3D STEAM

Co-funded by the European Union

3Dsteam Lesson Planner Tool for Teachers

Experimenting with volumes

AUTHORS (NAMES / SCHOOL / COUNTRY):
Petra Kočková, University of Ostrava, Czech Republic

LESSON PLANNER

General Information

- **RELATED SUBJECTS:**
  Mathematics, ICT, Technical Education, Physics
- **GRADE RECOMMENDATIONS:**
  Grade 6–9 (ages 11–15)
- **TOTAL ACTIVITY TIME:**
  2 lessons of 45 minutes (90 minutes total)

Learning Objectives

THE IMPORTANCE OF LEARNING OBJECTIVES DURING THE LESSON:

- Develop spatial reasoning and understanding of volume through hands-on 3D modeling
- Use digital modeling tools to design and modify cubes and other basic geometric solids
- Apply volume formulas to calculate and compare different shapes
- Explore how changes in size and proportions affect the volume of 3D objects
- Collaborate on solving real-life inspired challenges involving shape, size, and capacity

THE VALUE OF LEARNING OBJECTIVES AFTER THE LESSON:

- Understand how volume is used in everyday contexts (e.g., packaging, storage, design)
- Gain confidence in using 3D modeling and printing tools
- Transfer volume-related skills to other STEAM subjects and problem-solving scenarios
- Strengthen logical thinking and the ability to work with spatial concepts

- Develop a deeper appreciation for the link between mathematics, design, and technology

---

Overview

TOPIC & PURPOSE:

This activity combines math and technology through 3D modeling and printing. Students design two solids with a 1:2 ratio, calculate their volumes, and test how many smaller solids fit into the larger one. It enhances spatial imagination, logical reasoning, and practical math applications.

ACTIVITY PRE-REQUISITES:

- Basic knowledge of geometric solids (cube, cylinder)
- Familiarity with volume formulas
- Basic ICT skills and 3D modeling environment

3D Modeling and 3D Printing Integration

3D MODELING TOOLS AND SOFTWARE:

Tinkercad or similar beginner 3D tool / Prusa Slicer

3D PRINTING PROCESS:

Design 3D solids digitally, export STL, and print using slicing software and 3D printer

LEARNING OBJECTIVES RELATED TO 3D MODELING AND PRINTING:

- Create and manipulate 3D solids
- Understand model scaling and its effect on volume
- Verify theoretical calculations with real models

STEAM Elements

SCIENCE: Volume, density, material properties

TECHNOLOGY: Use of 3D modeling and slicing tools

ENGINEERING: Designing solids with precise proportions

ARTS: (Optional) Decorating 3D shapes

MATHEMATICS: Volume formulas, scale factor, ratios

Syllabus

LESSONS:

- Introduction to volume and 3D shapes (Math)
- Volume comparison and 3D modeling (Physics /ICT)

SUBJECTS:

Mathematics, ICT, Physics, Technical Education

TOPIC OF THE UNIT:

Volume, ratios, and practical application through 3D printing

LEARNING OBJECTIVES DURING THE LESSON:

- Accurately calculate volume
- Understand how scaling affects volume
- Apply math in practical, hands-on tasks

LEARNING OBJECTIVES AFTER THE LESSON:

- Relate math concepts to physical models
- Apply logical thinking in real-world scenarios

Instructional Plan by Lesson

LESSON 1:

TIME PLAN: 45 minutes

TEACHING & LEARNING ACTIVITIES:

- Brainstorm: Where do we use volume in real life? (5 min)
- Show examples of solids and discuss volume formulas (10 min)
- Group activity: calculate volume of simple 3D shapes (15 min)
- Introduce the modeling task (two solids, 1:2 ratio) (10 min)
- Design solids in 3D software (5 min)

MATERIALS:

PC/tablet with 3D software, paper for sketching, volume formulas

LEARNING OBJECTIVES:

Understand and apply volume calculations

INTRODUCTION:

Connect volume to real-life problems (e.g., filling containers)

LEARNING ACTIVITIES:

Use volume formula, scale designs

WRAP-UP & EVALUATION:

Review volume concepts and solid design

3D MODELING ACTIVITIES:

Design two proportional solids for printing

3D PRINTING ACTIVITIES:

Prepare STL files and slice models

LESSON 2:

TIME PLAN: 45 minutes

TEACHING & LEARNING ACTIVITIES:

- Review formulas and check models (5 min)
- Print and measure 3D models (15 min)
- Compare calculated vs. measured volumes (10 min)
- Group reflection and presentation (10 min)
- Optional: start “3D tangram challenge” (5 min)

MATERIALS:

3D printer, printed solids, measuring tools

LEARNING OBJECTIVES:

Compare theoretical and actual measurements

INTRODUCTION:

Recap prior session and explain experiment goal

LEARNING ACTIVITIES:

Volume comparison and problem solving

WRAP-UP & EVALUATION:

Presentation of findings

3D MODELING ACTIVITIES:

Adjust and finalize models

3D PRINTING ACTIVITIES:

Evaluate physical output against design

Evaluation Plan by Lesson

LESSON 1:

EVALUATION CRITERIA:

- Correct use of volume formulas
- Accurate 3D modeling in scale

EVALUATION METHOD:

- Teacher observation, group checks, math worksheet

3D MODELING AND PRINTING ASSESSMENT:

- Appropriateness of 3D model proportions

LESSON 2:

EVALUATION CRITERIA:

- Measured vs. calculated volume comparison
- Teamwork and problem-solving

EVALUATION METHOD:

- Group presentation, guided discussion

3D MODELING AND PRINTING ASSESSMENT:

- Success of printed model fitting task

Additional Resources

NOTES:

- Try other shapes (e.g., cones, pyramids)
- Extension: design 3D tangram animals

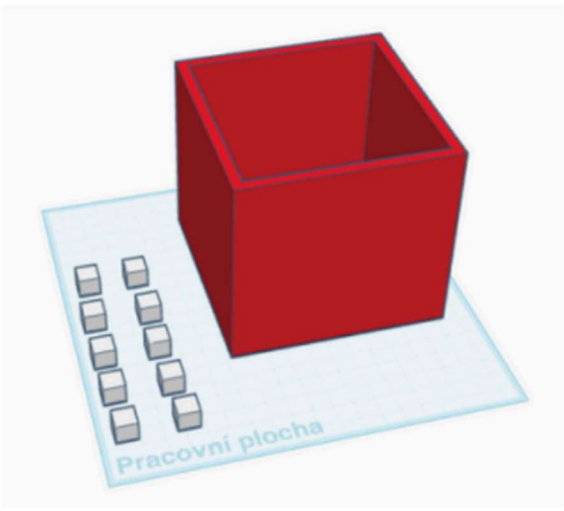
ACTIVITY SHEETS TO BE LINKED:

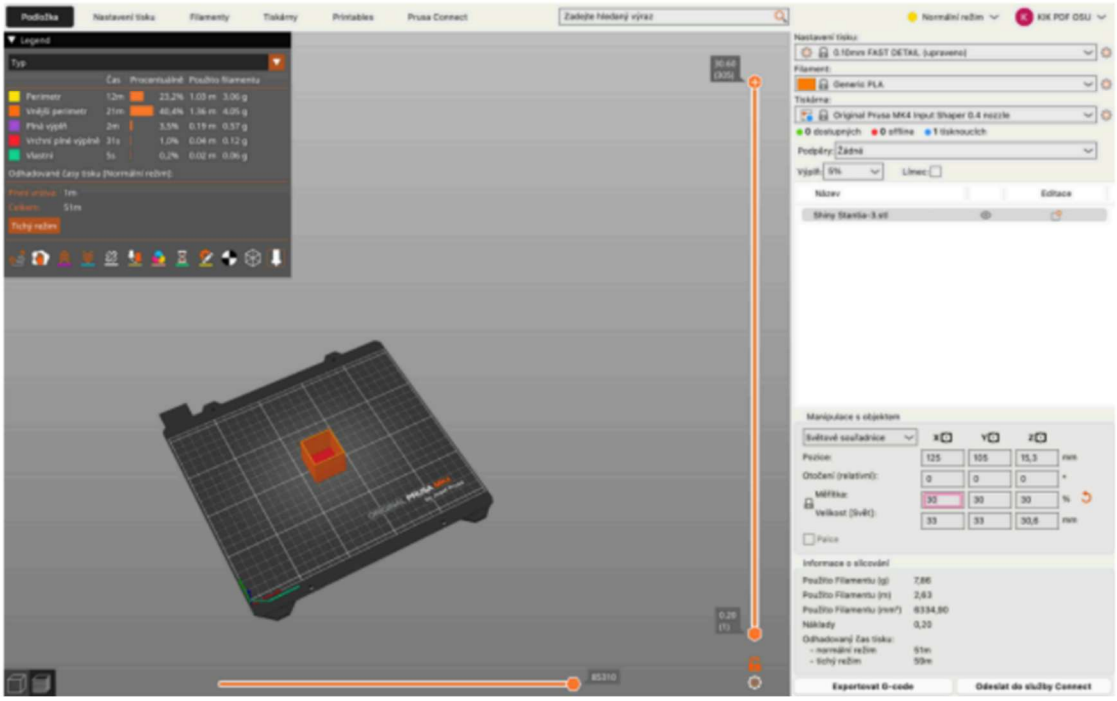
https://drive.google.com/file/d/1DgVRkvkJXE_u0yxUel5eu_lHbii9wdoU/view

REFERENCES / SUPPORTING MATERIALS TO BE LINKED:

https://www.tinkercad.com

https://www.prusa3d.com


Pracovní plocha


Podložka
Nastavení tisku
Filamenty
Tiskárny
Printables
Prusa Connect
Zadejte hledaný výraz
Normální režim
KIK PDF OSU
Legenda
Typ
Čas
Procentuálně
Použito filamentu
Perimetr
Vnější perimetr
Plná výplň
Vrchní plné výplně
Vlastní
Odhadované časy tisku (Normální režim):
Tichý režim
Nastavení tisku:
0.10mm FAST DETAIL (upraveno)
Filament:
Generic PLA
Tiskárna:
Original Prusa MK4 Input Shaper 0.4 nozzle
0 dostupných
0 offline
1 tiskoucích
Podpěry:
Žádná
Výplň:
5%
Okraj
Název
Editace
Manipulace s objektem
Světové souřadnice
Pozice:
Otočení (relativní):
Měřítko:
Velikost (Svět):
Palce
Informace o slicování
Použito filamentu (g)
Použito filamentu (m)
Náklady
Odhadovaný čas tisku:
- normální režim
- tichý režim
Exportovat G-code
Odeslat do služby Connect