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| Activity plan | | | | |
| ACTIVITY PLAN | | | | |
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| **Theme** | **Subtopic** | **Activity Title** |
| 3. Creative and Critical Thinking in EcoSTEAM Education | 3.3. Environmental Art and Expression | Applications of circle and ellipse construction in Landscaping Design Top of Form |

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| Introduction part (or activity overview) |
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| **Introduction part (or activity overview)** | Students, after learning what an ellipse and a circle are and how to independently construct an ellipse and a circle using the garden method, will be able to apply their knowledge in designing environmentally – friendly yards. They will solve problems related to the construction and layout of ellipses and oval flower beds in yards and gardens considering environmental factors. |
| **SETTING** | Classroom , school yards and gardens. |

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| Materials Needed |
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| **Materials Needed** | Computer (phone or tablet for interactive applets in GeoGebra), styrofoam, cardboard or drawing paper, video presentation equipment, markers**,**flip charts,thread and nails(rope and stakes for outdoor activities),images of yards or gardens, handout with ellipse and circle construction steps |

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| **Learning Outcomes** | * Understanding the definition and properties of the circle and ellipse * Identifying different methods of circle and ellipse construction * Constructing circles and ellipses with the garden method in the classroom (on paper) and outside (in the environment) * Develop problem-solving skills by tackling real-world challenges related to circle and ellipse layout and environmental considerations. |
| **Activity Contents** | **ACTIVITY 1 (50 min): Marking out an ellipse and creating a tree ring**  ***Theoretical part 1*** *(10 minutes)*  Through questions, the teacher initiates the students' prior knowledge of circle and ellipse as a mathematical curve and their application. The teacher reminds the students that there are several methods for constructing a circle and an ellipse, and one of the simplest is the garden method, which has applications outside the classroom. Students are reminded how to construct a circle and an ellipse using the gardening method. Gardening construction of a circle and an ellipse, can also be drawn in a simple and effective way on a piece of cardboard or styrofoam. In the following video, the students can see how one can draw an ellipse on a piece od wood using thumbs, pencil and string.  Video: **“Drawing an ellipse on a piece of wood ”**  <https://www.youtube.com/watch?v=6bw_8McExOs> (duration 2min 31 s)  *Task 1 (30 min)*  Students apply the learned knowledge - they have to draw a circle and an ellipse using a piece of cardboard, two sticks, a pencil and string. The work instructions are given on the individual worksheet (**Appendix 1**).  ***Theoretical part 2*** *(10 min)*  Тhe simple act of drawing a circle and an ellipse using cardboard, thumbs, pencil and string has practical applications in various areas of life, from design and art to ecology. It shows how mathematics and geometry play a role in understanding and representing our environment, including the natural world. Below are videos in which you can see how elliptical and circular shapes are practically marked using a mathematical construction method.  Video: **“Marking out an ellipse” -** how to mark an ellipse on a green surface or ground  <https://www.youtube.com/watch?v=LRQA7Sx3m0w> (duration: 2minute 26 seconds)  Video:**“How to create a perfect tree ring ”** - how to mark a circle around a tree  <https://www.youtube.com/watch?v=qW6LzzVbxwI> (duration: 2minute 49 seconds)  **ACTIVITY 2 (50 minutes): Elliptical and circular elegance in landscape design**  *Theoretical part 1 (15 min)*   * Circles and ellipses are fundamental geometric shapes that have numerous applications in everyday life across various fields. Here are some real-life applications of circles and ellipses: Wheels of vehicles like cars, bicycles, and trains are circular to ensure smooth and continuous motion. Athletic tracks and sports fields are mostly in the form of a circle or an ellipse; Circular domes in buildings (e.g. the Pantheon in Rome) and elliptical rooms and halls are often included in architecture to create an interesting and functional use of space and structural stability; Elliptical and circular shapes can be used in the planning of ecological spaces to maximize space and improve environmental design; Circular or semi-circular solar panels to maximize sunlight exposure; The orbits of the planets around the Sun are elliptical. * The application of circular or elliptical shapes in landscape design is particularly interesting. A circular or elliptical fountain or pond, an elliptical or circular flower bed or seating area can make the garden very beautiful. Elliptical hedges or shrubs can be used to divide different areas of the garden, providing privacy or defining specific spaces. Circular planters or raised beds can help organize and structure the garden, creating a sense of order and balance.   Below are two videos showing the application of elliptical and circular shapes in landscaping Video: **“Dumbarton oaks gardens: ellipse ”**  <https://www.youtube.com/watch?v=QGTNwGovOtg> (duration: 2minute 32 seconds) Video: **“Best tips for landscaping around trees ”**  <https://www.youtube.com/watch?v=rJko1-MAfAI> (duration: 3minute 20 seconds)  *Task 1 (30 min)*  Then the teacher divides the students into groups of 5 students and assigns each group a challenge to design a landscape in their environment.  Based on the acquired knowledge, each group should create a sketch of a green area that they want to arrange by applying circular and elliptical shapes. Oval shapes can be flower beds, ovals or rings around trees decorated with pebbles, fountains, etc. Students can make sketches in a computer drawing program or on paper. They can research landscapes online to get ideas.  Finally, each group presents its findings to the class.  *Discussion and reflection (5 min)*   * Students highlight real-world applications of the circle and ellipse. * Students discuss the challenges they faced during the construction and design process. * The importance of considering environmental factors in backyard design is emphasized. |
| **Assessments** | Verbal feedback during class;  Conversation with/among students;  Monitoring of students during group work;  Evaluation of the thoroughness and accuracy of individual work;  Each student self-assesses his contribution to the work;  Aassesments the presentation of the work; |
| **Key Competences** | * Cognitive competence * Creativity competence * Communication competence * Social, emotional and healthy living competences * Digital competence * Practical skills in planning and constructing |
| **Connections with Eco STEAM** | **Eco**- By seeing the application of ellipses and circles in garden design students will gain a deeper understanding of the interconnectedness of nature and the importance of responsible gardening practices.  **S**cience: Students will understand that the orbits of the planets around the Sun are elliptical.  **T**echnology: Students will use various digital programs for landscaping design.  **E**ngineering: Using the wireframe method to draw circles and ellipses can help engineers accurately represent these shapes in their plans and models.  **A**rt: Students will design landscapes and a sketch of ellipse and circle.  **M**ath: Students will learn how mathematics and geometry play a role in understanding and representing our environment |
| **References** | * Mathematics textbook for high school education in the Republic of Nort Macedonia * Master's thesis: "Application of the GeoGebra computer package in the study of analytical geometry" Author: Aleksandra Arsovska, UKIM Skopje * videos with a link given above in the text |
| **Notes** | * Encourage creativity and innovation in designing ecological yards and emphasize the importance of sustainability and environmental awareness in landscape design. * A local landscape designer or environmental expert may be invited to discuss sustainable backyard design and provide feedback on student designs. |

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| Appendix 1. Instructions for STUDENT'S individual ACTIVITY SHEET |
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| Instructions for constructing an ellipse |
| Draw a circle and an ellipse using a piece of cardboard, two thumbtacks, a pencil, and string. Place the thumbtacks in the cardboard to form the foci of the ellipse. Cut a piece of string longer than the distance between the two thumbtacks (the length of the string represents the constant in the definition). Tack each end of the string to the cardboard, and trace a curve with a pencil held taut against the string. The result is an ellipse.  Think about how you will draw a circle. |
| elipsa.jpg |
| If you want to get different shapes of the ellipse and circle, change the length of the string or the distance between the foci. |
| After constructing an ellipse and a circle, make a sketch of this ellipse and circle inserted in your living environment (courtyard, garden, school yard, etc.) as a flowerbed or green area around a tree, etc. Get motivated by the photos and videos you've seen in class or use digital sources to get creative ideas for creating an eco-friendly environment |

**Assessment Table for individual work:**

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| Assessment Criteria | Points | Comments |
| Understanding the application of the ellipse and circle in real life | \_\_/5 |  |
| Understending the propertiesof the ellipse and circle | \_\_/5 |  |
| Constructing an ellipse and a circle with the garden method | \_\_/10 |  |
| Understanding the role of mathematics in landscape design | \_\_/5 |  |
| Quality of the aesthetic and artistic constructions | \_\_/5 |  |

**Assessment Table for group work:**

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| Assessment Criteria | Points | Comments |
| Internet research skills | \_\_/5 |  |
| Dexterity and creativity in the application of oval shapes in the project | \_\_/5 |  |
| Ellipse and circle construction skills | \_\_/5 |  |
| Ecological Interpretations in the project | \_\_/5 |  |
| Teamwork and Collaboration | \_\_/5 |  |
| Skills of presenting the work | \_\_/5 |  |