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| Activity plan | | | |
| ACTIVITY PLAN | | | |
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| **Theme** | **Subtopic** | **Activity Title** |
| 1. Environmental Awareness and Conservation | * 1. Waste Management and Recycling | Cycle of biomass |

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| Introduction part (or activity overview) |
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| **Introduction part (or activity overview)** | Deepen students' understanding of biomass as a renewable energy source and how environmental waste can be used to generate thermal energy. Initiate students to think and discuss about the biomass cycle and how the use of biomass as a renewable energy source contributes to a cleaner environment. This topic is not just about scientific principles; it's about paving the way for a sustainable and cleaner future. |
| **SETTING** | Classroom |

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| Materials Needed |
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| **Materials Needed** | Computer (phone or tablet can be used to collect information), Biomass cycle poster (it can also be digital), video presentation equipment, flip charts, markers |

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| **Learning** Outcomes | * Understanding the concept of biomass and its various forms, including organic materials from plants and animals. * Identifying different sources of biomass and their characteristics. * Understanding the biomass cycle, detailing the stages from production to decomposition. * Recognizing the environmental impact of traditional energy sources and the need for sustainable alternatives. |  |
| **Activity Contents** | **ACTIVITY 1 (65minutes) : How the biomass cycle works?**  *Introduction discussion*: (10 minutes)  Students, through brainstorming, list all the forms of biomass they know (animal and plant waste, wood waste, urban waste, etc.), the teacher writes them down on a flip chart.  ***Theoretical part 1 (****15 minutes)*  The teacher explains to the students that biomass has been in use since people first began burning wood to cook food and keep warm. Wood is still the largest biomass energy resource today. Other sources include food crops, grassy and woody plants, residues from agriculture or forestry, oil-rich algae, and the organic component of municipal and industrial wastes. Even the fumes from landfills (which contain methane, the main component in natural gas) can be used as a biomass energy source.  Students then watch a short video about biomass:  Video: **“Biomass energy basics”**  <https://www.nrel.gov/research/re-biomass.html> (duration 3minutes 22 seconds)  Overview: An educational video designed to provide foundational knowledge and understanding of the fundamental concepts related to biomass energy.  *Theoretical part 2 (5 minutes)*  The teacher explains to the students that biomass, depending on its type and composition, has a certain accumulated energy as a result of photosynthesis. This energy is usually converted into thermal and chemical, and further into mechanical and electrical.  *Task 1 (20 minutes)*  Students form 4 groups and discuss the cycle of biomass energy shown on the poster (it can be printed or in digital form <https://www.shutterstock.com/image-vector/biomass-energy-landscape-poster-useful-infographics-2149391247>), also what its benefits are for ecology. Researching using digital sources, students should be able to describe the cycle of biomass and complete the group activity sheet (Appendix 1).  *Theoretical part 3 (5 minutes)*  After the students in groups exchange their thoughts about the cycle of biomass, the teacher plays videos about this process:  Videos:  “**Bioenergy, forests and carbon sinks - Bioenergy explained**“  <https://www.youtube.com/watch?v=gUfJfHph-zk> (duration 1minutes 26seconds)  Overview: This video sheds light on where biomass used for bioenergy comes from. The industry makes use of residue and wood that cannot be used in other sectors as a source of energy. As part of sustainable forest management, bioenergy provides energy, rural development, GHG emission reductions and increased forest resilience.  **“How Biomass works”**  <https://www.youtube.com/watch?v=-jln6yi7LF0> (duration 3minutes 23 seconds)  Overview: Аn educational video that aims to explain the basic mechanisms and processes involved in the utilization of biomass for energy production and the biomass cycle.  *Reflection: (10 minutes)*  After watching the videos, the students correct their answers in the sheet if, after the theoretical part, they noticed or learned something new, with which they self-evaluate their work. After completing this activity, students are encouraged to think about what each individual could and would like to do for a more sustainable biomass cycle.  **ACTIVITY 2 (35minutes) : Calculation of moisture content of biomass**  ***Theoretical part 1*** *(5 minutes)*  The teacher explains to the students that the thermal power and energy efficiency of different types of biomass depends, among other things, on the humidity of the biomass itself, which can be calculated with a formula.  *Task 2 (20 minutes)*  Using the dry and wet mass value data of several types of biomass and using a formula, each student individually calculates the moisture content of each of the biomasses and completes the individual work sheet (Appendix 2) .  *Task 3 (10 minutes)*  Аfter completing the calculations for the humidity of the different types of biomass, students discuss which type of biomass is most suitable for processing from an energy point of view, and which one from an environmental point of view. |  |
| **Assessments** | Verbal feedback during class;  Conversation with/among students;  Monitoring of students during group work;  Evaluation of the thoroughness and accuracu of individual work;  Each student self-assesses his contribution to the work; |  |
| **Key Competences** | * Cognitive competence * Creativity competence * Communication competence * Social, emotional and healthy living competences * Digital competence |  |
| **Connections with Eco STEAM** | **Eco**- The production and use of biomass other than as a renewable energy source can affect a variety of ecosystem services, including soil fertility and water quality.  **S**cience: Fuels, renewable energy sources and their conversion into thermal energy.  **T**echnology: Students will learn how biomass combustion plants work.  **E**ngineering: Students can design biomass burning plants and waste recycling devices.  **A**rt: Students can draw the biomass cycle.  **M**ath: Students perform various mathematical calculations to find out the moisture content of different types of biomass. |  |
| **References** | * Physics textbook for high school education in the Republic of Nort Macedonia * Dr. Ilija J.Petrovski, B.Sc. M.Sc., STEAM BOILERS 2004, Education Skopje * Dr. Emil Zaev, Biomasa 2017, UKIM Skopje * <https://www.ea.gov.mk/chesto-postavuvani-prasha%D1%9Aa/za-obnovlivi-izvori-na-energi%D1%98a/> |  |
| **Notes** | •Students can apply knowledge of the biomass cycle to propose solutions for waste management and energy production.  • Developing strategies to optimize the use of biomass while minimizing the impact on the environment. |  |

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| Appendix 1. STUDENT'S GROUP ACTIVITY SHEET |
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| Research Aspects | Describe the biomass cycle by answering the questions | |
| What is the process of biomass? |  | |
| List at least 4 types of biomass! |  | |
| What is the carbon cycle and biomass? |  | |
| How does the cycle of biomass energy work ? |  | |
| Team members : | | |
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| Appendix 2. TABLE OF VALUES FOR STUDENT'S INDIVIDUAL WORK |
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| Type of biomass | Mass of freshbiomass (kg) | Mass of dry biomass (kg) |
| Wood shavings | 100 | 70 |
| Corn straw | 200 | 120 |
| Clover | 150 | 90 |
| Acacia | 80 | 50 |
| Sugar cane | 300 | 180 |
| Formula for moisture calculation:  Moisture (%) = ((Mass of fresh biomass - Mass of dry biomass) / Mass of fresh biomass) \* 100 | | |

**Assessment Table for individual work:**

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| Assessment Criteria | Points | Comments |
| Understanding the biomass cycle and active involvement in teaching | \_\_/5 |  |
| Мoisture calculations of biomass types | \_\_/10 |  |
| Data analysis and critical thinking | \_\_/5 |  |
| Quality of Notes and Comments | \_\_/5 |  |

**Assessment Table for group work:**

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| Assessment Criteria | Points | Comments |
| Internet research skills | \_\_/5 |  |
| Clarity in Presentation of Data | \_\_/5 |  |
| Understanding the concepts of the biomass cycle | \_\_/5 |  |
| Ecological Interpretations and Insights | \_\_/5 |  |
| Teamwork and Collaboration | \_\_/5 |  |
| Skills of presenting the work | \_\_/5 |  |