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| ACTIVITY PLAN | | |
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| **Theme** | **Subtopic** | **Activity Title** |
| 3. Creative and Critical Thinking in EcoSTEAM Education | 3.4. Evaluating and Analyzing Environmental Information | How different colored light has an effect on plant growth |

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| Introduction part (or activity overview) |
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| **Introduction part (or activity overview)** | Students discuss wavelength of white light – the visible spectrum of colours which make up the colours of the rainbow: this is why when you pass white light through a prism, the ray of light splits up to reveal these colours. A picture can be used showing this phenomenon, also any previous knowledge from physics.  They further analyse possible applications in biology – questions: Why are plants green? What is chlorophyll? What is photosynthesis? Finally, what is the effect of the colours of the spectrum on bean plant growth? |
| **SETTING** | In this experiment you will observe the effects of different coloured light on plant growth. |

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| Materials Needed |
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| **Materials Needed** | Different coloured cellophane, around 4 will do (such as green, red, blue, yellow, violet), 5 plastic cups, 5 shoe boxes, 5 bean plant seeds or any other type of plant seeds that are easy to grow.  Soil, Water, Ruler, Tape, Scissors. |

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| **Learning Outcomes** | – Investigating the effects of different coloured lights on plant growth.  – Observing whether any specific colours of light encourage more growth compared to other colours, or whether they have no influence at all. |  |
| **Activity Contents** | **Activity 1: Realization of the experiment (Duration: 90 minutes)**  *Introduction discussion*: (10 minutes)  **Theoretical part:**  **The teacher gives them directions regarding the experiment:**  Students want to produce the best bean plants possible. They experiment using multiple coloured filters in order to work out which colour of light is best.  Step 1: Start off the experiment by filling the 5 plastic cups at least ¾ full with soil.  Step 2: Place your thumb on the surface of the soil present in the cups and press down gently to make a small hole.  Step 3: Place the seeds in the hole and cover with soil.  Step 4: Repeat steps 2 and 3 for all the plastic cups containing the soil.  Step 5: Get the shoe boxes, remove their lids and using the scissors cut out one side of each box.  Step 6: Cut a hole in the bottom of the shoe box. Make the hole as big as possible without cutting the corners of the box. Pierce 5-10 small holes in the remaining sides of the box.  Step 7: Now tape the coloured cellophane over the side that has been removed and side and over the hole in the bottom of the box.  Step 8: Repeat steps 5 and 7 three more times using a different colour cellophane for each shoe box.  Step 9: It is important to keep one box that is not taped with cellophane to be used as a control.  Step 10: Place one of the boxes over each cup.  Step 11: Place the boxes in an area which is well lit such as next to a window, with the opening in the box facing the light.  Step 12: Water the plant each day for 3-5 weeks (until the plant grows to a sufficient height).  Step 13: Use the ruler to see which plant grew the tallest. Also take notice of the leaf colours, their size, time taken for the seeds to germinate etc. Act like a detective and note down every observation you make.  **Activity 2: Discussion (Duration: 40 minutes)**  The teacher discusses and analyzes connected topics: different wavelengths of light are responsible for the different growth responses, leaf cells possess chlorophylls and carotenoids, organelles which can only absorb specific wavelengths of light, photosynthesis but also: hydroponics, biofuel cells, acoustic analysis of growth, greenhouse control of received light etc.  Students discuss what they witnessed, what they produced, how was it achieved. They share possible solutions to environmental issues, analyse sustainability in terms of plant growth.  **Example questions (reflection):**  **Which light colour caused the greatest plant growth?** Red and blue light, colours which are furthest away from green in the light spectrum.  **Name a pigment that absorbs light.** Chlorophyll, carotene.  **What is the function of chlorophyll?** Converts light energy into chemical energy which the plant can use.  **What colour filter will be/was the most detrimental towards plant growth?** Green since it is reflected rather than absorbed by the plant.  **Why are plants green?** Chlorophyll reflects green light and absorbs all other light.  **Why are carrots orange?** Carotene reflects orange light and absorbs all other light.  **Additional tips:**  Be creative and try the experiment with different plant seeds. See if the same results are obtained.  You could also try out this experiment during different seasons, which may influence plant growth due to factors such as air temperature and humidity. Try the experiment in summer and in winter and compare results. |  |
| **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 for a correctly conducted experiment. During the assessment, the following are taken into account: The speed of work and correct implementation of all steps of the experiment. |  |
| **Key Competences** | Communication competence  Cognitive competence  Competence for creativity  artistic competence |  |
| **Connections with Eco STEAM** | **Eco** - Organic plants.  **S**ience - knowledge of chemistry, biology and physics; environmental sciences – fostering sustainability thinking.  **T**echnology - using a computer in the research process, color spectrum prism  **E**ngineering - constructing a greenhouse  **A**rt - arranging the greenhouse with plants  **M**athematics - calculations |  |
| **References** | [**http://www.epicgardening.com/types-of-hydroponic-lighting/**](http://www.epicgardening.com/types-of-hydroponic-lighting/)  [**http://www.nature.com/articles/srep44526**](http://www.nature.com/articles/srep44526)  [**https://www.sciencedaily.com/releases/2010/02/100218092846.htm**](https://www.sciencedaily.com/releases/2010/02/100218092846.htm) |  |
| **Notes** | **Photosynthesis** can be represented by the following equation:  6 CO2 + 6 H2O → C6H12O6 + 6 O2 |  |

**Assessment Table for individual work:**

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| Evaluation Criteria | Points | Comments |
| Understanding pigments that absorb light | \_\_/5 |  |
| Understanding what photosynthesis is | \_\_/5 |  |
| Understanding what the function of chlorophyll is | \_\_/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 |  |
| Height of produced plant | \_\_/10 |  |
| Calculation of cost price | \_\_/5 |  |
| Ecological Interpretations in the project | \_\_/5 |  |
| Teamwork and Collaboration | \_\_/5 |  |
| Skills of presenting the work | \_\_/5 |  |