

ACTIVITY 11

Design Your Own Geometrical Chess Set

Example how the figures could look like

1. 1 König - King
2. 1 Dame - Queen
3. 2 Läufer - Bishop
4. 2 Springer/Pferde - Knight
5. 2 Türme - Rook
6. 8 Bauern - Pawn

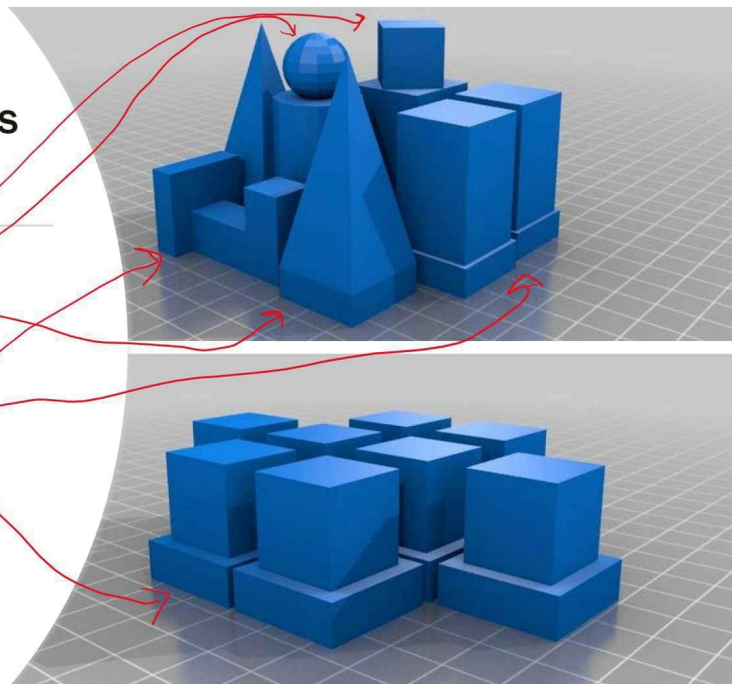


Illustration from the activity

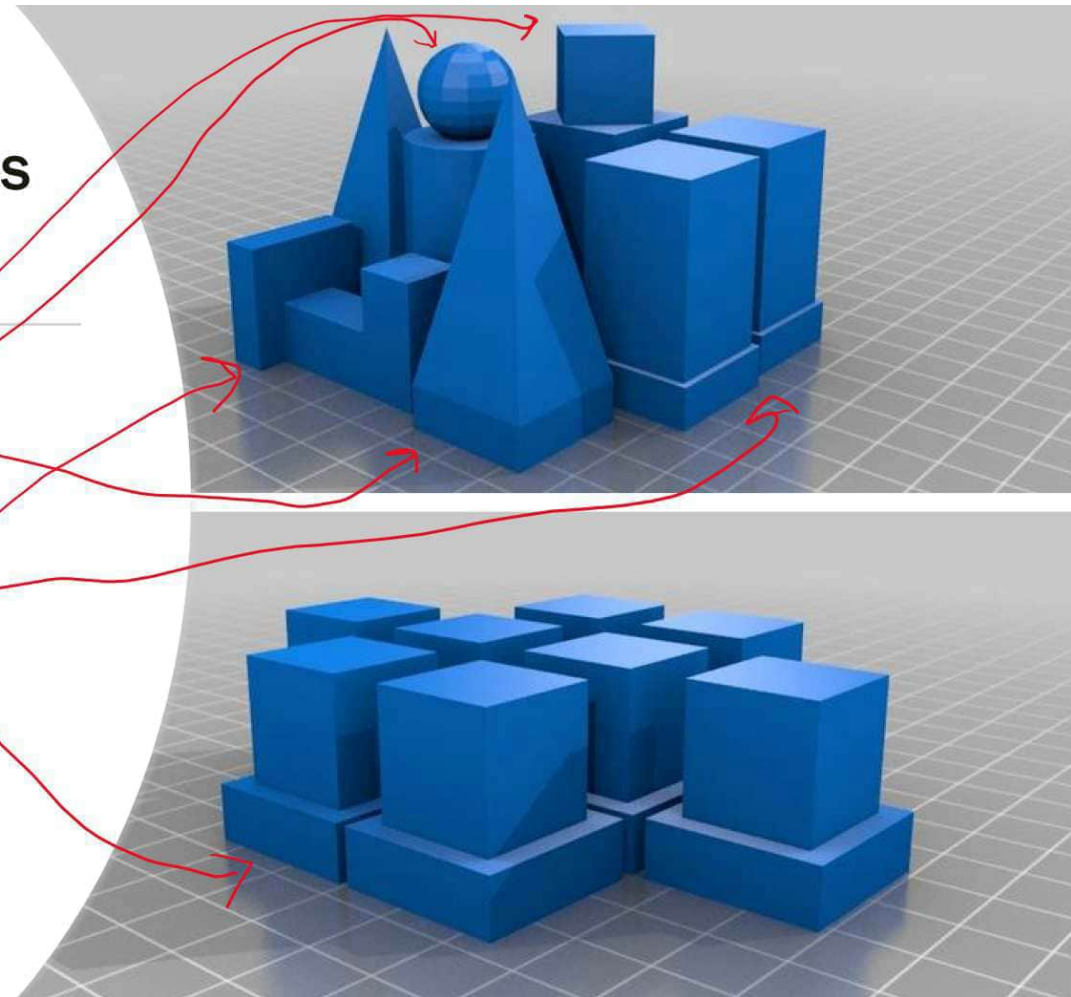
Design Your Own Geometrical Chess Set

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RELATED SUBJECTS	GRADE RECOMMENDATIONS	TOTAL ACTIVITY TIME	LEARNING OBJECTIVES DURING THE LESSON SUBJECT-SPECIFIC COMPETENCIES	LEARNING OBJECTIVES AFTER THE LESSON
Mathematics, Handicraft, Digital Literacy	Grades 7-10 (Ages 13-16)	270 minutes (3 double lessons)	- Understand basic geometry of chess figures. - Use digital modeling software effectively (Tinkercad). - Develop crafting skills by creating a physical chessboard.	- Enhanced spatial reasoning, logical thinking, and creativity. - Practical experience with digital fabrication and 3D printing technology.

Example how the figures could look like

1. 1 König - King
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Students design and 3D print custom chess sets, simultaneously crafting chessboards to practically engage with geometry, technology, and handicraft skills.

- Basic geometry (shapes, volumes, spatial reasoning).
- Introductory skills in digital technology and software usage.

3D Modelling and 3D Printing Integration

3D MODELING TOOLS AND SOFTWARE:	Tinkercad, Craftware Pro
3D PRINTING PROCESS:	Students will design chess figures in Tinkercad, export as STL files, prepare in Craftware Pro, and print using a 3D printer.
LEARNING OBJECTIVES RELATED TO 3D MODELING AND PRINTING:	- Accurate digital modeling. - Practical experience in 3D printing preparation and execution.

STEAM Elements

STEAM SUBJECTS	SCIENCE	TECHNOLOGY	ENGINEERING	ARTS	MATHEMATICS
SHORT INTRODUCTION TO RELATED SUBJECT ELEMENTS	Understanding material properties and structural stability of printed objects.	Digital modeling and using 3D printing software.	Designing, preparing, and executing 3D prints.	Aesthetic design of chess figures and chessboard.	Geometric shapes, spatial reasoning, and measurements.

Syllabus

LESS ONS	SUBJECTS	TOPIC OF THE UNIT	LEARNING OBJECTIVES DURING THE LESSON: SUBJECT-SPECIFIC COMPETENCIES	LEARNING OBJECTIVES AFTER THE LESSON: STEAM COMPETENCIES
1	Mathematics, Digital Literacy	Introduction to Chess Geometry and Figures	☐ Exploring the link between chess pieces and geometric forms ☐ Introduction to 3D modeling basics • - Understand geometric properties (e.g., symmetry, shapes, volumes) of chess figures • Apply knowledge of 2D and 3D geometry to conceptualize a design • Gain basic skills in navigating and using Tinkercad for modeling	☐ - Develop spatial reasoning through geometry-driven design ☐ Strengthen logical thinking through the rules and structure of chess ☐ Build foundational digital skills applicable across design and tech platforms
2	Mathematics, Technology	Digital Modeling and 3D Printing Preparation • Designing digital chess figures in Tinkercad • Preparing files for 3D printing with slicing software	• - Create accurate 3D chess models using geometric tools and modeling techniques • Apply mathematical concepts (proportion, symmetry, transformation) in modeling • Learn the basics of 3D slicing software and export processes	☐ - Acquire technical skills in 3D design and printing workflow ☐ Experience the iterative design process, adjusting models for functionality and printability ☐ Understand the link between mathematical design and engineering execution

3	Handicraft, Arts	Crafting the Chessboard and Final Presentation • Building and decorating a physical chessboard • Reflecting on the full project • Chess gameplay using printed pieces	• - Develop manual crafting and measurement skills through construction of a chessboard • Practice artistic expression through painting and customizing designs • Engage in reflective and strategic thinking through chess gameplay and discussion	□ - Integrate creative and engineering practices to present a complete STEAM project □ Apply learned skills in geometry, design, and fabrication in a hands-on, collaborative setting □ Develop presentation and peer feedback skills through class exhibition and gameplay experience
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Instructional Plan by Lesson

(Copy this section as many times as needed for each lesson)

TIME PLAN	TEACHING & LEARNING ACTIVITIES	MATERIALS (SOFTWARE, HARDWARE)	LEARNING OBJECTIVES
INTRODUCTION (10 MINUTES)	- Present the overall project scope: designing a custom chess set ☐ Brief history of chess and the geometry behind chess figures ☐ Discuss how shapes represent function (e.g., bishop's cut, rook's tower)	☐ - Presentation slides ☐ Physical chess set or images	☐ - Understand the connection between chess and geometry ☐ Recognize geometric features in existing chess pieces
LEARNING ACTIVITIES (25 MINUTES)	☐ Geometry activity: identify basic 3D shapes in chess figures ☐ Group task: sketch one chess piece using only geometric shapes ☐ Class discussion: what challenges might arise when modeling these pieces digitally?	Rulers, geometry templates	☐ - Analyze the composition of geometric objects ☐ Apply geometric reasoning in real-world design tasks
3D MODELLING ACTIVITIES (35 MINUTES)	☐ Introduction to Tinkercad: navigation, basic tools ☐ Guided modeling: build a pawn step-by-step	☐ - Computers ☐ Tinkercad (online) ☐ Teacher tutorial file	- Use basic CAD tools to create simple 3D forms ☐ Apply spatial reasoning in 3D space

	☐ Students begin rough modeling of a second piece (their choice)		
3D PRINTING ACTIVITIES (10 MINUTES)	☐ - Teacher shows STL file export process ☐ Live demonstration of importing file into slicing software (Craftware or Cura) ☐ Show preview of a print job	☐ - Sample STL files ☐ 3D printer or slicing preview on projector ☐ Craftware or Cura software	- Understand the pipeline from design to print Learn basic file handling and slicing concepts
WRAP-UP & EVALUATION (10 MINUTES)	- Recap what shapes belong to which piece Q&A: What worked in Tinkercad? What was confusing? Exit ticket: name 3 geometric solids and one use in your chess piece design	Discussion prompts on board	• Reflect on first experiences with digital modeling • Solidify geometry vocabulary and Tinkercad basics

TIME PLAN	TEACHING & LEARNING ACTIVITIES	MATERIALS (SOFTWARE, HARDWARE)	LEARNING OBJECTIVES
INTRODUCTION (5 MINUTES)	- Review last lesson's models	☐ - Student models	☐ - Set clear goal for modeling completion

	Introduce today's goal: design, finalize, and prepare full chess piece set for printing	☐ Tinkercad and slicing software screenshots	☐ Understand full design-to-print workflow
LEARNING ACTIVITIES (15 MINUTES)	☐ - Peer review: Students exchange models and give feedback (accuracy, creativity) ☐ Teacher mini-demo: How to check if a model is "watertight" and printable ☐ Discussion: Scaling, symmetry, and piece proportion	☐ Teacher sample models (correct/incorrect)	☐ - Evaluate 3D designs with an engineering mindset ☐ Use peer feedback constructively
3D MODELLING ACTIVITIES (45 MINUTES)	☐ - Students refine existing models or create new pieces (goal: complete at least 3–4 distinct pieces) ☐ Optional: Advanced modeling tips (chamfering, group/un-group, holes) ☐ Save STL files for printing	☐ - Computers ☐ Tinkercad ☐ Teacher modeling help sheet	☐ - Use advanced modeling techniques ☐ Finalize printable designs using CAD tools
3D PRINTING ACTIVITIES (15 MINUTES)	☐ - Students practice slicing their STL files with teacher guidance ☐ Adjust orientation, infill, supports ☐ Start printing one student piece if time allows	☐ - Craftware, Cura, or PrusaSlicer ☐ 3D printer ☐ Sample print queue list	☐ - Learn slicing software basics Prepare files independently for printing

WRAP-UP & EVALUATION (10 MINUTES)	☐ - Group discussion: What did you change and why? ☐ Submit STL files and peer feedback forms ☐ Reflection prompt: What makes a model both creative and functional?	☐ - Submission folder ☐ Printed or digital reflection sheet	- Reflect on modeling process and peer input - Assess readiness for 3D printing
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TIME PLAN	TEACHING & LEARNING ACTIVITIES	MATERIALS (SOFTWARE, HARDWARE)	LEARNING OBJECTIVES
INTRODUCTION (10 MINUTES)	- Present today's challenge: design and decorate the chessboard Show aesthetic examples (minimalist, ornate, geometric styles)	☐ - Sample boards (images or physical) ☐ Color palettes and design references	- Inspire creative planning and craftsmanship ☐ Link board aesthetics to game strategy
LEARNING ACTIVITIES (40 MINUTES)	☐ - Students measure and draw out the chessboard ☐ Cut or prepare materials (wood, cardboard, foamboard) ☐ Begin painting or decorating squares	- Rulers, cutters, paint, markers Chessboard templates	☐ - Apply accurate measurements and precision ☐ Practice planning and execution in physical design

3D MODELLING ACTIVITIES (X MINUTES)	-	-	-
3D PRINTING ACTIVITIES (20 MINUTES)	☐ Continue printing chess pieces (rotate through students) ☐ Students observe the printing process and troubleshoot if needed ☐ Compare printed pieces to digital models	☐ - 3D printer ☐ Previously sliced files ☐ Troubleshooting checklist	☐ - Gain insight into printing process and quality control ☐ Learn from success or failure of their models
WRAP-UP & EVALUATION (20 MINUTES)	☐ - Final chessboard and piece display ☐ Play chess with their own sets (if all pieces ready) ☐ Group reflection and feedback: "What was your favorite part of the process?" "What skill did you improve the most?"	☐ Photo station or display wall ☐ Chess game setup	☐ - Reflect on full STEAM experience ☐ Practice strategic thinking and presentation skills ☐ Celebrate craftsmanship and creativity

Evaluation Plan by Lesson

LESSON	EVALUATION CRITERIA	EVALUATION METHOD	3D MODELING AND PRINTING ASSESSMENT:
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1	<i>Does the student understand how geometric forms relate to chess piece design?</i> <i>Can the student identify and describe key shapes used in 3D modeling?</i>	- Concept mapping: students draw and label shapes within chess pieces • Observation during sketching and geometry activities • Exit ticket with terminology questions	☐ - Accuracy in identifying basic shapes (sphere, cone, cylinder) within chess piece sketches ☐ Quality of first Tinkercad model (e.g., basic pawn), evaluated using a simple rubric (shape use, symmetry, completeness) ☐ Ability to group and align shapes properly in the 3D workspace
2	<i>Did the student create accurate and functional 3D models of multiple chess pieces?</i> <i>Can the student prepare STL files correctly for slicing and printing?</i>	- Teacher observation during Tinkercad modeling session • Peer review using a checklist (creativity, symmetry, recognizability) • Submission of STL files and reflection on design changes	☐ - Use of consistent scale, symmetry, and correct shape combinations ☐ Successful export of watertight STL files with proper grouping ☐ Completion of slicing in software with correct print orientation, infill, and support settings ☐ Initial test prints evaluated on form accuracy and structural stability
3	<i>Is the student able to present their chess set with confidence, showing both craftsmanship and understanding of design choices?</i> <i>Did the student engage in reflection and evaluation of their full STEAM process?</i>	- Observation of board construction and painting • Self-evaluation and peer feedback on the finished set • Group discussion and/or reflection sheet submission	☐ - Final printed chess pieces evaluated for: • Print quality (layer adhesion, stability) • Design fidelity (match to digital model) • Aesthetic quality (symmetry, creativity) ☐ Overall chess set (board + pieces) evaluated using a rubric for completeness, usability, and STEAM integration

			☐ <i>Optional: video or photo presentation of the complete project</i>
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Additional Resources

NOTES:

ACTIVITY SHEETS TO BE LINKED:

EVALUATION MATERIALS TO BE LINKED:

REFERENCES / SUPPORTING MATERIALS TO BE LINKED:

LESSON 1: INSTRUCTIONAL PLAN

TIME PLAN

TEACHING & LEARNING
ACTIVITIES

MATERIALS (SOFTWARE,
HARDWARE)

LEARNING OBJECTIVES

Introduction (5 min)	Present lesson goals and engage students in initial discussion.	Presentation slides, visual aids	Clear understanding of objectives and expectations.
Learning Activities (15 min)	Interactive group discussions, practical tasks.	Worksheets, chess pieces examples	Engage students in active learning and collaboration.
3D Modelling Activities (15 min)	Students model chess figures using Tinkercad software.	Computers, Tinkercad	Gain hands-on experience with digital modeling.
3D Printing Activities (5 min)	Brief demonstration of 3D printing process.	3D printer, sample objects	Basic understanding of 3D printing technology.
Wrap-up & Evaluation (5 min)	Summary of lesson, Q&A, brief evaluations.	Discussion prompts, evaluation sheets	Confirm comprehension and clarify doubts.

LESSON 2: INSTRUCTIONAL PLAN

TIME PLAN	TEACHING & LEARNING ACTIVITIES	MATERIALS (SOFTWARE, HARDWARE)	LEARNING OBJECTIVES
Introduction (5 min)	Present lesson goals and engage students in initial discussion.	Presentation slides, visual aids	Clear understanding of objectives and expectations.
Learning Activities (15 min)	Interactive group discussions, practical tasks.	Worksheets, chess pieces examples	Engage students in active learning and collaboration.
3D Modelling Activities (15 min)	Students model chess figures using Tinkercad software.	Computers, Tinkercad	Gain hands-on experience with digital modeling.
3D Printing Activities (5 min)	Brief demonstration of 3D printing process.	3D printer, sample objects	Basic understanding of 3D printing technology.
Wrap-up & Evaluation (5 min)	Summary of lesson, Q&A, brief evaluations.	Discussion prompts, evaluation sheets	Confirm comprehension and clarify doubts.

LESSON 3: INSTRUCTIONAL PLAN

TIME PLAN	TEACHING & LEARNING ACTIVITIES	MATERIALS (SOFTWARE, HARDWARE)	LEARNING OBJECTIVES
Introduction (5 min)	Present lesson goals and engage students in initial discussion.	Presentation slides, visual aids	Clear understanding of objectives and expectations.

Learning Activities (15 min)	Interactive group discussions, practical tasks.	Worksheets, chess pieces examples	Engage students in active learning and collaboration.
3D Modelling Activities (15 min)	Students model chess figures using Tinkercad software.	Computers, Tinkercad	Gain hands-on experience with digital modeling.
3D Printing Activities (5 min)	Brief demonstration of 3D printing process.	3D printer, sample objects	Basic understanding of 3D printing technology.
Wrap-up & Evaluation (5 min)	Summary of lesson, Q&A, brief evaluations.	Discussion prompts, evaluation sheets	Confirm comprehension and clarify doubts.

LESSON 4: INSTRUCTIONAL PLAN

TIME PLAN	TEACHING & LEARNING ACTIVITIES	MATERIALS (SOFTWARE, HARDWARE)	LEARNING OBJECTIVES
Introduction (5 min)	Present lesson goals and engage students in initial discussion.	Presentation slides, visual aids	Clear understanding of objectives and expectations.
Learning Activities (15 min)	Interactive group discussions, practical tasks.	Worksheets, chess pieces examples	Engage students in active learning and collaboration.
3D Modelling Activities (15 min)	Students model chess figures using Tinkercad software.	Computers, Tinkercad	Gain hands-on experience with digital modeling.
3D Printing Activities (5 min)	Brief demonstration of 3D printing process.	3D printer, sample objects	Basic understanding of 3D printing technology.
Wrap-up & Evaluation (5 min)	Summary of lesson, Q&A, brief evaluations.	Discussion prompts, evaluation sheets	Confirm comprehension and clarify doubts.

LESSON 5: INSTRUCTIONAL PLAN

TIME PLAN	TEACHING & LEARNING ACTIVITIES	MATERIALS (SOFTWARE, HARDWARE)	LEARNING OBJECTIVES
Introduction (5 min)	Present lesson goals and engage students in initial discussion.	Presentation slides, visual aids	Clear understanding of objectives and expectations.
Learning Activities (15 min)	Interactive group discussions, practical tasks.	Worksheets, chess pieces examples	Engage students in active learning and collaboration.



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3D Modelling Activities (15 min)

Students model chess figures using Tinkercad software.

Computers, Tinkercad

Gain hands-on experience with digital modeling.

3D Printing Activities (5 min)

Brief demonstration of 3D printing process.

3D printer, sample objects

Basic understanding of 3D printing technology.

Wrap-up & Evaluation (5 min)

Summary of lesson, Q&A, brief evaluations.

Discussion prompts, evaluation sheets

Confirm comprehension and clarify doubts.





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