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| ACTIVITY PLAN | | | | |
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| **Theme** | **Subtopic** | **Activity Title** |
| STEAM Integration in Environmental Education | Engineering for Sustainable Infrastructure | Water Resource Management Systems |

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| Introduction part (or activity overview) |
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| **Introduction part (or activity overview)** | This activity explores the engineering principles behind designing sustainable water resource management systems. Students will delve into hydrological cycles, water treatment technologies, and sustainable practices to manage water resources efficiently, considering both urban and rural settings. |
| **SETTING** | Location: Classroom equipped with computers, internet access, and necessary tools for creating simulations or physical models.  Educational Context: Collaborative group work (2-3 students per group) |

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| Materials Needed |
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| **Materials Needed** | Computers with internet access for research and simulations  Software for environmental modeling (e.g., HEC-HMS, Aqua3D)  Projector and screen for presentations  Materials for building physical models of water management systems (optional) |

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| **Learning Outcomes** | * Understand hydrological processes and the impact of human activities on water cycles. * Apply engineering principles to design effective and sustainable water management systems. * Develop skills in environmental simulation, data analysis, and project presentation. |  |
| **Activity Contents** | **Theoretical Part (Duration: 90 minutes)**: This segment provides an in-depth exploration of the science and engineering principles that underpin the sustainable management of water resources, a critical issue given the global challenges of water scarcity, pollution, and the impacts of climate change. The session will delve into the hydrological cycle, the engineering solutions currently in practice, and the emerging technologies that promise greater sustainability.   * **Understanding the Hydrological Cycle**: Begin with a detailed review of the hydrological cycle, explaining processes such as evaporation, condensation, precipitation, infiltration, and runoff. Highlight how these natural processes are impacted by human activities like urbanization, agriculture, and industrialization. * **Water Scarcity and Pollution Challenges**: Discuss global water issues, focusing on scarcity and pollution. Examine case studies from around the world where water scarcity has led to serious social and economic repercussions. Explore the sources of water pollution, including agricultural runoff, industrial discharges, and improper waste disposal, and their effects on ecosystems and human health. * **Sustainable Water Management Principles**: Introduce students to the principles of sustainable water management which include reducing demand, increasing supply through non-conventional sources, and improving water quality via natural and engineered systems. Discuss the role of water conservation strategies such as rainwater harvesting, water-efficient fixtures, and xeriscaping in urban planning. * **Innovations in Water Engineering**: Cover advanced water treatment technologies like reverse osmosis, ultraviolet disinfection, and membrane bioreactors. Discuss the integration of 'smart' water management systems using IoT technology that allows for real-time monitoring and control of water use. Examine how renewable energy sources are being used to power water treatment plants, reducing the carbon footprint associated with water management. * **Adaptation to Climate Change**: Analyze how engineering solutions can help adapt to the impacts of climate change on water resources. This includes the construction of resilient water infrastructure capable of withstanding extreme weather events and sea-level rise, and the restoration of natural ecosystems such as wetlands to enhance water regulation and purification. * **Video Resources**:   + **"Comprehensive Guide to the Hydrological Cycle"** (<https://www.youtube.com/watch?v=exampleLink1>) – Provides an animated explanation of the hydrological cycle, emphasizing its relevance to environmental management.   + **"Engineering Innovations in Water Sustainability"** (<https://www.youtube.com/watch?v=exampleLink2>) – Showcases cutting-edge engineering technologies that are making water systems more sustainable and resilient.   **Task 1: Water System Analysis (Duration: 90 minutes)** **Step 1**: Each group selects either an urban or rural area and researches its water management challenges and current systems in place.  **Step 2**: Perform a detailed analysis that includes:   * Evaluation of existing water supply and sanitation infrastructure. * Identification of key issues such as water loss, contamination, or inadequate supply.   **Step 3**: Create a comprehensive presentation that outlines the findings, supported by data visualization tools such as maps, flow diagrams, and graphs.  **Task 2: Designing a Sustainable Water Management Model (Duration: 120 minutes)** **Step 1**: Based on the analysis in Task 1, students design a conceptual model for a sustainable water resource management system tailored to the chosen area.  **Step 2**: Develop a detailed project plan that includes:   * Proposed engineering solutions for water conservation, treatment, and distribution. * Integration of innovative technologies like IoT for smart water management or renewable energy-powered desalination plants. * Environmental and socio-economic impact assessments.   **Step 3**: Utilize digital modeling tools or physical models to demonstrate the proposed system. **Step 4**: Each group presents their model to the class, highlighting design rationale, expected benefits, and potential challenges. |  |
| **Assessments** | Depth and accuracy of hydrological and infrastructure analysis.  Innovation and sustainability of the water management system design.  Effectiveness of digital or physical modeling.  Clarity and persuasiveness of the presentation. |  |
| **Key Competences** | Analytical and technical skills  Environmental awareness  Project management and planning  Communication and teamwork |  |
| **Connections with Eco STEAM** | Engineering: Applying engineering concepts to solve real-world environmental challenges in water management.  Eco Science: Understanding the scientific principles that govern water cycles and treatment processes.  Technology: Using advanced software and technologies for system design and simulation.  Arts: Creatively presenting project plans and models.  Math: Employing quantitative methods to analyze water systems and predict the outcomes of proposed solutions. |  |
| **References** | <https://www.gwp.org/> Global Water Partnership |  |
| **Notes** | Consider extending this activity into a project-based learning module, where students could potentially engage with local water authorities or environmental agencies to discuss the feasibility and implementation of their designs. |  |

**Evaluation Table for Water Resource Management Systems Activity**

| **Evaluation Criteria** | **Points Available** | **Comments** |
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| **1. Depth and Accuracy of Hydrological Analysis** | 20 | Evaluate the thoroughness and accuracy of the analysis conducted on the hydrological cycle and water management issues. |
| **2. Understanding of Sustainable Water Management Principles** | 20 | Assess the accuracy and application of sustainable water management principles in the proposed solutions. |
| **3. Innovation in Water Management Solutions** | 20 | Rate the creativity and innovation in the design of the proposed water resource management systems. |
| **4. Technical Proficiency in Digital Modeling** | 10 | Evaluate the skill and accuracy in using digital tools to model the water management solutions. |
| **5. Sustainability Features Integration** | 10 | Judge how well sustainability features are integrated into the design (e.g., use of renewable energy, water recycling technologies). |
| **6. Clarity and Organization of Presentation** | 10 | Assess the effectiveness of the presentation in terms of clarity, organization, and the use of visual aids. |
| **7. Team Collaboration and Interaction** | 10 | Rate the level of effective collaboration and contribution from all team members throughout the project. |

**Total Points:** 100