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| ACTIVITY PLAN | | | | |
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| **Theme** | **Subtopic** | **Activity Title** |
| STEAM Integration in Environmental Education. | Science in Environmental Studies. | Greenhouse Effect Modeling |

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| Introduction part (or activity overview) |
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| **Introduction part (or activity overview)** | This activity is designed to deepen knowledge about the greenhouse effect. Working in groups, students will create a model of the greenhouse effect, use it to determine the impact of carbon dioxide on environmental temperature, and explain the mechanism of the greenhouse effect. |
| **SETTING** | Laboratory |

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| Materials Needed |
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| **Materials Needed** | Computers, glass covers (aquariums, crystallizers), Petri dishes, thermometers, incandescent lamps, Wurtz flasks, cylindrical separating funnels, rubber hoses, scales, laboratory stands with clamps, soil, distilled water, hydrochloric acid, calcium carbonate, clock. |

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| **Learning Outcomes** | * - Connect and deepen knowledge about the greenhouse effect acquired in biology, chemistry, and physics classes. * - Improve planning and modeling skills. * - Develop teamwork skills. * - Apply mathematics knowledge in analyzing and presenting work results. |  |
| **Activity Contents** | **Activity1: Greenhouse Effect Modeling**  **Theoretical Part (Duration: 25 minutes):** While watching films about the greenhouse effect, students answer the following questions: What is the natural greenhouse effect? What is its significance? Which gases cause climate change? What emits greenhouse gases? After watching the films, the anthropogenic greenhouse effect is discussed, and the predicted consequences of climate change are examined.  **Videos:**  [**https://www.youtube.com/watch?v=XFCdxppTsu0**](https://www.youtube.com/watch?v=XFCdxppTsu0)  [**https://www.youtube.com/watch?v=Xt1JuroQcmM**](https://www.youtube.com/watch?v=Xt1JuroQcmM)  **Task (Duration: 90 minutes):**  **Step 1:** Students divide into groups. The groups design and create a model of the greenhouse effect.  **Step 2:** Using the created model, they conduct an experiment to determine the impact of carbon dioxide on air temperature. A control test is performed using a container that is not filled with carbon dioxide gas, and an experimental test is done with carbon dioxide. Temperature changes are recorded for 30 minutes.  **Step 3:** The research results are presented graphically.  **Step 4:** Create a diagram of the anthropogenic greenhouse effect in a chosen manner.  **Step 5:** Present the created model and research results to the class. |  |
| **Assessments** | After completing the work, students perform self-assessment (Appendix 1). Group work is graded (Appendix 2). |  |
| **Key Competences** | Cognitive competence  Creativity competence  Social, emotional and healthy living competences  Digital competence |  |
| **Connections with Eco STEAM** | Eco – Understand the impact of human activity on the climate.  Science – Connect knowledge of chemistry, physics, and biology.  Technology – Skillfully and creatively use digital technologies.  Engineering – Create a model of the greenhouse effect.  Math – Represent research data graphically. |  |
| **References** | •https://science.nasa.gov/earth/climate-change/steamy-relationships-how-atmospheric-water-vapor-amplifies-earths-greenhouse-effect/  •https://www.nsa.smm.lt/wp-content/uploads/2021/03/2775\_Ch-VBE-1-2012.pdf |  |
| **Notes** | Material for the Teacher  Students create the greenhouse effect model independently. If groups need teacher assistance, their work can be guided as follows:  1. Take two Petri dishes. Add an equal amount of black soil to each.  2. Make thermometer holders. Place the holders with thermometers in the dishes.  3. Cover the dishes with 1-liter glass covers.  4. Construct an apparatus to generate carbon dioxide. Secure a cylindrical separating funnel in a laboratory stand. Pour 50 ml of diluted hydrochloric acid (1:2) into it. Connect the cylindrical funnel to a Wurtz flask containing 50 g of calcium carbonate powder. Lead a rubber hose from the flask to one glass cover. Slowly drip the hydrochloric acid into the Wurtz flask, releasing carbon dioxide, which fills one glass cover (Appendix 3).  5. Place incandescent lamps (75 W) at equal distances from both glass covers.  6. Record the air temperature inside the glass covers every 5 minutes. Conduct the experiment for 30 minutes. After 30 minutes, the air temperature in the control and experimental covers should differ by 3-4 degrees.  If materials are limited, first conduct the control experiment, then the experimental one. Carbon dioxide can also be obtained by exhaling several times into the container.  Other ideas:  You can investigate the impact of water vapor (water the soil in one container and leave it dry in the other), or the effect of atmosphere (use a glass-covered container and an open glass container) on air temperature. |  |
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# APPENDIX 1. SELF-ASSESSMENT SHEET

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| Self-Assessment Questions | Answers |
| What new information did you learn about the greenhouse effect? |  |
| What skills did you acquire? |  |
| What did you enjoy? |  |
| What was difficult? |  |
| What would you do differently next time? |  |
| Notes |  |

# APPENDIX 2. EVALUATION SHEET

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| Evaluation Criteria | Points | Comments |
| Model | \_\_/3 |  |
| Graphical Presentation of Results | \_\_/3 |  |
| Greenhouse Effect Diagram | \_\_/3 |  |
| Work Presentation | \_\_/3 |  |
| Independence | \_\_/3 |  |

**APPENDIX 3. GREENHOUSE EFFECT MODEL (FOR INVESTIGATING THE IMPACT OF CARBON DIOXIDE ON AIR TEMPERATURE)**

