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3D STEAM

Project: Accelerating STEAM-related Knowledge and Skills via 3D Modelling and 3D Printing
Reg. no. 2023-1-CZ01-KA220-HED-000160664

Teaching Planning Tool – 3D Modelling and 3D Printing (STEAM)

PART 1: Conceptual Planning (General Information)

Title of the Thematic (STEAM) Unit

How Does the Ladybug Get Its Spots? – The Journey of the Seven-Spotted Ozobot

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SUBJECT	An integrated STEAM unit in pre-primary education within the following educational area: Human and Nature, Human and the World of Work, Mathematics and Information Processing, Art and Culture (Art and Music Education) or in primary education subjects: Science, Technology, Mathematics, Art education, Music education.
YEAR	Children aged 5–6 years in kindergarten / pupils at the primary school level.
NUMBER OF LESSONS	2–3 learning activities / teaching hours.
DIDACTIC OBJECTIVES	- Understand the final phase of the ladybug's life cycle and its characteristic features. - Connect scientific knowledge with technology through creative and experiential learning. - Develop observation, problem-solving, and coding skills using the Ozobot robot. - Foster creativity, collaboration, and self-expression through visual art and music activities.
SPECIFIC OBJECTIVES	- The child/pupil explains how the ladybug changes during its life cycle. - The child/pupil recognizes and counts the number of spots on a ladybug. - The child/pupil designs and codes a path for Ozobot symbolizing the ladybug's journey. - The child/pupil creates a "cloak" for the Ozobot – a ladybug with seven black spots. - The child/pupil presents a musical path for Ozobot based on the rhythm of the song "*Seven-Spotted Ladybug*."

THEMATISATION AND PROBLEMATISATION

The topic "How Does the Ladybug Get Its Spots?" is meaningful for children/pupils as it builds on their natural curiosity about nature and living creatures. They often observe insects and wonder how they live and change. Through exploring the ladybug's life cycle, children/pupils understand the principles of growth, development, and transformation in living organisms. The topic also fosters environmental awareness and

a positive relationship with nature, supports technological literacy through Ozobot programming, and develops creativity through artistic expression (music and visual arts).

Problem situation: Children/pupils are asked to consider how and why a ladybug gets its spots as it matures. This question motivates an inquiry-based approach and allows them to seek answers through play, observation, model creation, and coding Ozobot – their "ladybug."

Key questions:

- How does a ladybug change throughout its life?
- When and why does it get its spots?
- What is the purpose of the spots on its body?
- How can we represent the ladybug's journey to adulthood using Ozobot?
- What can we learn about nature and technology from observing a ladybug?
- How can we connect science, art, technology, and music in one activity?

DIDACTIC STRATEGY (Main Approaches):

PBL (Project-Based Learning): Children/pupils solve a real-world problem – how the ladybug changes during its life and how its spots appear. They learn through planning, collaboration, and creating a final product (Ozobot's cloak, coded path, and musical presentation).

ConstructioNism: (learning occurs through active creation) – The child/pupil "constructs" their understanding through hands-on activity (programming Ozobot, creating visual and musical representations, modeling and exploring), thereby developing deeper understanding of natural and technological phenomena.

E–U–R Method (Evocation – Realization of Meaning – Reflection):

- Evocation: Motivation through the question "How does the ladybug get its spots?"; brainstorming, discussion, introduction of Ozobot as the "Ladybug."
- Realization of Meaning: Inquiry-based learning – observing the life cycle, designing Ozobot's path, collecting "spots."
- Reflection: Musical and movement presentation of Ozobot's journey, discussion about what the children learned and how they collaborated.

CONNECTION TO COMPETENCIES DEVELOPMENT:

- Scientific Competences: Understanding and describing the life cycle of insects.
- Digital and Mathematical Competences: Use of Ozobot and basic programming concepts.
- Creative Competences: Artistic and musical expression (designing the cloak, rhythm activities).
- Social and Communication Competences: Cooperation, sharing, and presentation.

STUDENTS' (CHILD' / PUPIL') ENTRY SKILLS

☒ Basics of TinkerCAD *(optional – depending on technology availability)*: The child/pupil can create a simple 3D shape (e.g., a ladybug's wing or spot) or understands the concept of digital modeling.

☒ Experience with GeoGebra3D *(not required)*: The child/pupil recognizes basic geometric shapes and understands the relationship between shape and space.

☒ Working with STL/OBJ files: Under teacher guidance, the child/pupil can identify a 3D model and observe how it is prepared for printing (principle explanation).

☒ Basic slicing (PrusaSlicer / Cura / Bambu Studio) *(performed by teacher or older student – demonstration)*: The child/pupil observes the model preparation process and can name basic steps (design – edit – print).

☒ Experience with other software (please specify): Ozobot Edu, Ozobot Blockly, Tinkercad, Paint, PowerPoint (depending on availability). The child/pupil understands the basic principles of Ozobot movement using color codes.

☒ 3D printing safety: The child/pupil knows not to touch the device during printing, follows teacher's instructions, and behaves safely in a technology-rich environment.

3D TOOLS AND SOFTWARE

• Modelling software: Tinkercad, Fusion 360, Blender, GeoGebra 3D (for creating simple 3D objects – e.g., ladybug body, spots, wings, or environment for Ozobot).

• Slicer: PrusaSlicer, Bambu Studio (for converting models into printable G-code and viewing print layers).

• Viewer/AR: Phone – AR Viewer / USDZ (for visualizing 3D models in space – e.g., displaying the ladybug in the classroom using a tablet or phone).

Teacher's note: Depending on the children's age, most of these tools may be used in a demonstration or experiential mode – children/pupils observe, experiment, and describe what they see while the teacher explains the principles of 3D modeling, printing, and augmented reality.

3D PRINTING

Equipment required for the activity:

- 3D printer (e.g., Prusa i3 MK3S+, Bambu Lab P1P, Creality Ender 3) – to print the ladybug model or Ozobot spots.
- PLA filament (red, black) – an eco-friendly and safe material suitable for children.
- Computer or laptop – for modeling in Tinkercad and preparing models for printing.
- Internet access – for cloud-based Tinkercad work.
- Slicer software (PrusaSlicer, Bambu Studio) – for G-code conversion.
- USB or SD card – for transferring G-code to the printer.
- Basic protective equipment (e.g., gloves when handling the hot bed, safety glasses during maintenance).
- Printable models – e.g., Ozobot's ladybug "cloak," spots, or decorative wings.

- Base or platform – e.g., "grass" or "meadow" where Ozobot moves (can be printed or painted by children/pupils).

Teacher's note: 3D printing can be done in advance (teacher prepares models) or as a demonstration – children/pupils observe the printing process and discuss the principle of layering and object construction.

Learning objectives related to 3D modelling and printing

Main objective: The child/pupil can design and realize a simple 3D model (cloak or wings of a ladybug) and prepare it for 3D printing, applying basic principles of modeling and printing technology.

Secondary objectives:

- Recognize and use basic tools of modeling software (Tinkercad, Blender, Fusion 360).
- Understand the principle of layering and model preparation for 3D printing (slicing).
- Handle the printer and filament safely under teacher supervision.
- Analyze the final model and identify possible improvements before reprinting.
- Integrate the 3D model into a creative task (e.g., placement of spots, design of Ozobot's cloak).
- Present and explain their model (product) to peers and reflect on their own creative process.

STEAM Elements

STEAM ELEMENT	CHARACTERISTICS OF THE ELEMENT IN THE ACTIVITY
SCIENCE	Observation of the ladybug's life cycle, discovering how and when spots appear, and discussing their biological function (coloration and survival).
TECHNOLOGY	Use of Ozobot and color codes to represent ladybug movement; work with 3D modeling software (Tinkercad) and preparation for 3D printing.
ENGINEERING	Designing and programming Ozobot's route, planning spot placement, creating cloak and wings – solving a technical problem.
ARTS	Visual creation of the cloak and wings; rhythmic and musical presentation of Ozobot's journey to the song "*Seven-Spotted Ladybug*."
MATHEMATICS	Counting spots on the ladybug, planning Ozobot's route, spatial orientation, and relationships between shapes in 3D modeling.

Syllabus of Cross-Curricular Links

SUBJECTS	AREA OF LEARNING	CONTENT STANDARD	PERFORMANCE STANDARD
SCIENCE	Life cycle of animals	The child/pupil understands the basic stages of the insect life cycle, its key features, and the meaning of coloration.	The child/pupil describes the ladybug's developmental stages and explains the purpose of its spots.
TECHNOLOGY	Digital literacy, programming	The child/pupil uses basic programming tools (Ozobot, color codes) and	The child/pupil programs Ozobot to follow a

		understands robotic movement principles.	designed path representing the ladybug's life cycle.
ENGINEERING	Problem-solving, model creation	The child/pupil designs a simple model or product, plans its realization, and tests its functionality.	The child/pupil creates wings and a cloak model, tests Ozobot's movement along the path.
ART EDUCATION	Creative activity, visual expression	The child/pupil uses various techniques to create and decorate objects (colors, shapes, patterns).	The child/pupil designs and creates an aesthetic cloak and wings, collaborates in presentation.
MUSIC EDUCATION	Music literacy, rhythm	The child/pupil responds to rhythm and melody, connects movement with music.	The child/pupil presents Ozobot's movement to the rhythm of the song *"Seven-Spotted Ladybug."*
MATHEMATICS	Counting, geometry	The child/pupil recognizes and counts shapes, numbers, and patterns in the environment.	The child/pupil counts ladybug's spots and plans Ozobot's path based on spatial patterns.

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PART 2: Specific Planning – Lesson Plan

Title of the Lesson: How Does the Ladybug Get Its Spots? – The Journey of the Seven-Spotted Ozobot

Lesson Objectives:

- Understand the significance of the final stage of the ladybug's life cycle and its transformations.
- Connect knowledge about nature with technology through programming Ozobot.
- Develop creativity in designing the ladybug's path and in artistically depicting its wings.
- Apply the rhythm of the song "*Seven-spotted Ladybug*" when presenting the movement of Ozobot.
- Collaborate in a team and reflect on the learning process.

Expected Student Outcomes:

- Describes the stages of the ladybug's life cycle.
- Identifies and counts the number of its spots.
- Designs and codes Ozobot's route symbolizing the ladybug's journey.
- Creates seven black dots on Ozobot's "cloak" using a 3D pen,
- Explains the meaning of the spots and coloration.
- Presents their work in a musical and movement performance.

Lesson Plan (Phased Description)

1. Introduction – Motivation, Objectives, Criteria (Evocation Phase)

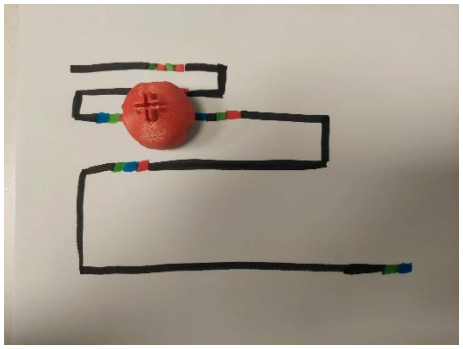
- Discussion with children/pupils: What do we know about ladybugs? What do they look like? How many spots do they have?
- Brainstorming: "How does a ladybug get its spots?"
- Introduction of learning objectives: Together we will find out how the ladybug grows up and changes.
- Presentation of Ozobot – "The Seven-Spotted Ozobot", which will accompany the ladybug on its journey.

Materials: pictures of ladybugs, Ozobot, markers, paper, canvas, interactive whiteboard.

2. Child/Pupil Learning – Knowledge Construction (Realization of Meaning)

- Children/pupils observe pictures or a video about the ladybug's life cycle.
- Discussion: What happens when the ladybug grows up? How does it get its spots?
- Practical activity: Designing a route for Ozobot (using color codes – Ozocodes).
- Task: "Let's help the ladybug earn her seven spots!"
- Along Ozobot's route, children place paper spots – one after each stop.
- Children/pupils program Ozobot to complete the entire route.

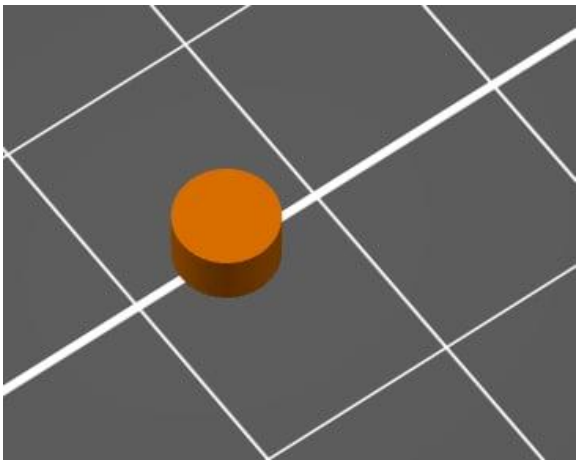
Materials: Ozobot, markers, white paper, color Ozocodes, paper spots, red "cloak" for Ozobot.

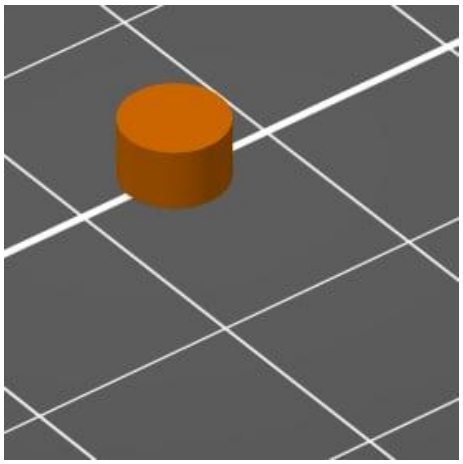


3. 3D Modeling – CAD (Creative Phase)

(Adapted to the child's/pupil's age; can be done manually or digitally)

- Children/pupils design the ladybug's wings – shape, number of spots, colors.
- They can model the wings from paper, modeling clay, using a 3D pen or in a simple 3D program (e.g., Tinkercad).
- The goal is to understand how the ladybug's shape and color help it in nature (camouflage, warning coloration).





4. 3D Printing – Slicing and Printing (or Creative Realization)

- The teacher (or children/pupils) prints a simple 3D model of the ladybug and its spots.
- Alternative: children/pupils create the ladybug as a paper decoration for Ozobot.
- They complete the "cloak" for Ozobot – a red cover with seven black spots.

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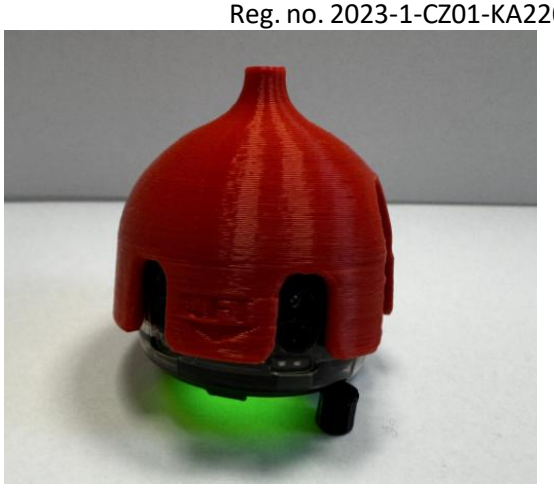

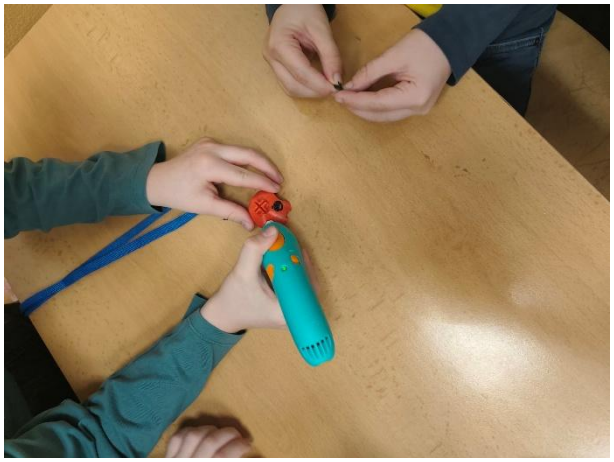

Assessment – Overview

- Group activity: Ozobot's Memory Journey – children/pupils run Ozobot along its path to the song "*The Seven-Spotted Ladybug*".
- Children/pupils describe what they learned, what they succeeded in, and what they would do differently.
- Teacher questions: How does the ladybug change? How did we help Ozobot get seven spots? What did you like the most? (what children/pupils succeeded or struggled with in each phase of the project).

Assessment of 3D Modelling and 3D Printing (Detailed)

1) Does the student (child/pupil) understand the principle of change in the ladybug's life cycle?

- Method: Mind map, discussion.

2) Did the student (child/pupil) create a ladybug cloak or model with the appropriate spots?

- Method: Product assessment – evaluation of the ladybug's wings and cloak, Ozobot's route, number of spots, visual design, and movement functionality.
- Assessment criteria: Accuracy of the number of spots on the cloak (7 spots). Color and shape design

of the cloak and wings. Functionality of Ozobot's route (whether it completes the full path as designed). Creative and aesthetic approach to the model.
- Observation and evaluation: The teacher or peers observe the product and assess it based on the established criteria.
- Feedback: Product evaluation is combined with a short discussion – what went well, what could be improved, and how the product reflects knowledge of the ladybug's life cycle.
- Documentation: Photographs of the final product. Short written description or oral presentation by the child/pupil about their model.

3) Can the student (child/pupil) present the result of their work and describe the process?
- Method: Presentation, peer review – children/pupils not only show their product (e.g., ladybug cloak, Ozobot route) but also reflect and evaluate their peers' products, supporting communication, critical thinking, and social skills.
- Preparation for presentation: The child/pupil explains how they created their model (cloak, wings, Ozobot route), highlighting the number of spots, color design, functionality, and innovative ideas.
- Presentation before the class or group: The child/pupil presents their product and demonstrates how Ozobot follows the route. Other children/pupils observe and ask questions, promoting discussion and argumentation skills.
- Peer review – assessment by classmates: Each child/pupil briefly evaluates a peer's product using simple criteria: Number and correct placement of spots: Color and shape design. Functionality of Ozobot's route. Creative and aesthetic approach. Assessment can be verbal or visual (e.g., stars, smiley faces, colored cards).
- Feedback and reflection: The child/pupil receives comments from peers and the teacher. Discussion follows on what went well, what can be improved, and how the product connects to learning about the ladybug's life cycle.

4) Does the student (child/pupil) implement or improve their design after receiving feedback?

- Method: Prototype revision – the child/pupil analyzes and adjusts their initial product (e.g., ladybug cloak or wings, Ozobot route) based on experience, testing, or feedback from the teacher or peers.
- Prototype testing: The child/pupil runs Ozobot along the route or evaluates the 3D model of the cloak and spots, observing whether movement and design function correctly.
- Analysis and identification of shortcomings: The child/pupil or teacher identifies issues (e.g., route collision, ill-fitting cloak, incorrect number of spots).
- Prototype modification: The child/pupil adjusts the model, route, or cloak according to identified issues; in 3D modeling, may change shape, size, spot placement, color, or proportions.
- Testing and re-evaluation: The revised prototype is tested again, and its functionality and aesthetics are reviewed. The process can be repeated until the product is satisfactory.

5) Teamwork in creating and programming Ozobot?

- Method: Observation, self-assessment – combining direct observation of the child's/pupil's behavior and activity by the teacher or peers with reflection on their own learning and performance. This helps identify how the child/pupil collaborates, solves problems, thinks creatively, and applies acquired knowledge using Ozobot and 3D modeling.
- Teacher observation: The teacher monitors the child/pupil's activity during the creation of the

ladybug model, Ozobot route design, or presentation, focusing on teamwork, accuracy, creativity, adherence to instructions, and safety.

- Peer observation (optional): Peers observe how classmates perform tasks and provide brief feedback (e.g., what they did well, what they could improve).
- Child/pupil self-assessment: The child/pupil evaluates themselves using a simple form or discussion: What went well? What would I improve next time? What skills have I gained? How did I cooperate with others?
- Feedback and reflection: The teacher discusses the self-assessment with the child/pupil and adds observations. The child/pupil learns to critically evaluate their own work and set goals for future activities.

Additional Information (Optional)

Notes: The topic allows for differentiated learning – children/pupils can design simpler or more complex routes for Ozobot according to their abilities.

Teaching Resources / Support Materials: Pictures of the ladybug's life cycle, Ozobot, markers, paper, song "*The Seven-Spotted Ladybug*", worksheets, insect video.

Evaluation Resources / Materials: Observation sheets, mind map, photo documentation, self-assessment form.

Other Resources / Materials: Tinkercad (or another 3D program), 3D printer (if available), art supplies.