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| ACTIVITY PLAN | | |
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| **Theme** | **Subtopic** | **Activity Title** |
| 2. STEAM Integration in Environmental Education | 2.1. Science in Environmental Studies | Effect of ocean acidity on marine animals |

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| Introduction part (or activity overview) |
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| **Introduction part (or activity overview)** | This educative experiment is aimed to raise awareness about the devastating effects of ocean acidification on shelled marine organisms.  The burning of fossil fuels leads to an increase in carbon dioxide in the environment. The increased levels of carbon dioxide in the air causes more carbon dioxide to dissolve in the ocean which in turn leads to an increase in the acidity of the ocean. This is termed ocean acidification and some of the effects of this devastating phenomena are represented through this experiment. |
| **SETTING** | A lab/ chemistry classroom - Instead of using a jar, you can use a beaker. It is important to seal the beaker to prevent any potential spills.  At home - If you do not have any vinegar, use your science brain to locate other acidic food items present at your home. You might want to use lemon juice or even ketchup instead. |

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| Materials Needed |
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| **Materials Needed** | 3 eggs, 3 jam jars, Stretch and seal, Water, Vinegar, Bleach |

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| **Learning Outcomes** | The main goal of this experiment is to show the devastating effects of ocean acidification on marine animals possessing a calcium carbonate shell.  Another objective is to show what happens to the egg shell when placed in acidic and basic environments and to relate the results to what would happen to a shelled marine organism. |
| **Activity Contents** | **Activity 1: Ocean acidification and its impact on marine organisms (Duration: 15 minutes)**  **Theoretical part:**  **The teacher gives them directions and links regarding the experiment:**  http://news.nationalgeographic.com/news/2014/05/140502-ocean-snail-shell-dissolving-acidification-climate-change-science/  https://www3.epa.gov/climatechange/kids/impacts/signs/acidity.html  Students read about an experiment: shell placed in vinegar solution is no longer present after the experiment was performed. This is an acid-base reaction:  acetic acid (vinegar) + calcium carbonate (eggshell) → calcium acetate + carbon dioxide + water  Ocean acidification occurs when an increase level of carbon dioxide in the air forces more carbon dioxide to dissolve in the water. Carbon dioxide reacts with water to form carbonic acid which leads to a lowering of pH i.e. increase in acidity. This in turn causes the shells of marine organisms to dissolve.  CO2 + H2O ↔ H2CO3 ↔ HCO3- + H+  **Activity 2: Realization of an experiment (Duration: 80 minutes)**  **The teacher introduces the students to the steps of experiment.**  Step 1: Place 50 mL of vinegar in a jar together with 100 mL of water. Label this jar as acidic.  Step 2: Place 50 mL of bleach in a jar together with 100 mL of water. Label this jar as basic.  Step 3: Place 150 mL of water in a jar and label this as neutral.  Step 4: Place an egg in each of the jar and seal them with either a lid or with stretch and seal.  Step 5: Leave for 24 hours and observe any differences on the egg.  Step 6: If nothing happens, repeat steps 1-5 but this time using constantly the same eggs.  Step 7: Finally, remove the eggs and see what has happened to the egg shells.  Students carry out the experiment, using the steps given by the teacher,  **Activity 3: Discussion** **(Duration: 60 minutes)**  The teacher discusses and analyzes connected topics: ocean acidification, ocean acidity, coral reef ecosystems, calcium carbonate, hydrogen ions, carbon dioxide in the atmosphere.  Students discuss what they witnessed, what they produced, how was it achieved. They share possible solutions to environmental issues, analyse sustainability in terms of lower/ stop ocean acidification.  **Example questions (reflection):**  **What is ocean acidification?** Increase in the acidity of the ocean causing a decrease in pH.  **Why were eggshells used?** To represent the calcium carbonate shells of marine organisms.  **Why was vinegar used?** To show the effects of acid on calcium carbonate.  **Why were bubbles produced in the vinegar solution?** Carbon dioxide  **What causes ocean acidification?** Increase in atmospheric carbon dioxide levels.  **Activity 4 – Research related to the experiment (Duration: 30 minutes)**  Students look at some researches and EU funded projects connected with the topic:  **http://ec.europa.eu/environment/integration/research/newsalert/pdf/ocean\_acidification\_puts\_norwegian\_fishing\_industry\_at\_risk\_486na2\_en.pdf**  **http://cordis.europa.eu/project/rcn/209836\_en.html**  **http://cordis.europa.eu/result/rcn/161225\_en.html**  **http://cordis.europa.eu/project/rcn/100200\_en.html**  **Additional tips**  Investigate the action of other household items on the egg shell. Use your science knowledge to observe what substances are more acidic than others.  If you happen to be next to a beach, collect some seashells and this time perform the experiment using actual seashells. See if the results compare to what happened to the eggshell.  Make the experiment a little bit more fun by attaching a balloon to the neck of a conical flask where the shells with the vinegar are placed and see what happens to the balloon. The balloon should inflate since the decomposition of calcium carbonate present in the eggshell leads to the generation of carbon dioxide gas. |
| **Assessments** | The final result is evaluated with a grade.  All students in the class can be included in the evaluation.  Each student independently evaluates his contribution to the work.  Students can compete in the best-performed experiment.  The assessment takes into account: student engagement, egg shape, description, costing and conclusions. |
| **Key Competences** | Communication competence  Cognitive competence  Competence for creativity  Artistic competence |
| **Connections with Eco STEAM** | **Eco** - using natural materials, from the kitchen.  **S**cience - knowledge of chemistry, biology and physics; environmental sciences - fostering sustainability thinking.  **T**echnology - using a computer in the research process.  **E**ngineering - carbon dioxide production.  **C**hemistry - preparation of chemical solutions. |
| **References** | http://news.nationalgeographic.com/news/2014/05/140502-ocean-snail-shell-dissolving-acidification-climate-change-science/  https://www3.epa.gov/climatechange/kids/impacts/signs/acidity.html  http://ec.europa.eu/environment/integration/research/newsalert/pdf/ocean\_acidification\_puts\_norwegian\_fishing\_industry\_at\_risk\_486na2\_en.pdf  http://cordis.europa.eu/project/rcn/209836\_en.html  http://cordis.europa.eu/result/rcn/161225\_en.html  <http://cordis.europa.eu/project/rcn/100200_en.html> |
| **Notes** | This experiment can be messy, hence it is ideal to place the jars on a tray so that any spillages can be contained. It is also ideal to keep hand towels close by.  Some children can be allergic to eggs, therefore be careful if any weird behaviour is observed during/after the experiment.  Bleach is very dangerous therefore it is ideal that it is only handled by the demonstrators. To show the importance of lab safety it is ideal to advise the children to wear lab coats, safety goggles and gloves while performing the experiment. |

**Assessment Table for individual work:**

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| Evaluation Criteria | Points | Comments |
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| Understanding the concept of acidification of the oceans | \_\_/5 |  |
| Understanding the process of osmosis | \_\_/5 |  |
| Communication competence | \_\_/5 |  |
| Cognitive competence | \_\_/5 |  |
| Competence for creativity | \_\_/5 |  |
| Answered questions correctly | \_\_/10 |  |
| Completed homework | \_\_/10 |  |

**Assessment Table for group work:**

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| Assessment Criteria | Points | Comments |
| Internet research skills | \_\_/5 |  |
| Changing the shell of an egg | \_\_/10 |  |
| Calculation of cost price | \_\_/5 |  |
| Ecological Interpretations in the project | \_\_/5 |  |
| Teamwork and Collaboration | \_\_/5 |  |
| Skills of presenting the work | \_\_/5 |  |