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| ACTIVITY PLAN | | | | |
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| **Theme** | **Subtopic** | **Activity Title** |
| Environmental Awareness and Conservation | Biodiversity and Ecosystems | * Water Body Studies * Investigation of the Condition of a Water Body |

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| Introduction part (or activity overview) |
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| **Introduction part (or activity overview)** | Chemical water tests are essential to determine water quality and identify various chemical substances that may affect human health, the environment, or other biological systems. These tests will help students monitor the condition of water bodies, identify sources of pollution, and take measures for water protection if necessary. |
| **SETTING** | 1. Computer class. Students will work in pairs. 2. Water body. Chemistry laboratory. Students will work in pairs. |

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| Materials Needed |
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| **Materials Needed** | **Materials:** water testing strips (which can determine 7 water parameters) i.e., chlorine content in water, acidity - pH, total or permanent water hardness (content of Ca and Mg sulfates and chlorides) - GH, nitrites- , nitrates - , carbonate or temporary water hardness (content of Ca and Mg bicarbonate () – KH, CO2 content, samples of the water being tested, distilled water for rinsing.  **Tools:** computers, phones, student activity sheet, bathometer (water sampler), clean and airtight containers for samples of the water being tested, chemical beakers, thermometer, filter paper.  Or a portable "Okotest Water Laboratory" laboratory designed for water testing. |

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| **Learning Outcomes** | * Deepen knowledge about water pollution issues, learn about the causes of pollution, its consequences, and possible preventive measures to be applied. * Conduct physical and chemical analyses of a water body, which will motivate students and encourage an interest in natural sciences and environmental protection. * Foster critical thinking and the ability to identify, analyze, and solve problems related to water pollution. |  |
| **Activity Contents** | **Activity 1: Introduction to water pollution, its causes, and its impact on humans and nature.**  **Theoretical Part (Duration: 10 minutes):** A discussion on water pollution. The importance of water for humans, plants, and animals is debated.  **Information for the Teacher**  Water is the most widespread substance on Earth, covering 2/3 of the Earth's surface. It is present in all living organisms and is essential for sustaining life. The reserves of fresh water on Earth are limited. Meanwhile, with the increasing human population and industrial development, more and more water is being consumed and polluted.  Chemical water pollutants include:   * Detergents (various cleaning agents), which enter natural water bodies with domestic wastewater; * Mineral fertilizers, often unbalanced and used in large quantities in agriculture. Washed out of the soil by precipitation, they usually enter natural water bodies in the form of nitrates; * Heavy metals, whose main sources are industry and motor vehicle transport; * Increased hydrogen ion concentration (pH), i.e., the so-called water acidity, is also very dangerous for water plants and animals.   **Task (Duration: 35 minutes):**  Step 1: Students are divided into groups.  Step 2: Using digital sources or reviewing a link about water pollution:  <https://www.youtube.com/watch?v=bGWr5jXJfbs>  Duration: Approx. 4.05 minutes  Step 3: Discuss the following topics:   1. Causes of water pollution:    * What are the main sources of water pollution?    * How do cities and industries affect the quality of water bodies? 2. The impact of water pollution on ecosystems:    * How does water pollution affect river and lake ecosystems?    * What are the most critical aspects of water pollution for animals and plants? 3. Urban wastewater:    * Why do cities treat wastewater and why is this process important?    * What can cities do to reduce the threat of sewage to water bodies? 4. Industrial pollution:    * What are the sources of industrial pollution contributing to water pollution?    * What are the most effective measures that industry can take to reduce its impact on water quality? 5. The impact of water pollution on human health:    * How does water pollution affect human health?    * What are the health hazards of water pollution and how can they be mitigated? 6. Climate change and pollution:    * How can climate change affect water pollution?    * What can be done to reduce water pollution and adapt to changing climate conditions? 7. Legal regulatory measures:    * What legal regulatory measures are in place to control water pollution?    * How effective is the pollution control system and how is it implemented? 8. Youth education and awareness:    * How to promote youth education and awareness in addressing water pollution issues?    * What is the role of the youth in the future fight against water pollution?   Step 4: Each group prepares a presentation on a chosen topic using Microsoft PowerPoint, Padlet, Canva, Movie Maker (film creation), or another presentation program.  **Activity 2: Investigation of the Condition of a Water Body.**  **Theoretical Part (Duration: 10 minutes):** An introductory discussion in which the teacher explains about the study of surface water bodies and how to correctly perform water tests.  **Information for the Teacher**  The ecological condition of surface water bodies is assessed based on the indicators of physico-chemical, hydromorphological, and biological quality elements. The ecological condition is divided into five classes - very good, good, moderate, poor, and very poor. Physical indicators of natural water include color, odor, clarity, turbidity, temperature, and specific electrical conductivity. The assessment indicators for chemical quality elements are nitrate nitrogen (NO3-), ammonium nitrogen (NH4+), total nitrogen (Nb), phosphate phosphorus (PO43-), total phosphorus (Pb), biochemical oxygen demand over 7 days (BDS7) and the amount of dissolved oxygen in water (O2). The most commonly found cations in natural water are Na+ , Ca2+ , Mg2+, K+ , and anions: HCO3- , SO42- , Cl- , CO32- . Other less common cations and anions are Fe2+, Fe3+, Mn2+, SO32- .  Water contains dissolved gases: CO2, O2, N2, H2S, CH4. Chemical compounds formed due to the vital activity of organisms are called biogenic substances. These include various forms of nitrogen (ammonia, nitrites, nitrates), compounds of phosphorus, silicon, iron.  The pH indicator is very important for assessing water quality. The speed of biological and biochemical processes occurring in water, the forms of migration of chemical elements, and the development of water fauna and flora, etc., depend on the water environment. The pH of natural waters depends on the ratio of carbonic acid and bicarbonate concentrations and usually ranges from pH = 4.5 to 8.3. Depending on the time of year and day, the pH in river water can vary from 6.5 to 8.5. In winter, the pH usually ranges from 6.8 to 8.5, and in summer, from 7.4 to 8.2. The pH of effluent and polluted surface waters can change due to the acids and/or alkalis present in it.  **Task (Duration: 80 minutes):** Students are divided into pairs into groups.  Step 1: Use a bathometer or a self-made device to collect water samples from a river, lake, pond, or sea.  Step 2: Fill the bottles with water to the top to eliminate air. Measurements must be taken immediately or the samples kept cold (for example, in a refrigerator).  Step 3: Assess the physical parameters of the water: color, odor, clarity/turbidity, and measure the water temperature with a thermometer.  Step 4: Perform measurements with water testing strips (the strips determine 7 water parameters: Cl2 content in water; acidity - pH; total water hardness - GH; nitrites - NO2; nitrates - NO3; carbonate hardness of water - KH; CO2 content.  Step 5: Dip the strip into the water sample bottle for 2-3 seconds, slightly move the strip for a more accurate result.  Step 6: Remove the strip from the water, shake off the water. After a minute, you can compare the obtained results (colors that have appeared on the strip) with the data provided on the scale. CO2 results can be found in the table.  Step 7: Record the obtained results in Table 1 (Appendix 1). |  |
| **Assessments** | Each student assesses their work according to the provided Appendix 2. Each group presents the results of their work, evaluates successes and failures, their contribution to the group work, and performs an oral reflection. The final result is graded. All students in the class are included in the evaluation. |  |
| **Key Competences** | * Cognitive competence * Creativity competence * Communication competence * Social, emotional and healthy living competences * Citizenship competence * Digital competence * Cultural competence |  |
| **Connections with Eco STEAM** | Eco - gain knowledge about the sources of water pollution, their impact on the environment, nature, and human health.  Science - knowledge in biology, chemistry, economics, and environmental sciences.  Technology - use of digital tools.  Engineering – perform water quality analysis research.  Art - visually observe natural changes in the presence of pollution sources.  Math - application of mathematical calculations, which provide the ability to systematically analyze and interpret the data obtained from water testing. |  |
| **References** | *Link: Prevention of Groundwater and Surface Water Pollution in the EU (Updated: 09-10-2023)*  <https://byt.lt/OiGiu>  Surface Water Standards: <https://byt.lt/gEjI2>  *School Chemistry Experiments Practice. Student's Book. 2014, 219-222 pages.* |  |
| **Notes** |  |  |
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| Appendix 1. Physical and Chemical Indicators of the Water Body (filled out by each group separately) |
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| Report Sheet  **Physical and Chemical Indicators of the Water Body**  Date ……………………………………………..  Surname, Name………………………………...............................................................…………........  Assumption / Hypothesis: …..............................................................................................................................................................  Objectives:  .................................................................................................................................................................  ................................................................................................................................................................    Experiment results and their analysis.     |  |  |  |  | | --- | --- | --- | --- | | Indicator and its units | Sample No. | | | | 1 | 2 | 3 | | Physical indicators:   1. temperature, °C, 2. color, 3. odor, 4. clarity/turbidity |  |  |  | |  |  |  | |  |  |  | |  |  |  | |  |  |  | | Nitrites NO2- , mg/L |  |  |  | | Nitrates NO3-, mg/L |  |  |  | | Carbonate or temporary water hardness KH |  |  |  | | Total or permanent water hardness GH |  |  |  | | pH (Water acidity/alkalinity) |  |  |  | | Chlorine content in water (Cl2) |  |  |  | | CO2 content |  |  |  |     Concliusions: ..........................................................................................................................................................  ….......................................................................................................................................................................  …………………………................................................................................................................................... |

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| Skills in performing theoretical and practical questions | I know very well, excellently | I know well | I know satisfactorily | What I didn't understand/couldn't do and what I would need to learn more about |
| 1. Formulate the hypothesis, objectives, and tasks of the research work |  |  |  |  |
| 2. Create a research work plan |  |  |  |
| 3. Independently conduct the research work |  |  |  |
| 4. Evaluate the obtained results |  |  |  |
| 5. Formulate conclusions and present the work |  |  |  |