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| ACTIVITY PLAN | | | | |
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| **Theme** | **Subtopic** | **Activity Title** |
| 5. Global and Local Perspectives in Environmental Education | 5.1 Understanding Global Environmental Issues | Global warming and Climate change |

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| Introduction part (or activity overview) |
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| **Introduction part (or activity overview)** | The main greenhouse gases that cause climate change include carbon dioxide and methane. This activity is designed to produce carbon dioxide and compare the heat retention of air with that of CO2. Working in groups, students will create a model of the greenhouse effect, examination of the negative impact of the greenhouse gas carbon dioxide on temperature and the living environment, experiencing disruption of the ozone layer that protects the earth's mantle from global warming. |
| **SETTING** | Chemical cabinet or classroom |

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| Materials Needed |
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| **Materials Needed** | Two identical transparent containers (glass jars, plastic bottles, containers or erlemayers), thermometer, light source (lamp or sunlight), CO2 source (vinegar and baking soda reaction), stopwatch or timer, balloon or tubes, computer. |

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| **Learning Outcomes** | Explain the role of greenhouse gases in the Earth's atmosphere and their contribution to climate change.  Evaluate different perspectives on climate change, considering scientific evidence, socio-economic factors.  Develop skills in environmental advocacy and communication to promote awareness and action on global warming issues.  Demonstrate the ability to interpret and communicate scientific data related to climate change through graphs, charts and scientific literature.  Apply knowledge of climate change science to propose and evaluate potential solutions at local, national, and global levels.  Design and implement strategies to reduce greenhouse gasses. |  |
| **Activity Contents** | **Activity 1: Greenhouse gasses research and description of the greenhouse effect**  **Theoretical Part (Duration: 25 minutes)**: Students use Phet application to simulate greenhouse effect with waves, photons, layer model. They examine in an interesting way the influence of temperature on the formation of waves, energy balance of atmosphere, flux meter sunlight and infrared during the formation of photons, greenhouse gasses concentration during the formation of layer model.  https://phet.colorado.edu/sims/html/greenhouse-effect/latest/greenhouse-effect\_all.html?locale=mk  While watching the simulations of greenhouse effect, students describe the effect of greenhouse gasses and clouds on sunlight, infrared radiation and surface temperature. They explain why greenhouse gasses affect the temperature. Students compare and contrast the behavior of sunlight and infrared radiation. They also describe radiation balance and use it to explain the relationship between the surface temperature and greenhouse gas concentration. Students compare the effect of greenhouse gasses to the effect of infrared absorbing layers.  **Video:**  <https://www.youtube.com/watch?v=f2qAd1sEsBA>  <https://www.youtube.com/watch?v=LvdV61Q6otI>  **Activity 2: Design and create a model of the greenhouse effect.**  **Duration: 90 minutes**  **Step 1:** Students divide into groups. The groups design and create a model of the greenhouse effect.  **Step 2:** Demonstrate an experiment to determine the impact of carbon dioxide on air temperature. A control test is performed using a jar, plastic bottle or erlenmeyer that is not filled with carbon dioxide gas, and an experimental test is done with carbon dioxide. Temperature changes are recorded for every 5 to 30 minutes, measure and record the initial temperatures of both containers using the thermometer.  **Step 3:** Mix vinegar and baking soda to produce carbon dioxide CO2  А chemical reaction occurs that can be represented by the chemical equation : CH3COOH + NaHCO3 → CH3COONa + H2O + CO2  The reaction is endothermicwhich makes the amount of heat captured by the CO2 more impressive.  **Task 1** : What is the volume of CO2 gas that will produce if you add 0,6 g baking soda to vinegar ?  **Step 4:** Simulate solar radiation with an infrared lamp.  **Step 5:** Repeat the experiment under the sunlight.  **Step 6**: Compare the heat retention of air with that of CO2 , analyze and compare temperature between the container with CO2 and the one with regular air.  **Step 7**: Present the obtained results and discuss with a class.  **Task 2** : Graphically present a diagram of the dependence of concentration of carbon dioxide to a temperature. |  |
| **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** – Тhe impact of human activities on climate change.  **S**cience – Connect knowledge of chemistry, physics, biology and math.  **T**echnology – Using digital technologies.  **E**ngineering – Design a model of the greenhouse effect.  **M**ath – Calculations for the volume of C02 and graphical representation of the obtained results. |  |
| **References** | <https://phet.colorado.edu/sims/html/greenhouse-effect/latest/greenhouse-effect_all.html?locale=mk>  <https://www.youtube.com/watch?v=f2qAd1sEsBA>  <https://www.youtube.com/watch?v=LvdV61Q6otI> |  |
| **Notes** | Climate change refers to long-term changes in temperatures and weather patterns. Such shifts can be natural, due to changes in solar activity or large volcanic eruptions. But since the 1800s, human activities have been the main driver of climate change, primarily due to the burning of fossil fuels such as coal, oil and gas, which generates emissions of greenhouse gases mainly carbon dioxide and methane, which trap the sun's heat and raise temperatures.  The Earth's average surface temperature is now about 1.2 °C warmer than it was in the late 1800s (before the Industrial Revolution) and warmer than at any time in the last 100,000 years. The last decade (2011-2020) was the warmest on record, and each of the last four decades has been warmer than any previous decade since 1850.  Many people think that climate change mainly means warmer temperatures. But the rise in temperature is only the beginning of the story. Because the Earth is a system, where everything is connected, changes in one area can affect changes in all others.  The consequences of climate change now include, among others, intense droughts, water shortages, wildfires, rising sea levels, floods, melting polar ice, catastrophic storms and declining biodiversity.  Many solutions to climate change can bring economic benefits while improving our lives and protecting the environment. We also have global frameworks and agreements to guide progress, such as the Sustainable Development Goals.  Switching energy systems from fossil fuels to renewable sources such as solar or wind will reduce the emissions that drive climate change. But we must act now. While a growing number of countries are committing to net zero emissions by 2050, emissions must be halved by 2030 to keep warming below 1.5°C. Achieving this means a huge drop in the use of coal, oil and gas: over two-thirds of today's proven fossil fuel reserves need to be kept in the country by 2050 to prevent catastrophic levels of climate change. |  |

# APPENDIX 1. SELF-ASSESSMENT SHEET

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| Self-Assessment | Answers and Interpretations |
| Specify the types of greenhouse gases emitted;  Discuss factors that influence emissions;  What are the primary activities or sources in your daily life that contribute to greenhouse gas emissions? |  |
| Describe any actions taken to reduce emissions from each source;  Consider the significance in terms of global warming potential and contribution to climate change;  What actions have you taken to reduce your greenhouse gas emissions ? |  |
| Relate the experiment's findings to real-world implications of increased CO2 levels in the atmosphere;  In your opinion, who are the goals for reducing greenhouse gas emissions in the future? |  |
| What skills did you improve? Did you cooperate and share informations, conclusions? |  |
| Did the experiment help you examine the impact of greenhouse gases on the global environment? |  |
| Notes |  |

# APPENDIX 2. EVALUATION SHEET

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| Evaluation Criteria | Points | Comments |
| Methodology and design of the experiment:  Effective demonstration of greenhouse effect principles | \_\_/10 |  |
| Identification of experimental design:  Clear and detailed description of materials, procedures аnd the way of performing the experiment | \_\_/10 |  |
| Accuracy of measurements and data:  Calculations  Greenhouse Effect Diagram  Graphical Presentation of Results | \_\_/15 |  |
| Analysis of the data and interpretation of the results in the context of the set hypotheses:  Presentation  The way of summarizing the key findings of the experiment | \_\_/10 |  |
| Critical thinking and debate | \_\_/5 |  |