

ACTIVITY 09

Experimenting with Volumes



Illustration from the activity

3Dsteam Lesson Planner Tool for Teachers

EXAMPLE

Experimenting with volumes

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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)
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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_IHbii9wdoU/view

REFERENCES / SUPPORTING MATERIALS TO BE LINKED:

<https://www.tinkercad.com>

<https://www.prusa3d.com>



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