected to it.
    - Perceiving Beauty: Consciously perceiving the beauty in nature, such as a beautiful sunset, the delicate details of a flower, or the majestic sight of a mountain, can help us to appreciate the value and wonder of nature more.
    - Seeking meaning: Nature is full of symbolism and meaning. The first spring bloomers can remind us of new life and hope, while falling leaves can help us reflect on letting go and renewal. By seeking meaning in the natural cycles and phenomena, we can feel more connected to the world around us.
    - Feeling and showing compassion for nature: By developing empathy and care for nature, we can form a deeper connection. This means not only treating the environment with respect, but also actively participating in its conservation and protection. By feeling and showing compassion, we contribute to a mutually respectful relationship with nature.

Means of evaluation:

Students may be assessed on their ability to:

- define interconnectedness.
- give examples of interconnectedness in the world around them.
- describe the consequences of interconnectedness between individuals, their environment and with the planet.

Variations of the lesson:

Differentiation:

- Give students who need extra support post-its to help them organise their thoughts on interconnectedness.
- Let students who need a challenge research a specific topic related to interconnectedness, such as the impacts of climate change on the food chain.

Expansion activities:

- Let students create a poster or presentation about the importance of interconnectedness.
- Take students on a field trip to park or other neighbourhood green space to observe interconnectedness of organisms in nature.
- Let students find out how environmental organisations are committed to protecting nature and how they can do their part.

Literature and links

Outdoor lesson day. https://www.buitenlesdag.nl/buitenlessen/ (in Dutch)

Outdoor learning: in health education. www.outdoorsvictoria.org.au (direct link to the Teachers' Toolkit)

Wilson, C., 2011. "Effective Approaches to Connecting Children with Nature". Publishing Team, Department of Conservation, PO Box 10420, The Terrace, Wellington 6143, New Zealand, 20 p.

Richardson, M., & Butler, C.W. (2022). The Nature Connection Handbook: A Guide to Increasing People's Connection to Nature. United Kingdom. https://findingnature.org.uk/wp-content/uploads/2022/04/the-nature-connection-handbook.pdf

Lesson: Outdoor Learning

Subject(s): Outdoor learning, biomimicry	Lesson Title: Outdoor Learning No. of lesson 3 of 6	
Date:	Class:	Duration: 50 minutes
BioBeo Theme: Outdoor Learning	Key words: Outdoor learning, biomimicry	

Learning Outcomes:

1. Students can measure abiotic factors in an environment.
2. Students can determine whether an environment has a lot of biodiversity.
3. Students get to know the different plants and animals in their environment.
4. Students are introduced to the idea that the natural world can be a source of inspiration for designing a product.
5. Students develop a sense of appreciation for nature.

Resources/Materials/Equipment:

- Access to a green space around the school, a park or forest nearby.
- PowerPoint presentation on Outdoor Learning with Examples of Biomimicry (Appendix 05).
- Outdoor Learning Worksheet (Appendix 06)
- Pencils
- Mobile phone with the app "obsidentify" installed (Google Playstore or Apple) or field guides
- Loupes
- Instruments (if available) for measuring abiotic factors: sound meter, light meter, humidity meter, thermometer, penetrometer, wind speed meter

Start of the lesson:

1. Go with the students to a green space around the school, such as a park or forest nearby.
2. Let students formulate a hypothesis about whether the environment they are in is biodiverse (Assignment 1, Appendix 6).

Continuation of the lesson:

3. Divide students into groups of 3 to 4 and have them measure the abiotic factors of the environment. Also ask them to give an example of abiotic factors that affect biodiversity (assignments 2 and 3, annex 06).
4. Let students look for different types of animals and plants. Let them use the "Obsidentify" app or field guides to identify the plants and animals they have found (assignments 4 and 5, appendix 06).
5. Let students answer the research question and complete the remaining assignments (assignments 6-8, Appendix 06). Encourage students to be inventive!

Conclusion:

6. After students have completed the worksheet return to the classroom.
7. Discuss the assignments and write down the ways to make the scene environment more biodiverse at the board.

Means of evaluation:

- Assess students' observability as they explore nature.
- Review students' completed worksheets.
- Discuss students' understanding of biomimicry.

Variations of the lesson:

Differentiation:

- Give struggling students more support during the observation activity. Help them identifying plants and animals.
- Let students who need a challenge identify plants and animals that are less easy to find. You can also have them write a short report about their findings.

Expansion activities:

- Let students draw the plants and animals they have found.
- Let students work out a proposal to create a (school) garden.

Literature and links

Education in engineering.
https://www.teachengineering.org/activities/view/cub_lifescience_lesson03_activity2

World Wide Fund for Nature. Inspiration from nature. https://www.wwf.org.uk/get-involved/schools/inspiration-van-de-natuur#bronnen

Lesson: Food loop

Topic: Food loop	Lesson Title: Food Loop No. of Lesson 4 of 6	
Date:	Class:	Duration: 50 minutes
BioBeo Theme: Food Loop	Key words: Food loop	

Learning Outcomes:

1. Students will be able to define the food loop and its different components.
2. Students can explain how a food loop works.
3. Students can determine their food print.
4. Students can give a number of tips to prevent food waste.
5. Students can create their own recipe with food scraps.

Resources/Materials/Equipment:

- Whiteboard or projector
- Pens, markers
- PowerPoint presentation on food loop (Annex 07)
- Internet access to show the YouTube video:
  - FAO Better food production (no narration, text in English)
  - T-shirts made of milk (in English, subtitles can be set)
- Food Loop Worksheets (Appendix 08)

Start of the lesson:

1. Start by showing an image about food waste and discuss it with students. Let students write down their own food waste (Appendix 8, Assignment 1).

2. Unlike humans, nature does not produce waste. In nature, there are food relationships between different organisms, the so-called food loop. Explain how food loops work. Producers make their own food, consumers eat producers, and reducers break down dead organisms. Let students come up with their own food loop and have them note that, unlike nature, humans do waste food (assignments 2-3, appendix 08).

Continuation of the lesson:

3. Sustainable food: how can you eat more sustainably? In this assignment, students come into contact with seasonal products and learn to waste as little food as possible. Let them complete the worksheet assignments on their own (Appendix 8, assignments 4-7).

4. Towards a sustainable bioeconomy. Show the FAO Better food production video and ask students to write down the examples of better food production they have seen (Assignment 8, Annex 08).

5. Bioeconomy in agriculture. Use the PowerPoint presentation to discuss the bioeconomy in agriculture, in which raw materials are processed into products and waste is returned to nature (used as a raw material).

6. T-shirts made with waste milk: Use the PowerPoint presentation to discuss an example from the bioeconomy where wasted food is used as a raw material for a product. In this case, milk from which a T-shirt is made.

Conclusion:

7. 8 steps to consume more sustainably: Conclude the lesson by asking students to think about how they can consume food more sustainably and contribute to a sustainable bioeconomy in terms of food consumption.

Means of evaluation:

- Let students define a food loop and name the different parts of a food loop. Let students explain how a food loop works and have them discuss the effects of environmental pollution, climate change, etc. on food loops.

Variations of the lesson:

Differentiation:

- Let students who need more support look up food loops on the internet.
- Let students who need a challenge discuss a specific food loop and have them present their findings to the class.

Expansion activities:

- Let students create a model of a food loop.
- Let students write a poem or story about a food loop.
- Let students research a food loop.

Literature and links

Biomass waste engineer to put an end to microplastics - Mi Terro. https://www.miterro.com/

Food and Agriculture Organization of the United Nations https://www.fao.org/home/en

Food Education | Nutrition Centre https://www.voedingscentrum.nl/professionals/gezond-op-school.aspx

Lesson: Forestry

Topic: Biology, Ecology	Lesson title: Enjoying the forest and forest products now and in the future No. of lesson 5 of 6	
Date:	Class:	Duration: 50 minutes
BioBeo Theme: Forestry, Interconnectedness, Circular Economy	Key words: Forestry	

Learning Outcomes:

1. Students will be able to demonstrate the importance of forests to our planet and articulate our dependence on forest products in our technologically advanced society.
2. Students can discuss the challenges facing forests and the importance of sustainable forestry.
3. Students can make informed choices between products from certified forestry and non-certified forestry.

Resources/Materials/Equipment:

- Whiteboard or projector
- Pens, markers
- PowerPoint presentation on forestry (Annex 09)
- Worksheet on Forestry (Appendix 10)
- Internet access to show YouTube movies:
  - "The importance of forests (= the importance of forests)": https://youtu.be/_dWJVHIE9S8 (in English, subtitles can be set)
  - "Threats to forests (= Threats to forests)": https://www.youtube.com/watch?v=EmyO4lrBGfw&t=91s (in English, subtitles can be set)
  - "Old growth forests (= Old growth forests)": https://www.youtube.com/watch?v=XIs0W0IQsos (in English, subtitles can be set)
  - "Sustainable forestry (= Sustainable forestry)": https://www.youtube.com/watch?v=n5DZlyhHQqo (in English, subtitles can be set)

Start of the lesson:

1. Ask students what their relationship is with the forest. When and how often do they go to the forest? Are there woods near the school, or close to their home?
2. What products from the forest do they use? Which examples can they give (directly from the forest, but also wood products and products from the paper industry or boards for the construction industry).
3. What do they know about forest management? Are trees being cut down in the forests that students are familiar with? Do they know people who work in forestry?

Continuation of the lesson:

4. Watch the video about THE IMPORTANCE OF FORESTS (by ECOSIA) (6 min)
5. Discuss the importance of forests to the earth. Forests provide a home for a wide variety of plants and animals, help regulate the climate, and provide clean air and water. In addition, forests are home to many non-timber forest products such as medicinal plants, berries and mushrooms that are harvested in many countries and are a significant source of nutrition. Forests are also important for humans as recreational areas, and as places where people can experience the (wild) power of nature.
6. Discuss forestry as the management of forests for timber production (e.g. planks, wood pulp), recreation (e.g. hiking area) and other purposes (e.g. mushroom production). Let students complete the first worksheet (Appendix 10).
7. Watch the video on THREATS TO FORESTS (by PEFC) (1.50 min)
8. Discuss the challenges faced by forests. Forests are destroyed by deforestation and fragmentation as new roads are built that require forests to be cut down. Forests are also being cut down for the sake of urbanisation, agriculture, and mining. Climate change also threatens forests because global warming allows pests, diseases, and invasive species to spread and harm native tree species. The destruction of native species makes forests more vulnerable and harms biodiversity.
9. Watch the video about ANCIENT GROWTH FORESTS (by Ancient Forest Alliance) (3 min)
10. Also discuss the impoverishment of biodiversity when old growth forests are cut down. After all, young forests take centuries to bring biodiversity back to the level of the old forest. Sustainable forestry means protecting old-growth forests with a lot of biodiversity, replanting trees after they have been cut down.
11. Watch the video on SUSTAINABLE FORESTRY (by PEFC) (1.33 min)

12. Discuss the importance of sustainable forestry. In a sustainable forest, felled trees are replaced, so that forests continue to exist in order to continue to provide us with natural materials. Sustainability is the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs. Further, sustainable forestry is about promoting selective logging rather than clear-cutting that is devastating to the ecology of the area. Discuss the importance of the renewable nature of forests. Discuss the prevention of unilateral tree planting (monoculture) and discuss that sustainable forest management promotes biodiversity, which better protects forests against pests and diseases.
13. What wooden and non-wooden products do you have at home? Discuss forestry and forest products and make the link with employment. Let students complete the worksheet (Appendix 10).
14. Discuss the health and well-being benefits of exercising in a forest: exposure to forest microbes improves human immunity, the air is often cleaner in the forest, the fractal patterns of tree canopies and the colour green have a relaxing effect on our nervous system. Discuss the recreational opportunities that forests offer.

Conclusion:

15. Discuss the importance of making sustainable choices that have a positive impact on life on earth.
16. Let students think about how they can actively contribute to sustainable forest use and sustainable use of wood and non-wood forest products. Let students complete the final worksheet (Appendix 10).

Means of evaluation:

- Observe student participation in class discussions.
- Have the answers written down on a sheet of paper and grade them.

Variations of the lesson:

Differentiation:

- Invite students who find the subject matter difficult to look up background information and give them more time to complete the lesson activities.
- Let students who need a challenge research a specific topic about forestry or sustainability. How has the forest cover in their region changed over the past centuries? What are the most invasive species in their area and where do they grow? Do they pose a risk to forest species?

Expansion activities:

- Let students create a summary after showing a video. This may replace the planned group discussion.
- Let students make a list of all the wood and non-wood forest products they use in their homes.
- To strengthen the emotional connection with the forest, ask students to reflect on their experience of being in a forest. How do you feel after being in a forest? What does your favourite forest look and feel like?
- Let students plant a tree or volunteer with a local environmental organisation.
- Let students write a letter to their policy person about the importance of sustainable forestry.

Literature and links

The importance of forests: https://www.youtube.com/watch?v=_dWJVHIE9S8&feature=youtu.be

Forests are under threat: https://www.youtube.com/watch?v=EmyO4lrBGfw&t=91s

Old-growth forests versus second-growth plantations: https://www.youtube.com/watch?v=XIs0W0IQsos

City of Trees: Inspiration kit for teachers and students about the importance of urban trees and forests https://clearinghouseproject.eu/city-of-trees/

Importance of forests: https://wwf.panda.org/discover/our_focus/forests_practice/importance_forests/

Responsible forest management: https://www.worldwildlife.org/industries/responsible-forestry

Bioeconomic potential of non-timber forest products: https://www.youtube.com/watch?v=8XIBfJtLa70

Lesson: Life below water

Subject(s): Life below water	Lesson Title: Life below water No. of lesson 6 of 6	
Date:	Class:	Duration: 50 minutes
BioBeo Theme: Life below water	Key words: Life below water	

Learning Outcomes:

1. Students can explain what the blue bioeconomy means.
2. Students can give examples of blue bioeconomy products.
3. Students can discuss the importance of protecting life below water and get to know seaweed as food.

Resources/Materials/Equipment:

- Whiteboard or projector
- Pens, markers
- PowerPoint presentation on Life below water (Appendix 11)
- Internet access to show the YouTube video Blue (bio-)economie (in English, subtitles can be set).
- Worksheet on Life Below Water (Appendix 12)
- Mobile phone/laptop/PC to watch the videos

Start of the lesson:

1. Start by showing a picture of sushi and have a teaching-learning conversation with your students: Who has ever eaten this?, What is this?, What are the ingredients?, What holds the rice together? With this image you connect with the world of the students. After all, most students know sushi, but don't really think about the fact that seaweed is one of the ingredients. Moreover, this way you have a stimulating start to the lessons.

   The rice in sushi is held together by seaweed. Seaweed is a raw material from the sea.
   In the blue bioeconomy (the bioeconomy of water), raw materials from the water are used sustainably for economic profit and employment while the water is not depleted.

2. Show the Blue (bio-)economy video and let students write down in pairs which products from the fishing industry they know. Students record their answers on the worksheet (Assignment 1, Appendix 12).

   The idea here is for students to think about what raw materials are available in fisheries. Students will name the most obvious examples here. The idea is that you come back to this at the end of the lesson and show students that there is a much wider range of products from fisheries/aquaculture.

Continuation of the lesson:

3. Divide the class into 4 groups. Each group starts in one of the 4 corners of the class. For each corner, students will be shown a YouTube video in which they have to answer a number of questions.

   Will we soon be eating seaweed from the North Sea? Seaweed as a meat substitute/salt substitute: https://www.youtube.com/watch?v=KOiKITXFeEk

   Algae Blooms, algae as a basic raw material for clothing: https://www.youtube.com/watch?v=Kih7YQA9uao

   Ohoo, packaging made from brown seaweed and plants: https://www.youtube.com/watch?v=KppS7LRbybw

   Marinatex, compostable plastic made from fish waste: https://www.youtube.com/watch?v=AHKaChoCDW8

   Goal: Students learn in a self-directed way about the different raw materials that come from fishing and what different applications there are. The intention is that through these exercises, students will think out of the box and will see that there are many other applications of fishing.

   Method: During the corner work, students are given 5 to 10 minutes per corner to complete the assignment. The assignments are listed in the worksheet (assignment 2, appendix 12).
   As soon as each corner is finished, students move clockwise.

   Supplies: worksheets, writing materials and a mobile phone/laptop/PC to watch the videos.

Conclusion:

4. Conclude the lesson by briefly going over the worksheets.

5. Finally, let students complete assignment 1 individually (Assignment 3, Appendix 12). Students complete their initial list of products they learned during this lesson. If necessary, have a short teaching-learning conversation: Which raw materials from fishing have you come to know? Why is aquaculture sustainable?

Means of evaluation:

- Students may be assessed on their participation in class discussions and/or the extent to which worksheets have been completed.

Variations of the lesson:

Differentiation:

- Let students who want to be challenged research a topic of their choice about life below water. Like, for example, the impact of climate change on life in the ocean.

Expansion activities:

- Make seaweed pesto with students (as group work or as a demonstration practical).
  Seaweed is a plant-like organism that is commonly found on the coast, it is attached to rocks, does not need fresh water and, unlike other crops, is almost completely edible.
  For seaweed pesto you will need (per 20 students): 40g wakame or kombu, 50g pine nuts, 1 clove of garlic, 25g basil, 25g arugula lettuce, 25ml extra virgin olive oil, 1/2 tablespoon lemon juice.
  Have a report made of the seaweed practicum.
  With this teaching method you make the applications of seaweed very tangible for students. In this way, you can increase the motivation of students.
  If you make the pesto in advance, you can also use it as a lesson start and simply let students taste it (instead of showing the sushi)
- Let students write a story about an animal that lives in the ocean.
- Let students make a presentation about life in the water (a pond, lake, sea, ocean).

Literature and links

EOS Magazine. https://eostrace.be/traces/trace-van-zeewier

Wageningen University & Research. https://www.wur.nl/nl/Dossiers/dossier/Dossier-Zeewier.htm