# OUTSTE(A)M in Action: Let's STE(A)M

## My OUTSTE(A)M Learning Scenario Template

**"Mathematics and Technical Drawing in Space Technology**

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# Presenting the template

The OUTSTE(A)M Learning Scenario template is for all educators in formal education (early childhood education and care, primary, secondary). A Learning Scenario provides all the details for a lesson or series of lessons and the activities that are to take place to help pupils understand better a specific topic.

### How to fill in the sections of the template

In the following pages, you will design your own OUTSTE(A)M Learning Scenario and share it with the community. Every bit is important: all educational activities, your instructional strategies, your aims, and the final outcomes are some of these aspects.

Each section provides you with instructions about what information needs to be included. Add the required information and delete the instructions before submitting.

### OUTSTE(A)M Learning Scenario Basic Information

In this section, you need to add some information that supports the **identification of your Learning Scenario**. This will give the reader an **overview** of the essential elements of your Learning Scenario, ensuring that anyone who wants to use it can easily understand its focus, target audience, and educational goals. The title and keywords will help make your scenario **searchable**, while the summary provides a quick **snapshot of the content**. Additionally, the license ensures that your work can be shared and adapted by others under the appropriate terms. The overview breaks down key logistical details, including the subject areas, topics covered, and required materials, making it **easier for other trainers to assess whether the Learning Scenario fits their needs.** Finally, the **aim** of the lesson clearly defines the intended **learning outcomes for learners**.

### The OUTSTE(A)M Learning Scenario activities

This section outlines the **step-by-step structure of your Learning Scenario**. In the Activity Plan, you will list each activity by name, describe the procedure, and indicate the duration. The Assessment unit allows you to detail how you plan to measure the learners' understanding, whether through quizzes, projects, or other methods. The Trainees' feedback section is about how you plan to gather the feedback of the teachers you will train on the activities you propose.

### Reflection on Practice

This section is crucial for aligning your Learning Scenario with broader STEM education strategies and competency frameworks. In the STEM Strategy Criteria, you will select which criteria your scenario addresses and optionally reflect on this. These criteria help ensure your scenario contributes to the development of a comprehensive STEM strategy. You will also find throughout the OUTSTE(A)M Learning Scenario template guiding questions to help you reflect on your development process and the choices you have made when designing this Learning Scenario (process-oriented assessment).

# My OUTSTE(A)M Learning Scenario

## Basic Information

**Title:** Mathematics and Technical Drawing in Space Technology

**Replace this sentence with the title of your Learning Scenario.**

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## Summary

This Learning Scenario engages students in designing and constructing a NASA Starshade model using mathematics and technical drawing. Students apply geometric concepts such as circles, angles, and symmetry to create their own precise templates and build functional models. They test their designs to explore how shape affects light blocking and understand real-world engineering applications. The activity promotes STEM skills, creativity, and problem-solving through hands-on, project-based learning.

## Keywords

Technical drawing, Geometry, STEM, Space engineering, Project-based learning

## Aim

By the end of this Learning Scenario, students will be able to apply geometry and technical drawing skills to design and construct a symmetrical Starshade model. They will understand how mathematics is used in real engineering to solve practical problems.

## License

## Overview

| | |
|---|---|
| **Subject(s)** | **Mathematics, Technical Drawing, Physics, Engineering, ICT** |
| **Topic(s)** | Geometric construction and symmetry in space engineering |
| **Age of pupils** | 15-16 |
| **Preparation time** | Mathematics – 1 hour<br>Technical Drawing – 2 hours<br>Physics – 1 hour |
| **Implementation time** | Mathematics – 45min<br>Technical Drawing – 45 min<br>Physics – 45 min |
| **Teaching Materials** | Online materials and resources:<br>• NASA JPL Space Origami – Starshade activity: https://www.jpl.nasa.gov/edu/resources/project/space-origami-make-your-own-starshade/<br>• YouTube video explaining the Starshade concept (NASA Starshade animation)<br>• Google Classroom (for sharing instructions and student work)<br>• Online images and diagrams of geometric constructions and symmetry<br><br>Physical materials:<br>• Plain paper (A4 or A3) and thicker paper or cardboard<br>• Graph paper (optional)<br>• Pencils, erasers, sharpeners<br>• Rulers<br>• Compasses<br>• Protractors<br>• Scissors<br>• Glue and tape<br>• Flashlights (or mobile phone flashlights)<br>• Coloured pencils or markers (optional) |

## Learning objectives

Apply geometric concepts such as circles, angles, and symmetry to create a precise technical drawing.

Use technical drawing tools (compass, ruler, protractor) accurately and safely.

Design and construct a functional Starshade model based on their own template.

Explain how mathematics and technical drawing are used in real-world engineering.

Develop problem-solving, creativity, and collaboration skills through hands-on STEM activities.

## Lesson plan

**How are the activities that follow relevant to your own context? Why are you suggesting them? What sources or personal experiences did you draw on?**

These activities are relevant because they align with the mathematics and technical drawing curriculum and help students apply geometry in a real-world engineering context. They are based on NASA educational resources and my experience that students are more motivated when learning through hands-on, practical STEM projects

| Activity Title | Procedure | Duration | STEM Criteria Codes |
|---|---|---|---|
| **Mission Launch: Discover the Starshade** | The teacher introduces the concept of space telescopes and explains the NASA Starshade mission using a short video and images. Students discuss why scientists need special shapes to block starlight and how geometry is used in space engineering. Students identify geometric shapes in the Starshade design and share their ideas | 15 min | SCI-INQ, STEM-REL |
| **Geometry Detectives: Exploring the Shape** | Students observe the Starshade template and identify geometric elements such as circles, symmetry, angles, and repeating patterns. The teacher guides students to analyse symmetry, radius, and geometric construction. Students explain how mathematics helps create precise engineering designs. | 20 min | MATH-ANA, SCI-INQ |
| **Blueprint Engineers: Technical Drawing Challenge** | Students create their own technical drawing of the Starshade using a ruler, compass, and pencil. They construct a circle, divide it into equal parts, and draw precise geometric patterns. The teacher explains the importance of accuracy and technical drawing in engineering. | 40 min | ENG-DES, MATH-APP |
| **Space Origami Lab: Building the Starshade** | Students cut and fold the Starshade template following instructions. They apply precision and spatial reasoning to build the model. The teacher connects the activity with real engineering and explains how folding and design affect performance. | 30 min | ENG-DES, CREA-DES |
| **Test Like NASA:** | Students test their Starshade models using a flashlight to simulate a star. They observe how the shape blocks light. Students discuss | 25 min | SCI-INQ, |

| | | | |
|---|---|---|---|
| **Explore and Reflect** | results and explain how geometry affects function. They reflect on how mathematics and technical drawing are used in real space missions. | | STEM-REL |
| **Space Engineers Presentation** | Students present their models and technical drawings to the class. They explain the mathematical concepts used and reflect on the design process. Peer discussion and feedback are encouraged | 20 min | COLL-COM, CREA-DES |
| **Provision for free play** | To encourage unstructured, child-driven exploration, a dedicated classroom area called the Starshade Design Studio will be set up. This space will allow students to freely explore geometry, technical drawing, and model construction inspired by the NASA Starshade project. The area will include drawing tables, a construction zone, and a light-testing station where students can experiment independently or collaboratively.<br><br>Students will have access to a variety of technical drawing tools, including plain and coloured paper, thicker cardboard, graph paper, pencils, erasers, rulers, compasses, and protractors. These tools will allow them to independently create their own Starshade templates by drawing circles, dividing them into equal sectors, and designing symmetrical petal shapes. They will also have access to construction materials such as scissors, glue, tape, recycled materials, and loose parts (e.g., bottle caps, strings, and cardboard pieces) to support creative model building and modification.<br><br>The space will also include exploration and inspiration resources, such as printed images of the NASA Starshade, examples of geometric patterns, and simple technical drawings. A testing station with flashlights and a white wall or screen will allow students to investigate how their designs block light and to experiment with distance, shape, and folding. Students may redesign, improve, or invent completely new shapes based on their observations.<br><br>This environment encourages students to take the role of space engineers, explore mathematical and technical ideas through play, and develop creativity, spatial reasoning, and problem-solving skills. The open access to | As needed | |

| | | | |
|---|---|---|---|
| | tools and materials supports experimentation, collaboration, and self-directed learning at each student's own pace. | | |

**In your opinion, what are your activities' main strengths? How would you address their weaknesses?**

**OUTSTE(A)M Concepts**

Here you can find a list of the pedagogical approaches and concepts that were introduced throughout the MOOC. Make sure to mark the ones you addressed with your activities.

| | | | |
|---|---|---|---|
| ☒ Project-based learning | ☒ Inquiry-based Learning | ☐ Play-based learning | ☐ OUTSTE(A)M Games and Toys |
| ☐ OUTSTE(A)M Job Profiles | ☐ Outdoor learning | ☒ STE(A)M Careers | ☐ Battling Gender Stereotypes |
| ☒ Age appropriate Technology | | | |

## Assessment

Students will be assessed through **formative assessment during the activities** and a **final evaluation of their technical drawing and Starshade model**. The assessment will focus on their understanding of geometric construction, accuracy in technical drawing, creativity, and their ability to explain the connection between mathematics and engineering.

**1. Observation during the activity**
The teacher will observe students while they work and assess their ability to:

- use technical drawing tools correctly (ruler, compass, protractor),
- divide a circle into equal sectors,

- create a symmetrical and precise template,
- participate actively and solve problems independently or collaboratively.

**2. Evaluation of the final product (technical drawing and model)**
Students' work will be assessed using the following criteria:

- **Accuracy:** the circle and sectors are correctly constructed,
- **Application of mathematics:** correct division of 360° into equal angles,
- **Technical drawing quality:** neatness, precision, and use of tools,
- **Functionality:** the model is successfully constructed and tested,
- **Creativity:** originality of the petal design and improvements.

**3. Student explanation and reflection**
Students will briefly explain their work and answer questions such as:

- What tools did you use to create your template?
- How did you divide the circle into equal parts?
- Why is symmetry important in your design?
- What would you improve if you redesigned your Starshade?

**4. Short quiz (exit ticket)**

**Question 1:**
A full circle has:
A) 180°
B) 270°
C) 360°
D) 90°

**Question 2:**
If you divide a circle into 12 equal parts, each angle is:
A) 60°
B) 45°
C) 30°
D) 15°

**Question 3:**
Which tool is used to draw a circle?
A) Ruler
B) Compass
C) Protractor
D) Set square

**Question 4:**
Why is symmetry important in engineering design?
A) It makes drawing faster
B) It makes the design more balanced and functional
C) It uses less paper
D) It makes cutting easier

This assessment method evaluates students' mathematical understanding, technical drawing skills, creativity, and their ability to connect classroom learning with real-world engineering.

## Student Feedback

Students' feedback will be collected through a combination of **oral discussion, reflection, and a short written feedback activity**.

At the end of the lesson, students will participate in a **group reflection discussion** where they will present their Starshade models and share their experiences. The teacher will guide the discussion using open questions such as:

- What did you enjoy most in this activity?
- What was the most challenging part?
- What new mathematics or technical drawing skill did you learn?
- What would you do differently next time?

In addition, students will complete a short **exit ticket feedback form** with simple questions, for example:

1. How interesting was the activity?
   a)Very interesting
   b) Interesting
   c)Not very interesting
2. How difficult was the activity?
   a)Easy
   b)Medium
   c)Difficult
3. What did you like the most?

4. What would you improve?

Students will also be encouraged to give peer feedback by observing other students' designs and sharing positive comments or suggestions for improvement.

This feedback will help the teacher evaluate student engagement, identify difficulties, and improve future STEM and technical drawing activities.

## Implementation

This Learning Scenario was designed to connect mathematics and technical drawing with a real-world space engineering application, making abstract geometric concepts more meaningful and engaging for students. By asking students to create their own Starshade template using technical drawing tools, the activity promotes active learning, precision, and problem-solving. Students are not only learning how to divide a circle and construct symmetrical shapes, but also understanding why accuracy is important in real engineering contexts.

During the implementation, it is expected that students will show different levels of confidence in using compasses and protractors. Some students may need additional guidance, especially when calculating angles or maintaining precision. To address this, the teacher will provide individual support and encourage peer collaboration. Allowing students to learn from mistakes and redesign their models is an important part of the engineering design process.

The free play and testing phase is especially valuable because it allows students to experiment, explore, and improve their ideas independently. This increases motivation and supports creativity, while also reinforcing STEM skills such as observation, testing, and iterative design.

One possible challenge is time management, as technical drawing and model construction require careful work. Therefore, the activity can be implemented over multiple lessons if needed. In future implementations, the lesson could also be extended by including digital drawing tools or connecting the activity with physics topics such as light and shadows.

Overall, this Learning Scenario supports interdisciplinary learning, student engagement, and the development of key STEM competences, including mathematical reasoning, technical skills, creativity, and understanding of real-world engineering applications.

**What challenges you could possibly face based on the activities you have suggested? How would plan to overcome them?**

## Reflection on practice

# STEM Strategy Criteria

Please indicate which Criteria correspond to this specific Learning Scenario, contributing on a broader scale to the development of a STEM School Strategy, and briefly explain how you applied the specific criterion: https://www.stemschoollabel.eu/criteria.

Examples:

Connections with industry: "*a school visit to a research centre will be scheduled, either physically or virtually, so learners can directly discuss with professionals the recent developments in the field.*"

Interdisciplinary instruction: "*we will examine and implement a variety of activities in a spectrum of subjects, ranging from ethics and philosophy (non-STEM) to biology and chemistry (STEM).*"

Click the arrow on the left of each category heading to see and select the corresponding criteria.

**A. Introduction**

☐ [A1] Personalisation of learning

☒ [A2] Problem and project-based learning (PBL)

☒ [A3] Inquiry based Science Education (IBSE)

Optional: reflect on how you addressed these criteria in your lesson plan

**B. Curriculum implementation**

☒ [B1] Emphasis on STEM topics and competencies

☒ [B2] Interdisciplinary instruction

☐ [B3] Contextualisation of STEM teaching

Optional: reflect on how you addressed these criteria in your lesson plan

**C. Assessment**

☒ [C1] Continuous assessment

☐ [C2] Personalised assessment

Optional: reflect on how you addressed these criteria in your lesson plan

**D. Professionalisation of staff**

☐ [D1] Highly qualified professionals

☒ [D2] Existence of supporting (pedagogical) staff

☐ [D3] Professional development

Optional: reflect on how these criteria are addressed at your school

**E. School leadership and culture**

☐ [E1] School leadership

☐ [E2] High level of cooperation among staff

☒ [E3] Inclusive culture

Optional: reflect on how these criteria are addressed at your school

**F. Connections**

☐ [F1] with industry

☐ [F2] with parents/guardians

☒ [F3] with other schools and/or educational platforms

☐ [F4] with universities and/or research centers

☐ [F5] with local communities

Optional: reflect on how these connections were made in your lesson plan.

**G. School infrastructure**

☒ [G1] Access to technology and equipment

☐ [G2] High quality instruction and classroom materials

Optional: reflect on how these criteria are addressed at your school.

## About OUTSTE(A)M

OUTSTE(A)M is a project funded by the European Union's (EU) Erasmus+ programme under the Grant Agreement (101133868), running from 1 January 2024 to 31 December 2026. Coordinated by European Partnership aislb (EUN), a network of 30+ education ministries, OUTSTE(A)M brings together 3 partners to develop a toolkit that will help teachers and educators promote high quality outdoor learning experiences in the field of STE(A)M, as a means of addressing the insufficient attention given to STE(A)M education in early childhood education and care settings (ECEC) as well as in primary schools.

## About Scientix

Scientix®, is the number one community for science education in Europe. It aims to promote and support a Europe-wide collaboration among STEM teachers, education researchers, policymakers and other educational stakeholders to inspire students to pursue careers in the field of Science, Technology, Engineering and Mathematics (STEM).

## Annex(es)

Add here any annex(es) for the Learning Scenario, if needed.