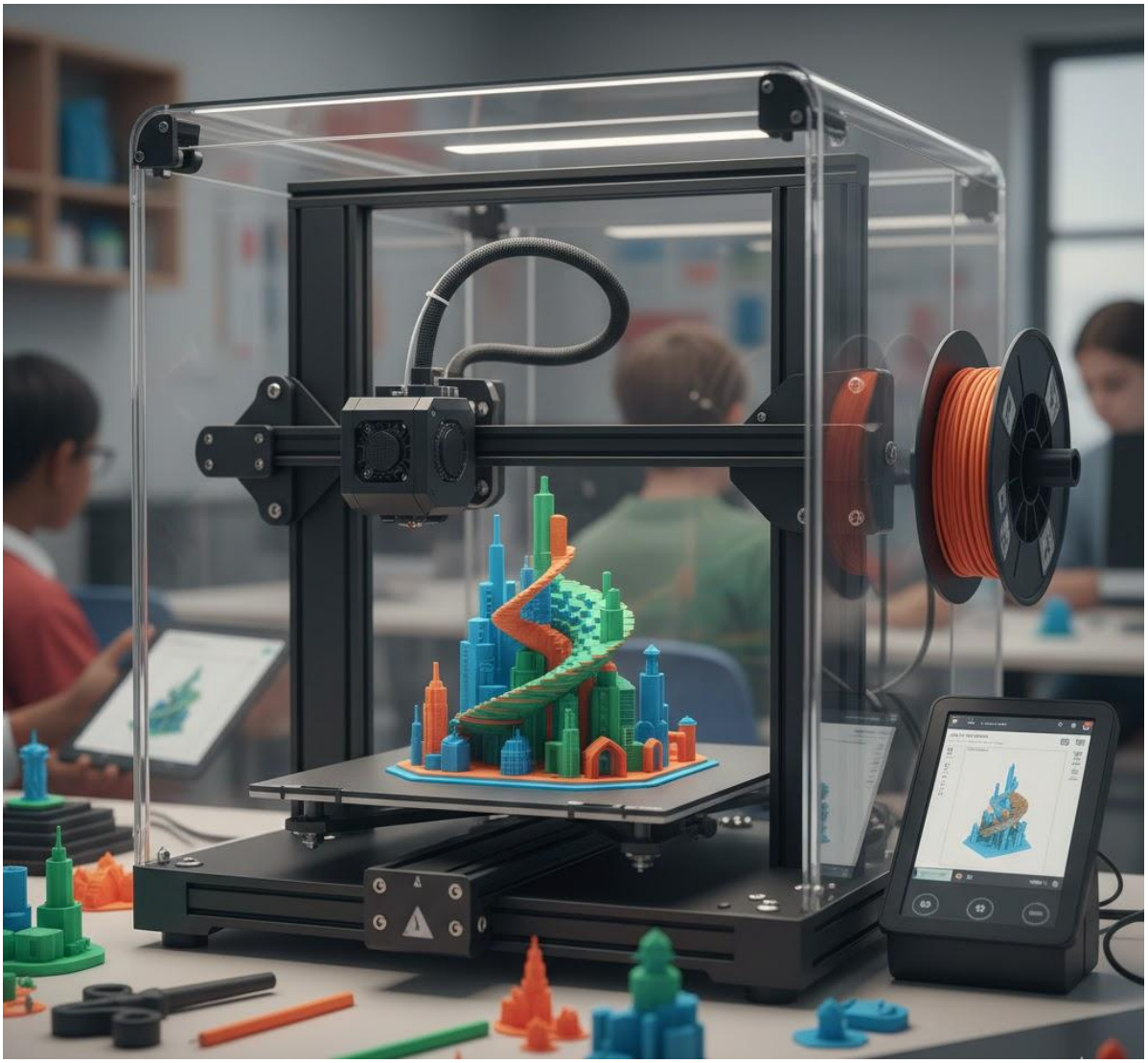
Elementary School Roudnice nad Labem, Karla Jeřábka 941, Litoměřice District
Elementary school in Borgarnes

3D PRINTING EDUCATION

METHODOLOGICAL MANUAL FOR ELEMENTARY SCHOOLS



Project partners:
Elementary School Roudnice nad Labem, Karla Jeřábka 941,
Litoměřice District, the Czech Republic
Elementary school in Borgarnes, Iceland

Funded by
the European Union

Authors and project team:
Mgr. Svitlana Hud
Mgr. Jiří Růžička
Ing. Martina Křížová
Hulda Hrönn Sigurðardóttir
Hildur Hallkelsdóttir

Editor:
Ing. Martina Křížová

Graphic Design:
Mgr. Svitlana Hud

Project name:
Education in 3D printing

Project number:
2024-1-CZ01-KA210-SCH-000245202

This project is funded by the Erasmus+ programme of the European Union.

Erasmus+ K210 - School education - Small-scale partnerships

Introduction

The methodology manual is intended for elementary school teachers, and its goal is to support the integration of meaningful and practical 3D printing in the teaching of mathematics and technical subjects. The handbook offers specific methods and activities that promote the development of students' spatial imagination, technical thinking, and digital skills.

This guide works with the online tool Tinkercad, which has been chosen as the most suitable environment for working with elementary school students.

The proposed projects have been thoroughly analysed, professionally adapted and pedagogically adapted to conform to established teaching objectives and teaching methods.

The assignments are designed to be understandable, clear, and usable in teaching for all students, regardless of their abilities, educational needs, or prior experience. Methodological methods are based on the expertise and teaching experience of the members of the project team and on practical testing of the Tinkercad tool in schools.

Contents

Methodological sheet number 1

1. CUBE

Lesson objective: How to create a cube in Tinkercad and prepare it for 3D printing. Learn how to create a cube model, prepare it for printing, and export it to the correct format.

https://www.YouTube.com/watch?v=M9eNm8IPbW8

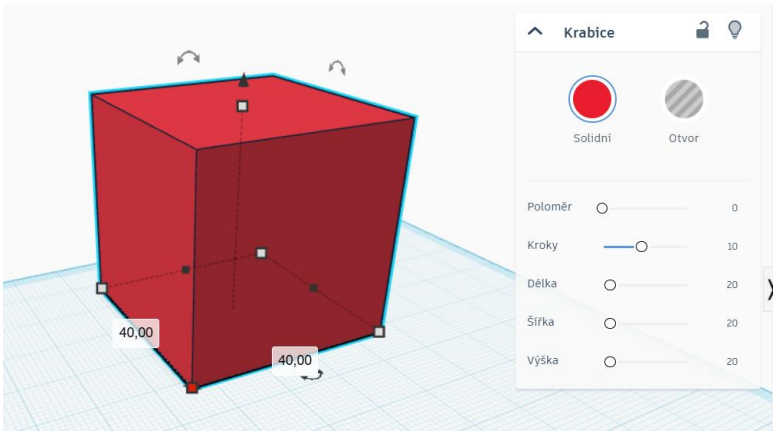
Procedure

1. Log in to Tinkercad and create a new project

1. Open Tinkercad in your browser.
2. Log in to your account or create a new account.
3. Click Create **New Design**.
4. Give the project a name – e.g., "Print Cube".

2. Object modelling, procedure according to YouTube:

1. From the right panel, in the **BASIC SHAPES** section, select the shape of the red cube, hereinafter referred to as the box.
2. Left click to drag the box to the desktop.
3. Click on the box with the left mouse button, points will be marked with which you can adjust its dimensions.
4. Left click on any vertex and adjust the length, width, and height of the object to the same value of **40 x 40 x 40 mm**. You can also set the parameters precisely by entering values in the fields next to the object.
5. Click on the **BOX SETTINGS** and adjust the other parameters as needed (radius, steps, length, width, height).



6. Check the size of the cube. Make sure the dimensions match the printing requirements.
7. Check the location of the cube on the work surface, the object must not be in the air.
8. Select the cube and make sure it doesn't contain any hidden defects.
9. Click the **EXPORT** button in the top right.
10. Select the **STL** format (standard format for 3D printing).

3. Preparing a file for printing

1. Upload the STL file to the prepress software (e.g. Ultimaker Cura, PrusaSlicer or another slicer according to your printer).
2. Set the print parameters (e.g. layer height, fill density, print speed, etc.).
3. Check the layer preview in the slicing software.

4. Print a model

1. Save the prepared file in **G-code format** and transfer it to a 3D printer.
2. Follow the manufacturer's instructions to start printing to the printer.

Time required

Activities	Estimated time
Login and set up a project	2-5 minutes
Model creation	5-10 minutes
Export and Prepare for Printing	10-15 minutes
Printing (depends on model size and fill density)	30-60 minutes

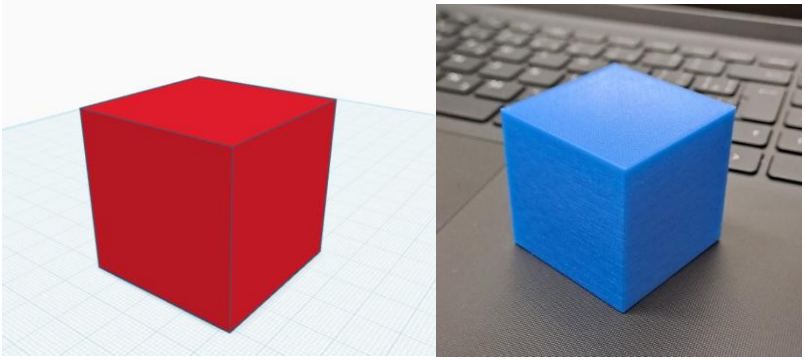
---

Tips and advice

- **Fill density:** For a firmer model, choose a 20-50% fill.
- **Checking the printer:** Make sure the print bed is clean and properly aligned.

Conclusion

After completing this lesson, you will have a finished cube model that is ready to print. This skill is the basis for creating more complex 3D models. You can use the printed cube as a teaching aid, building part or decoration.



Methodological sheet number 2

2. BLOCK

Lesson objective: How to create a block in Tinkercad and prepare it for 3D printing. Learn how to create a model of a cuboid, prepare it for printing and export it to the correct format.

https://www.YouTube.com/watch?v=WY4X31Um8qI

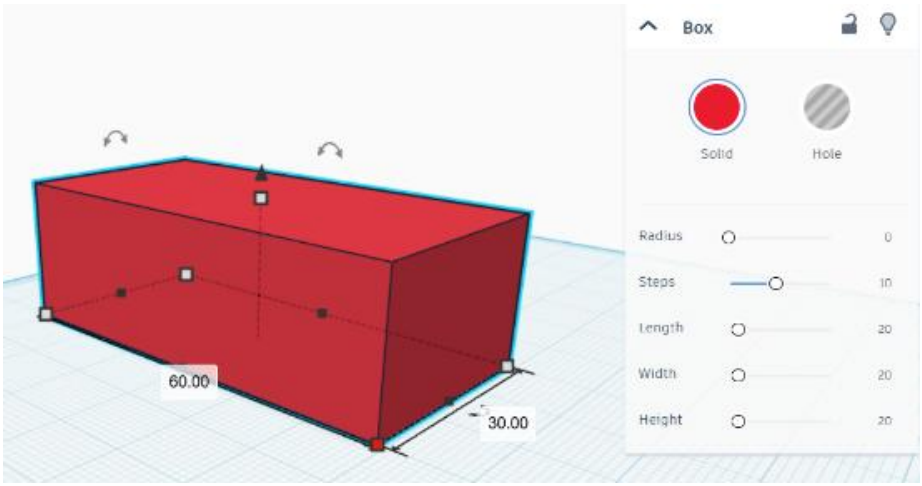
Procedure

1. Log in to Tinkercad and create a new project

1. Open Tinkercad in your browser.
2. Log in to your account or create a new account.
3. Click Create **New Design**.
4. Give the project a name – e.g. "Printing Block".

2. Modelling of the object, procedure according to YouTube:

1. From the right panel, in the **BASIC SHAPES** section**,** select the shape of the red cube, hereinafter referred to as the box.
2. Left click to drag the box to the desktop.
3. The **SETTINGS BOX** opens (where you can set the color, radius, steps, length, etc.).
4. Click on the box with the left mouse button, points will be marked with which you can adjust its dimensions.
5. Left click any vertex and adjust the length, width, and height of the object to values of **60 x 30 x 20 mm**. You can also make precise settings by entering values in the fields next to the object.



6. Check the size of the cuboid. Make sure the dimensions match the printing requirements.
7. Check the location of the block on the work surface, the object must not be in the air.
8. Select the cuboid and make sure it doesn't contain any hidden defects.

9. Click the **EXPORT** button in the top right.
10. Select the **STL** format (standard format for 3D printing).

3. Preparing a file for printing

1. Upload the STL file to the prepress software (e.g., Ultimaker Cura, PrusaSlicer, or another slicer according to your printer).
2. Set the print parameters (e.g. layer height, fill density, print speed, etc.).
3. Check the layer preview in the slicing software.

4. Model printing

1. Save the prepared file in **G-code format** and transfer it to a 3D printer.
2. Follow the manufacturer's instructions to start printing on the printer.

Time required

Activities	Estimated time
Login and set up a project	2-5 minutes
Model creation	5-10 minutes
Export and Prepare for Printing	10-15 minutes
Printing (depends on model size and fill density)	30-60 minutes

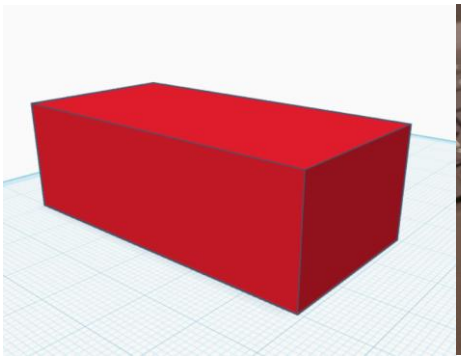
---

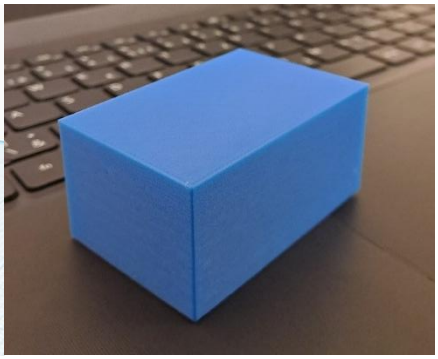
Tips and advice

- **Fill density:** For a firmer model, choose a 20-50% fill.
- **Checking the printer:** Make sure the print bed is clean and properly aligned.

Conclusion

After completing this lesson, you will have a finished model of the cuboid that is ready to be printed. This skill is the basis for creating more complex 3D models. You can use the printed block as a teaching aid, building piece or decoration.





Methodological sheet number 3

3. THE WARRIOR

Lesson objective: How to create a cylinder in Tinkercad and prepare it for 3D printing. Learn how to create a cylinder model, prepare it for printing and export it to the correct format.

https://youtu.be/6aYof9OJrBQ

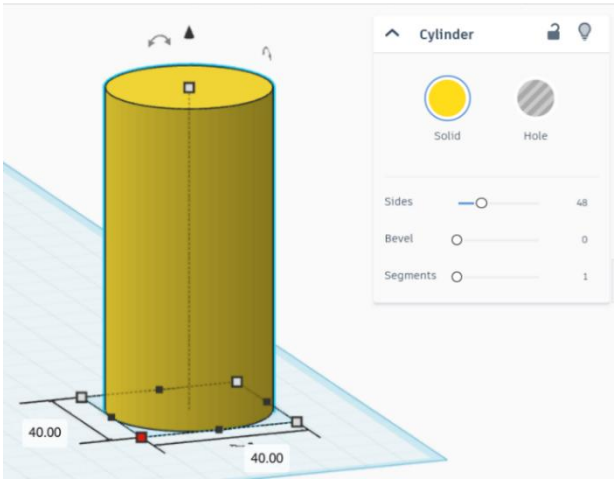
Procedure

1. Log in to Tinkercad and create a new project

1. Open Tinkercad in your browser.
2. Log in to your account or create a new account.
3. Click Create **New Design**.
4. Name the project – e.g. "Print roller".

2. Modelling of the object, procedure according to YouTube:

1. In the right panel of the **BASIC SHAPES** toolbar, find the **CYLINDER** shape.
2. Left click the **CYLINDER** shape onto the desktop.
3. Left click on an object, it will mark the points with which you can adjust its dimensions.
4. Left click on any vertex and adjust the length, width, and height of the object to values **40 x 40 x 80 mm**. You can also make precise settings by entering values in the fields next to the object.
5. In the **CYLINDER SETTINGS**, adjust the parameters as needed (color, sides, bevel, segments).



6. Check the size of the cylinder. Make sure the dimensions match the printing requirements.
7. Check the location of the cylinder on the work surface, the object must not be in the air.
8. Click the **EXPORT** button on the top right.
9. Select the **STL** format (standard format for 3D printing).

3. Preparing the file for printing

1. Upload the STL file to the prepress software (e.g., Ultimaker Cura, PrusaSlicer, or another slicer according to your printer).
2. Set the print parameters (e.g. layer height, fill density, print speed, etc.).
3. Check the layer preview in the slicing software.

4. Model printing

1. Save the prepared file in **G-code format** and transfer it to a 3D printer.
2. Follow the manufacturer's instructions to start printing on the printer.

Time required

Activities	Estimated time
Login and set up a project	2-5 minutes
Model creation	5-10 minutes
Export and Prepare for Printing	10-15 minutes
Printing (depends on model size and fill density)	30-60 minutes

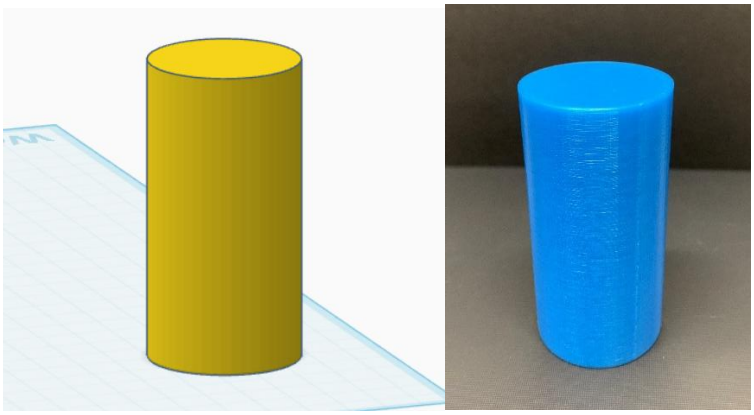
---

Tips and advice

- **Fill density:** For a firmer model, choose a 20-50% fill.
- **Checking the printer:** Make sure the print bed is clean and properly aligned.

Conclusion

After completing this lesson, you will have a finished cylinder model that is ready to print. This skill is the basis for creating more complex 3D models. You can use the printed cylinder as a teaching aid, building part or decoration.



Methodological sheet number 4

4. KUŽEL A JEHLAN

Lesson objective: How to create a cone and pyramid in Tinkercad and prepare them for 3D printing. Learn how to create a basic 3D model of a cone and pyramid, prepare them for printing and export them to the correct format.

https://youtu.be/GqF8x0GfZVQ

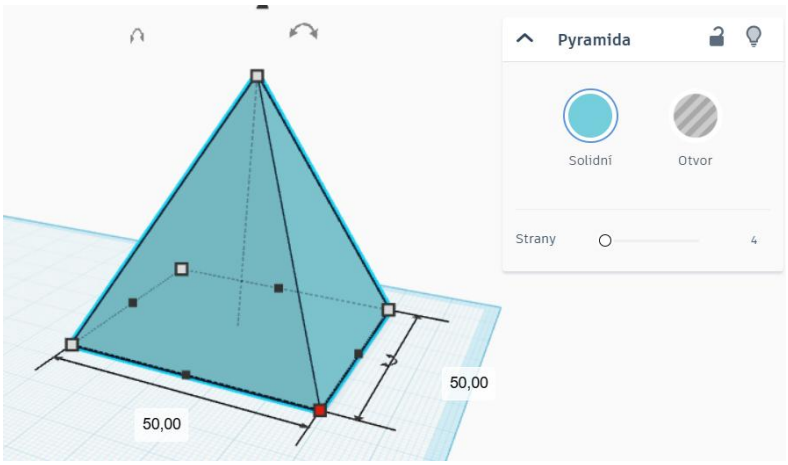
Procedure

1. Log in to Tinkercad and create a new project

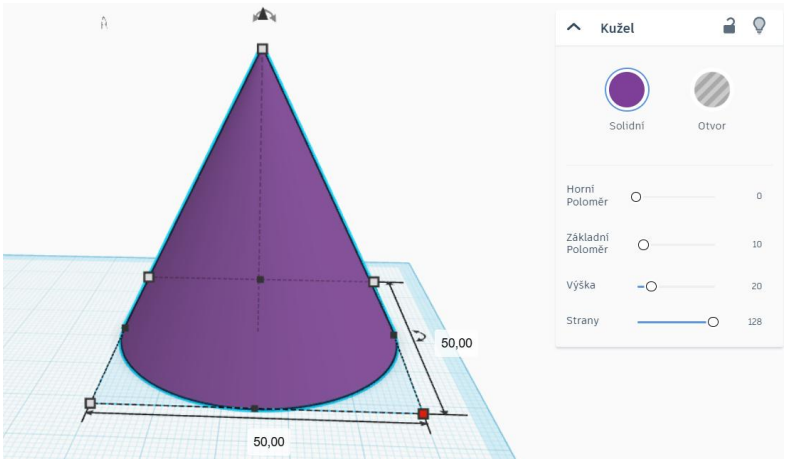
1. Open Tinkercad in your browser.
2. Log in to your account or create a new account.
3. Click Create **New Design**.
4. Name the project – e.g. "Printing Cone/Pyramid".

2. Modelling of the object, procedure according to YouTube:

1. In the right panel of the **BASIC SHAPES** toolbar, find the **PYRAMID** shape.
2. Left click to drag the **PYRAMID** shape onto the desktop.
3. Left click on an object, it will mark the points with which you can adjust its dimensions.
4. Left click any vertex and adjust the length, width, and height of the object to values of **50 x 50 x 50 mm**. You can also make precise settings by entering values in the fields next to the object.
5. In **PYRAMID SETTING**, adjust the parameters as needed (colour and sides).



6. In the same way, find the **CONE** shape on the **BASIC SHAPES** toolbar, drag the shape onto the canvas, adjust the length, width, and height of the object to **50 x 50 x 50 mm**. In the **CONE SETTINGS**, adjust the parameters as needed (upper radius, base radius, height, sides).



7. Check the size of the cone and pyramid. Make sure the dimensions match the printing requirements.
8. Check the location on the work surface, objects must not be in the air.
9. Click the **EXPORT** button in the top right (you can export both one object and several at the same time).
10. Select the **STL** format (standard format for 3D printing).

3. Preparing the file for printing

1. Upload the STL file to the prepress software (e.g., Ultimaker Cura, PrusaSlicer, or another slicer according to your printer).
2. Set the print parameters (e.g. layer height, fill density, print speed, etc.).
3. Check the layer preview in the slicing software.

4. Model printing

1. Save the prepared file in **G-code format** and transfer it to a 3D printer.
2. Follow the manufacturer's instructions to start printing on the printer.

Time required (for one object)

Activities	Estimated time
Login and set up a project	2-5 minutes
Model creation	5-10 minutes
Export and Prepare for Printing	10 minutes
Printing (depends on model size and fill density)	30-60 minutes

---

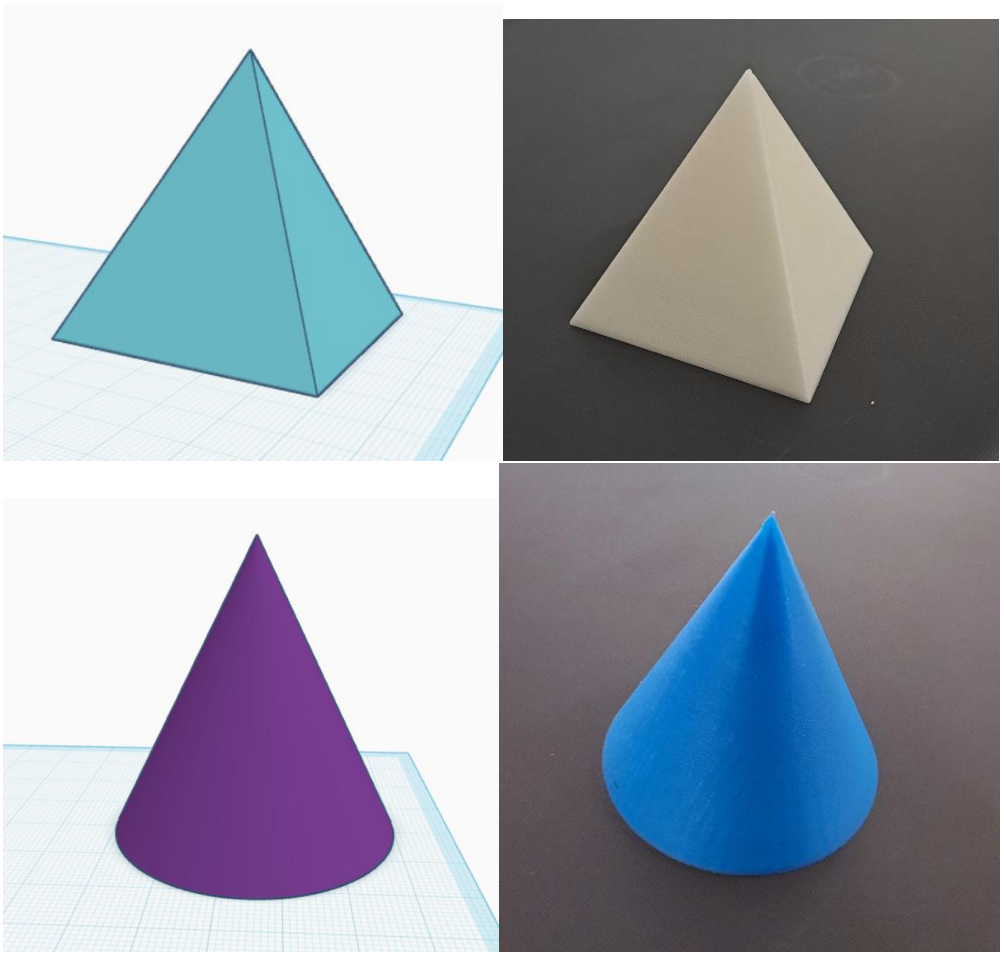
Tips and advice

- **Fill density:** For a firmer model, choose a 20-50% fill.

- **Checking the printer:** Make sure the print bed is clean and properly aligned.

Conclusion

After completing this lesson, you will have finished models of the cone and pyramid that are ready to print. This skill is the basis for creating more complex 3D models. You can use the printed models as a teaching aid, building part or decoration.



Methodological sheet number 5

5. PRISM WITH RHOMBUS BASE

Lesson objective: How to create a rhombus-shaped prism in Tinkercad and prepare it for 3D printing. Learn how to create a model of a prism with a rhombus base, prepare it for printing and export it to the correct format.

https://youtu.be/zc0LG3DXTOc

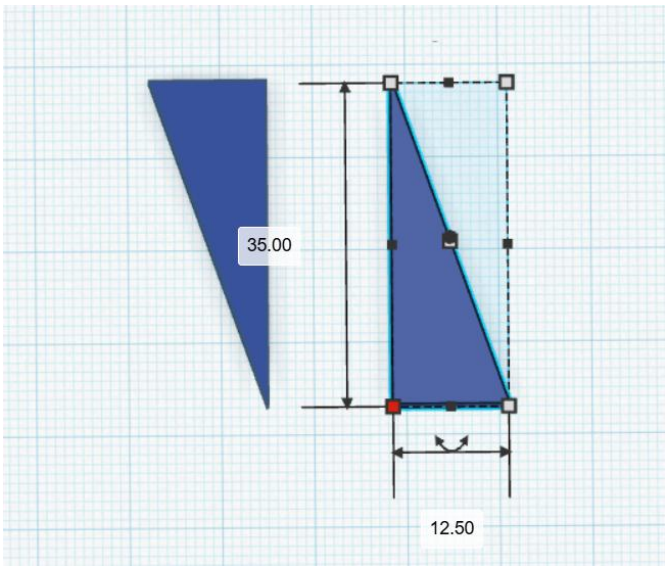
Procedure

1. Log in to Tinkercad and create a new project

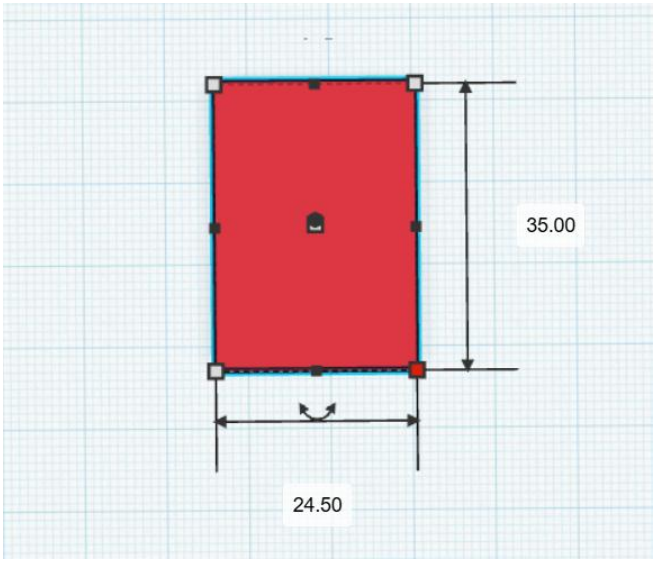
1. Open Tinkercad in your browser.
2. Log in to your account or create a new account.
3. Click Create **New Design**.
4. Name the project – e.g. "Prism with rhombus base".

2. Modelling of the object, procedure according to YouTube:

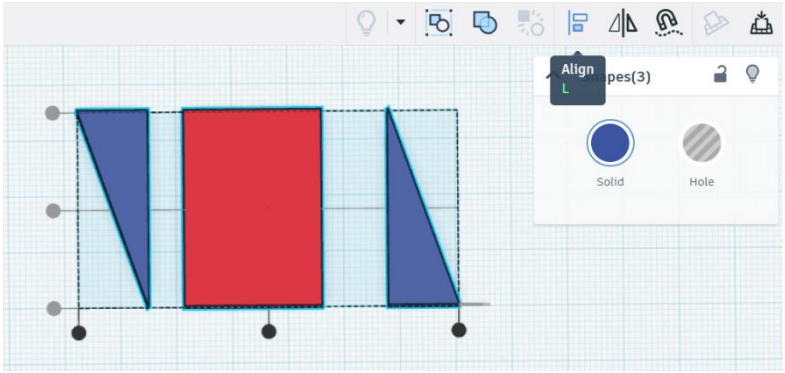
1. In the right panel of the **BASIC SHAPES** toolbar, find **the WEDGE** shape.
2. Left click the shape onto the workspace.
3. Rotate the shape along the Z axis to -90°.
4. Click on the object and adjust its dimensions to **30 x 12.5 mm**.
5. Copy the shape and place the wedges opposite each other (tips against each other).



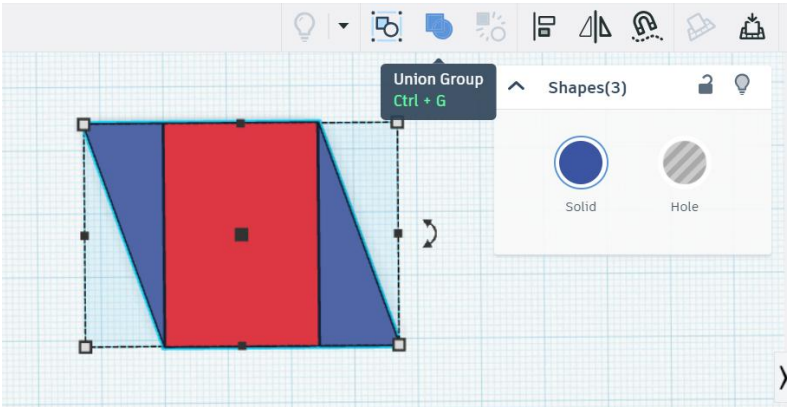
6. From the right panel of the **BASIC SHAPES** toolbar, drag the **BOX** shape to the canvas and adjust its dimensions to **35 x 24.5 mm**.



7. Place the **BOX** shape between the **WEDGE** shapes, align the objects using the **Align Tool**.
8. Place all the shapes next to each other so that there is no space between them.



9. Use **the Group tool (Ctrl+G)** to group objects.



10. Click on the object and adjust its height to **50 mm**.
11. Check the size of the prism. Make sure the dimensions match the printing requirements.
12. Check the location of the prism on the work surface, the object must not be in the air.
13. Click the **EXPORT** button on the top right.
14. Select the **STL** format (standard format for 3D printing).

3. Preparing a file for printing

1. Upload the STL file to the prepress software (e.g., Ultimaker Cura, PrusaSlicer, or another slicer according to your printer).
2. Set the print parameters (e.g. layer height, fill density, print speed, etc.).
3. Check the layer preview in the slicing software.

4. Model printing

1. Save the prepared file in **G-code format** and transfer it to a 3D printer.
2. Follow the manufacturer's instructions to start printing on the printer.

Time required

Activities	Estimated time
Login and set up a project	2-5 minutes
Model creation	15-20 minutes
Export and Prepare for Printing	10-15 minutes
Printing (depends on model size and fill density)	55-65 minutes

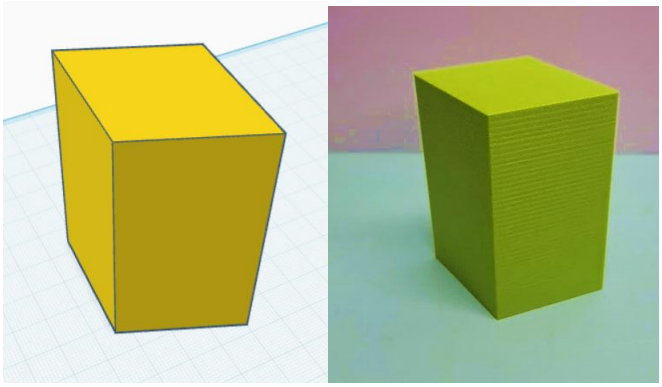
---

Tips and advice

- **Fill density:** For a firmer model, choose a 20-50% fill.
- **Checking the printer:** Make sure the print bed is clean and properly aligned.

Conclusion

After completing this lesson, you will have a finished model of a prism with a rhombus base, which is ready to be printed. This skill is the basis for creating more complex 3D models. You can use the printed prism as a teaching aid, a building part or a decoration.



Methodological sheet number 6

6. PRISM WITH RHOMBUS BASE

Lesson objective: How to create a cylinder in Tinkercad and prepare it for 3D printing. Learn how to create a model of a prism with a rhombus base, prepare it for printing and export it to the correct format.

https://youtu.be/_14bF9C4YmE

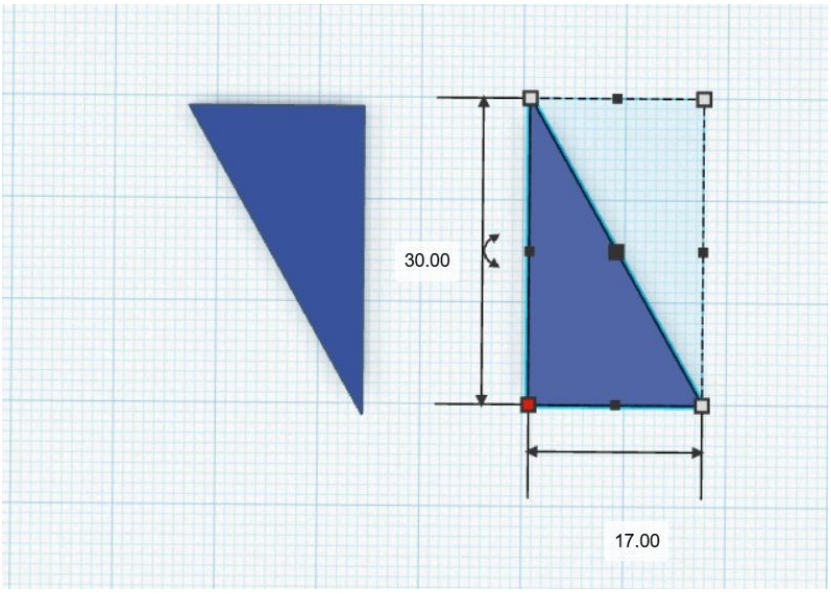
Procedure

1. Log in to Tinkercad and create a new project

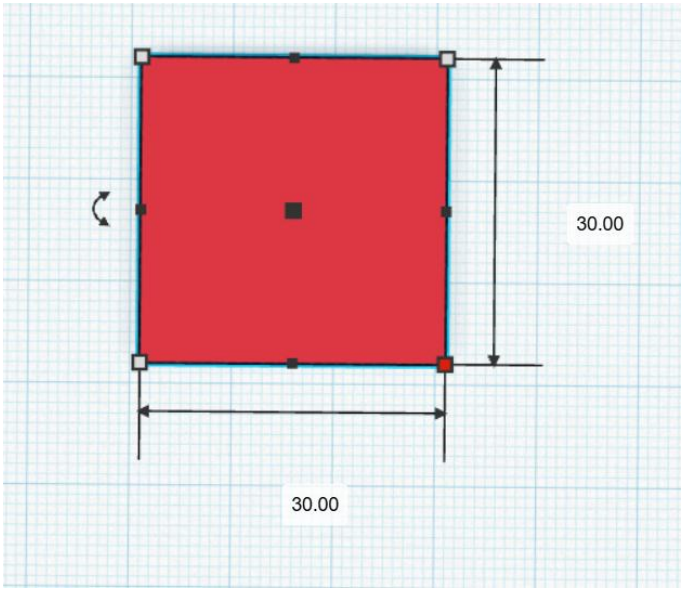
1. Open Tinkercad in your browser.
2. Log in to your account or create a new account.
3. Click Create **New Design**.
4. Give the project a name – e.g. "Prism with diamond base".

2. Modelling of the object, procedure according to YouTube:

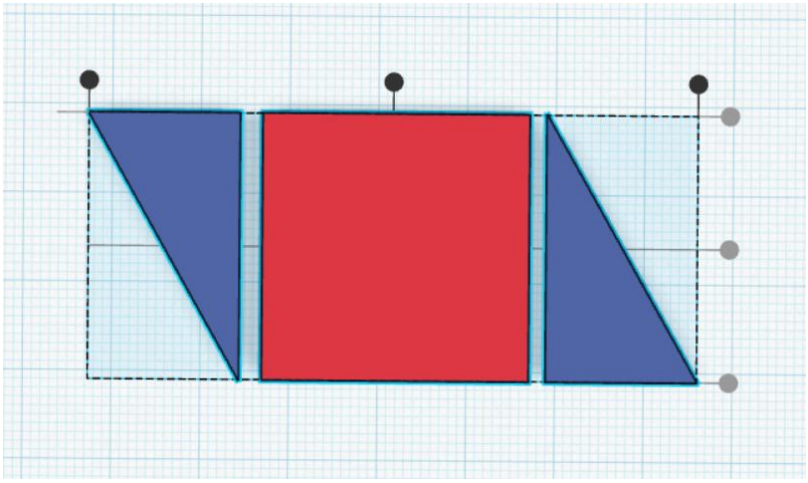
1. In the right panel of the **BASIC SHAPES** toolbar, find **the WEDGE** shape.
2. Left click the shape onto the workspace.
3. Rotate the shape along the Z axis to -90°.
4. Click on the object and adjust its dimensions to **35 x 17 mm**.
5. Copy the shape and place the wedges against each other (tips against each other).



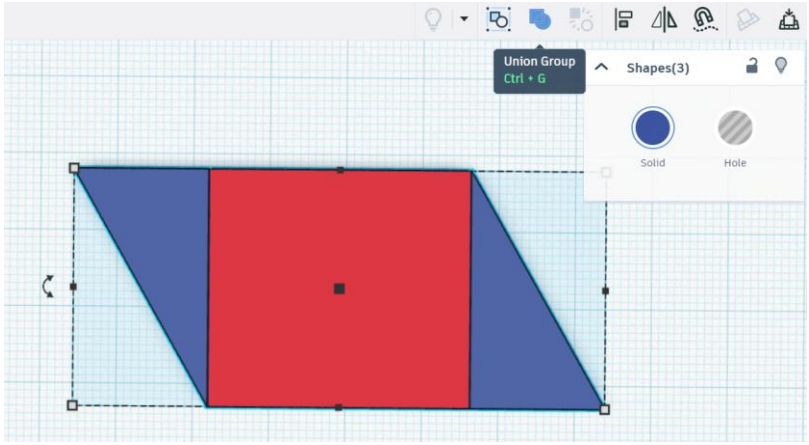
6. From the right panel of the **BASIC SHAPES** toolbar**,** drag the **BOX** shape to the canvas and adjust its dimensions to **30 x 30 mm**.



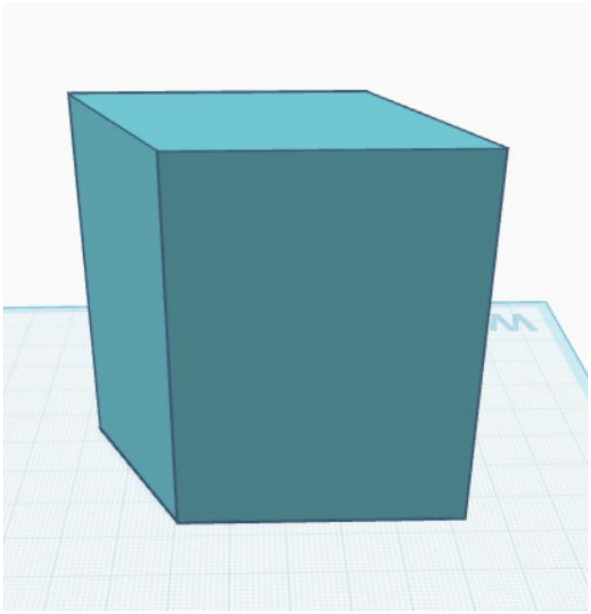
7. Place the **BOX** shape between the **WEDGE** shapes, align the objects using the **Align Tool**.



8. Place all the shapes next to each other so that there is no space between them.
9. Use **the Group tool (Ctrl+G)** to group objects.



10. Click on the object and adjust its height to **60 mm**.



11. Check the size of the prism. Make sure the dimensions match the printing requirements.
12. Check the location of the prism on the work surface, the object must not be in the air.
13. Click the **EXPORT** button on the top right.
14. Select the **STL** format (standard format for 3D printing).

3. Preparing a file for printing

1. Upload the STL file to the prepress software (e.g., Ultimaker Cura, PrusaSlicer, or another slicer according to your printer).
2. Set the print parameters (e.g. layer height, fill density, print speed, etc.).
3. Check the layer preview in the slicing software.

4. Model printing

1. Save the prepared file in **G-code format** and transfer it to a 3D printer.
2. Follow the manufacturer's instructions to start printing on the printer.

Time required

Activities	Estimated time
Login and set up a project	2-5 minutes
Model creation	15-20 minutes
Export and Prepare for Printing	10-15 minutes
Printing (depends on model size and fill density)	55-65 minutes

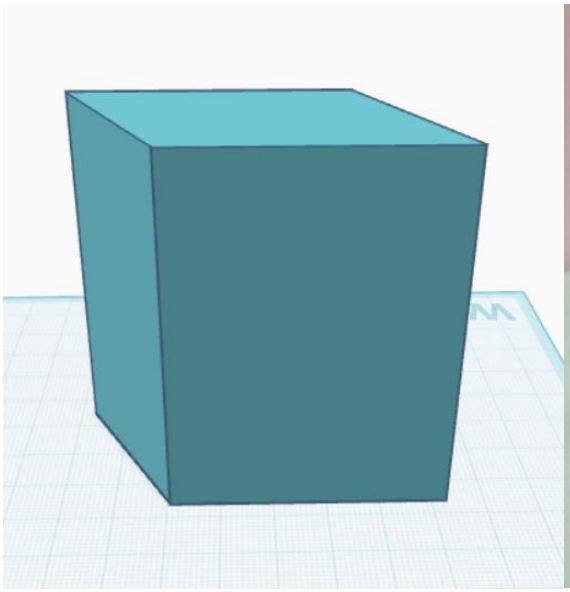
---

Tips and advice

- **Fill density:** For a firmer model, choose a 20-50% fill.
- **Checking the printer:** Make sure the print bed is clean and properly aligned.

Conclusion

After completing this lesson, you will have a finished model of a prism with a diamond base, which is ready to be printed. This skill is the basis for creating more complex 3D models. You can use the printed prism with a diamond base as a teaching aid, building part or decoration.



Methodological sheet number 7

7. PRISM WITH TRAPEZOIDAL BASE

Lesson objective: How to create a prism with a trapezoid base in Tinkercad and prepare it for 3D printing. Learn how to create a prism model with a trapezoid base, prepare it for printing and export it to the correct format.

https://youtu.be/ut7g2RYfltY

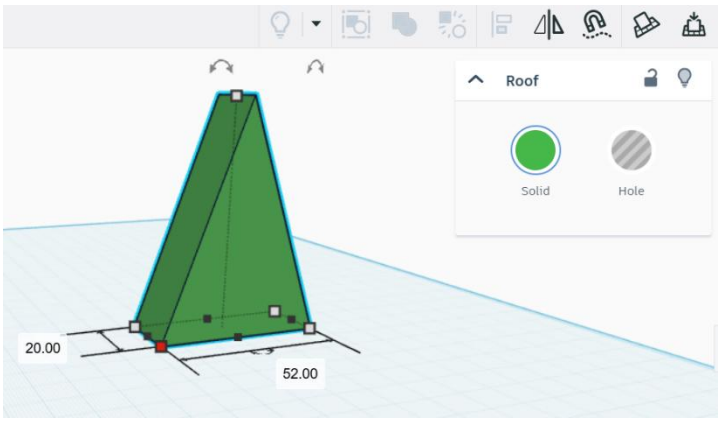
Procedure

1. Log in to Tinkercad and create a new project

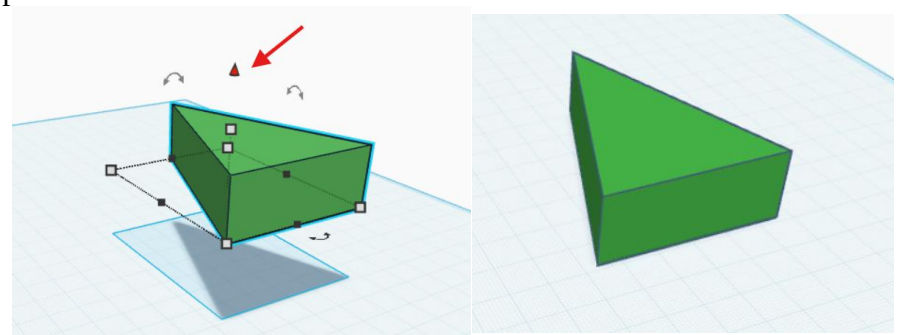
1. Open Tinkercad in your browser.
2. Log in to your account or create a new account.
3. Click Create **New Design**.
4. Give the project a name – e.g. "Prism with trapezoidal base".

2. Modelling of the object, procedure according to YouTube:

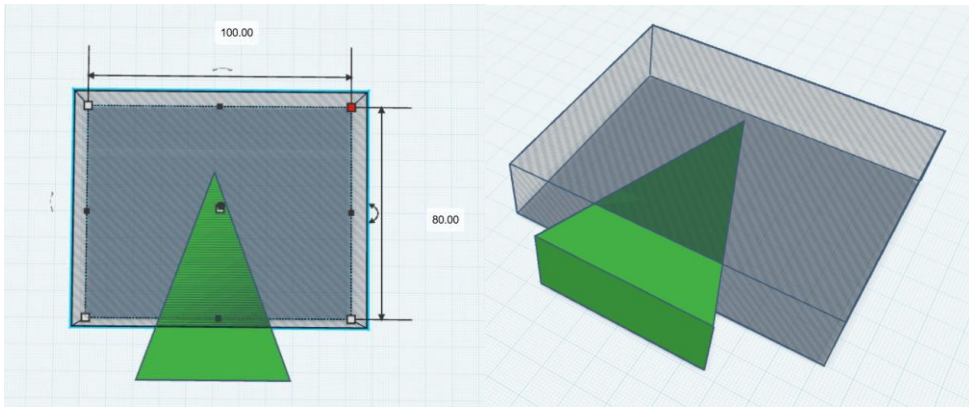
1. In the right panel of the **BASIC SHAPES** toolbar, find the **ROOF** shape.
2. Left click the shape onto the workspace.
3. Click on the object and adjust its dimensions to **52 x 20 x 70 mm**.
4. Rotate the shape along the Z axis to -90°.



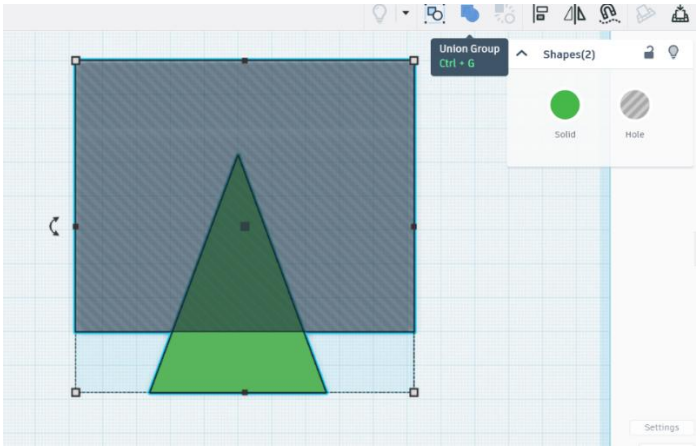
5. Grab the object with the black tip from the top and drag down to place the object on the desktop.



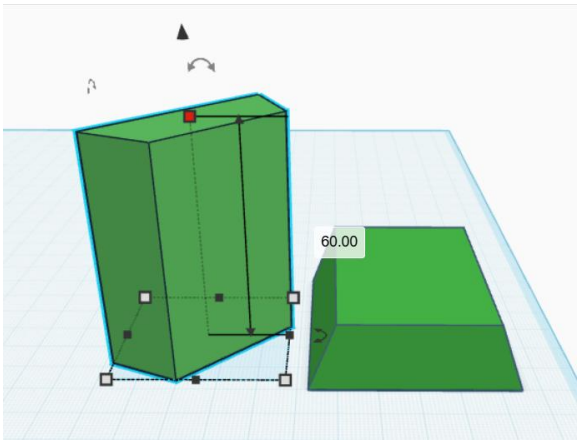
6. From the right panel of the **BASIC SHAPES** toolbar, drag the **BOX** shape as a **Hole** to the canvas, adjust its dimensions to **100 x 20 x 80 mm**, and position it so that it overlaps **approximately 2/3 of the ROOF shape**.



7. Use **the Group tool (Ctrl+G)** to group objects.



8. Click on the object and adjust its height to **60 mm**.



(variants of prism placement)

9. Check the size of the prism. Make sure the dimensions match the printing requirements.
10. Check the location of the prism on the work surface, the object must not be in the air.
11. Click the **EXPORT** button on the top right.

12. Select the **STL** format (standard format for 3D printing).

3. Preparing a file for printing

1. Upload the STL file to the prepress software (e.g., Ultimaker Cura, PrusaSlicer, or another slicer according to your printer).
2. Set the print parameters (e.g. layer height, fill density, print speed, etc.).
3. Check the layer preview in the slicing software.

4. Model printing

1. Save the prepared file in **G-code format** and transfer it to a 3D printer.
2. Follow the manufacturer's instructions to start printing on the printer.

Time required

Activities	Estimated time
Login and set up a project	2-5 minutes
Model creation	15-20 minutes
Export and Prepare for Printing	10-15 minutes
Printing (depends on model size and fill density)	55-65 minutes

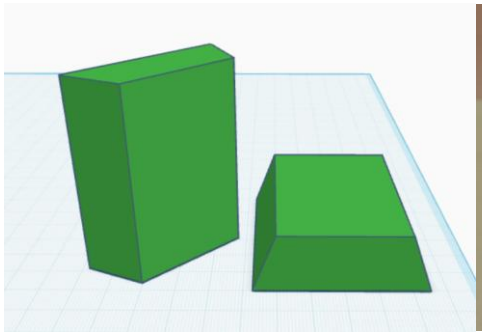
---

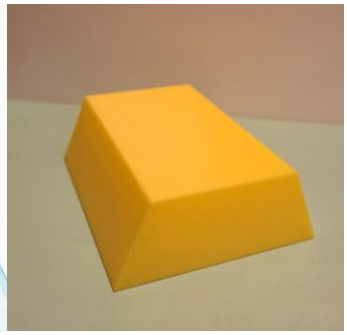
Tips and advice

- **Fill density:** For a firmer model, choose a 20-50% fill.
- **Checking the printer:** Make sure the print bed is clean and properly aligned.

Conclusion

By the end of this lesson, you will have a finished model of a prism with a trapezoid base that is ready to be printed. This skill is the basis for creating more complex 3D models. You can use the printed prism with a trapezoidal base as a teaching aid, a building part or a decoration.





Methodological Sheet No. 8

8. IRREGULAR AND REGULAR TRIANGULAR PRISM

Lesson objective: How to create a triangular prism in Tinkercad and prepare it for 3D printing. Learn how to create a model of a triangular prism, prepare it for printing and export it to the correct format.

https://youtu.be/AsGy6I5Xz2g

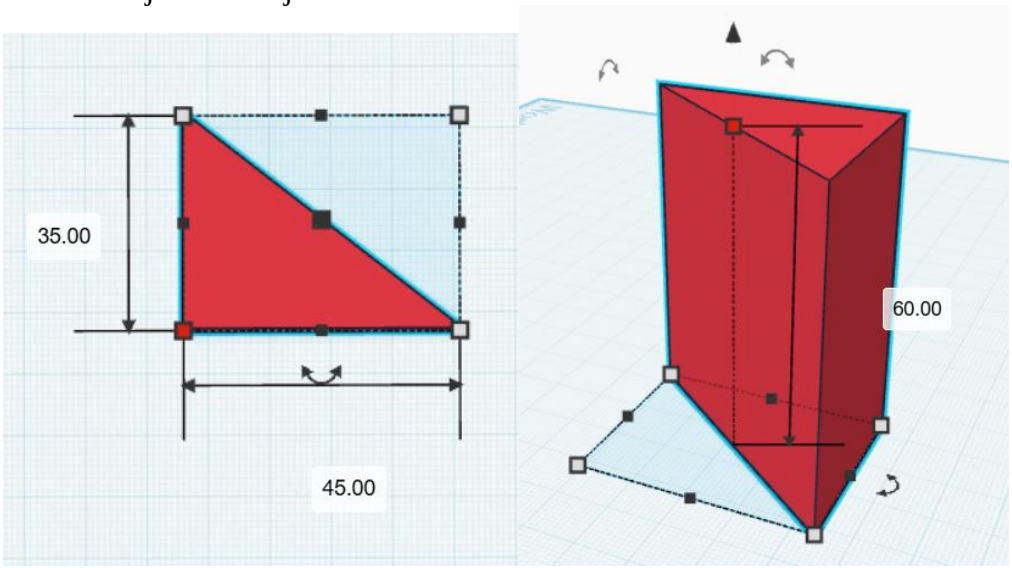
Procedure

1. Log in to Tinkercad and create a new project

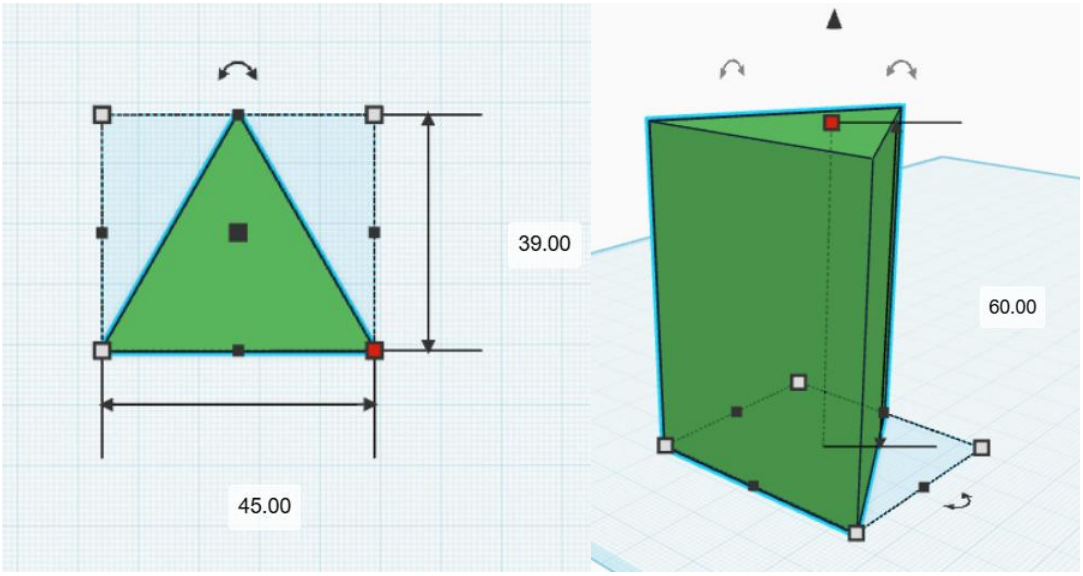
1. Open Tinkercad in your browser.
2. Log in to your account or create a new account.
3. Click Create **New Design**.
4. Name the project – e.g. "Triangular prisms".

2. Modelling of the object, procedure according to YouTube:

1. In the right panel of the **BASIC SHAPES** toolbar, find the **WEDGE** shape.
2. Left click the shape onto the workspace.
3. Rotate the shape along the Z axis to 90°.
4. Click on the object and adjust its dimensions to **45 x 35 x 60 mm**.



5. From the right panel of the **BASIC SHAPES** toolbar, drag a **ROOF** shape onto the workspace. Rotate the shape along the Z axis to -90◦ and adjust its dimensions to **45 x 39 x 60 mm**.



6. Check the size of the prisms. Make sure the dimensions match the printing requirements.
7. Check the location of the prisms on the work surface, the objects must not be in the air.
8. Click the **EXPORT** button on the top right (you can export both one object and several at the same time).
9. Select the **STL** format (standard format for 3D printing).

3. Preparing the file for printing

1. Upload the STL file to the prepress software (e.g., Ultimaker Cura, PrusaSlicer, or another slicer according to your printer).
2. Set the print parameters (e.g. layer height, fill density, print speed, etc.).
3. Check the layer preview in the slicing software.

4. Model printing

1. Save the prepared file in **G-code format** and transfer it to a 3D printer.
2. Follow the manufacturer's instructions to start printing on the printer.

Time required (for one object)

Activities	Estimated time
Login and set up a project	2-5 minutes
Model creation	15-20 minutes
Export and Prepare for Printing	10 minutes
Printing (depends on model size and fill density)	55-65 minutes

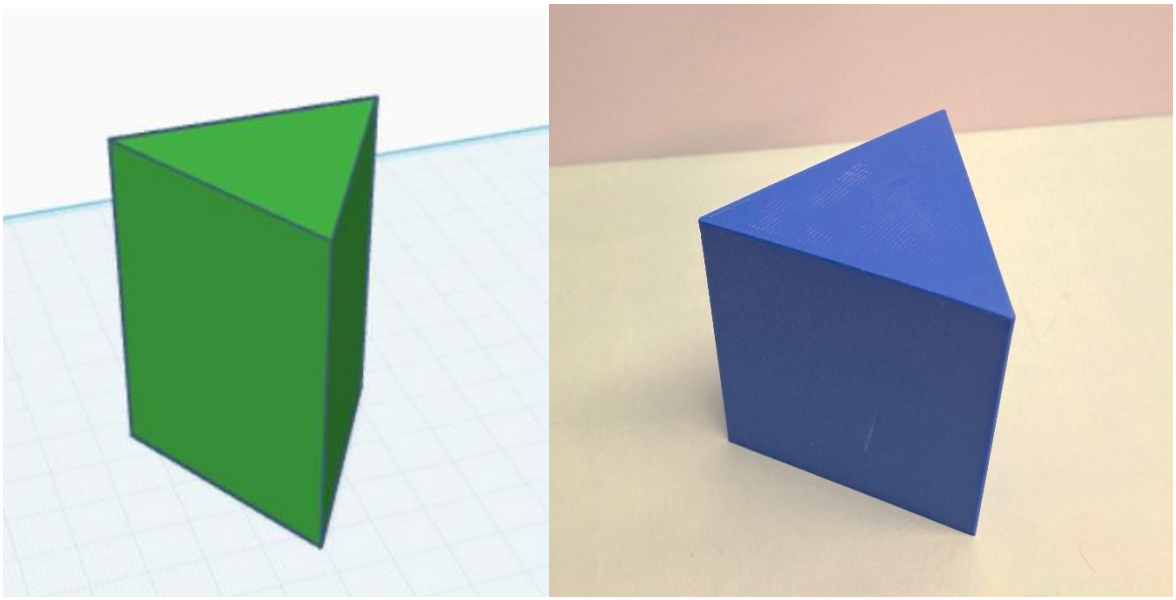
---

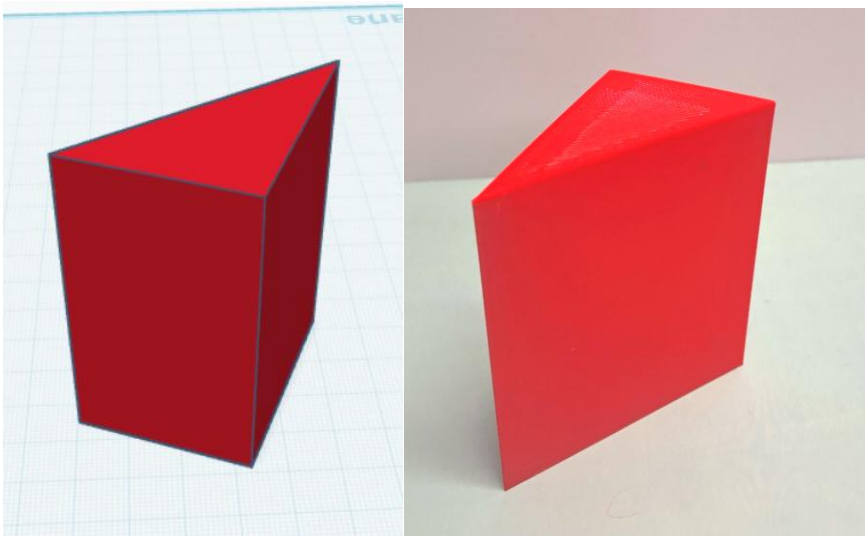
Tips and advice

- **Fill density:** For a firmer model, choose a 20-50% fill.
- **Checking the printer:** Make sure the print bed is clean and properly aligned.

Conclusion

After completing this lesson, you will have finished models of the triangular irregular and triangular prism, which are ready to print. This skill is the basis for creating more complex 3D models. You can use the printed triangular prisms as a teaching aid, building part or decoration.





Methodological sheet number 9

9. REGULAR HEXAGONAL PRISM

Lesson objective: How to create a regular hexagonal prism in Tinkercad and prepare it for 3D printing. Learn how to create a model of a regular hexagonal prism, prepare it for printing and export it to the correct format.

https://youtu.be/WEStX-HAQBA

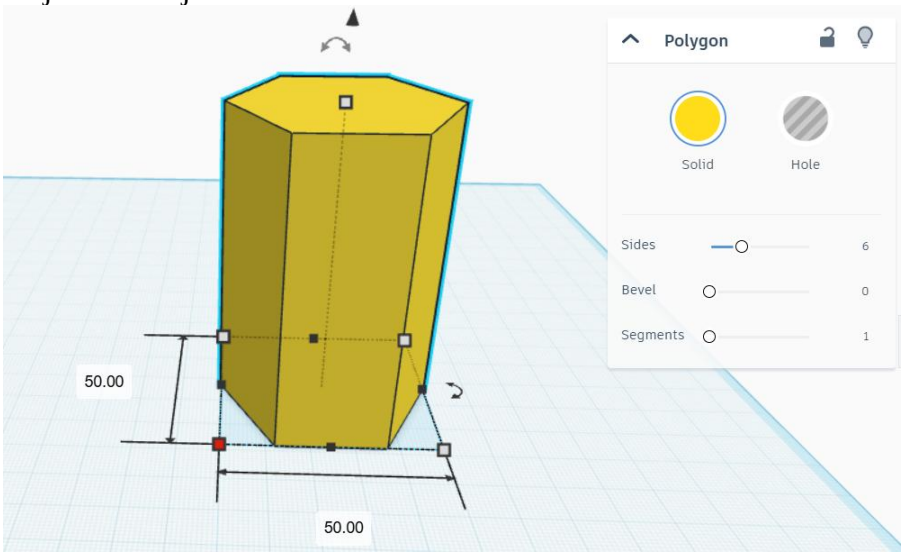
Procedure

1. Log in to Tinkercad and create a new project

1. Open Tinkercad in your browser.
2. Log in to your account or create a new account.
3. Click Create **New Design**.
4. Name the project – e.g. "Regular hexagonal prism".

2. Modelling of the object, procedure according to YouTube:

1. In the right panel of the **BASIC SHAPES** toolbar, find **the POLYGON** shape.
2. Left click the **POLYGON** shape onto the workspace.
3. Click on the object and adjust its dimensions to **50 x 50 x 70 mm**.



4. In **POLYGON SETTINGS,** adjust the parameters as needed (color, sides, bevel, segments).
5. Check the size of the prism. Make sure the dimensions match the printing requirements.
6. Check the location of the prism on the work surface, the object must not be in the air.
7. Click the **EXPORT** button on the top right.
8. Select the **STL** format (standard format for 3D printing).

3. Preparing the file for printing

1. Upload the STL file to the prepress software (e.g., Ultimaker Cura, PrusaSlicer, or another slicer according to your printer).
2. Set the print parameters (e.g. layer height, fill density, print speed, etc.).
3. Check the layer preview in the slicing software.

4. Model printing

1. Save the prepared file in **G-code format** and transfer it to a 3D printer.
2. Follow the manufacturer's instructions to start printing on the printer.

Time required

Activities	Estimated time
Login and set up a project	2-5 minutes
Model creation	5-10 minutes
Export and Prepare for Printing	10-15 minutes
Printing (depends on model size and fill density)	40-60 minutes

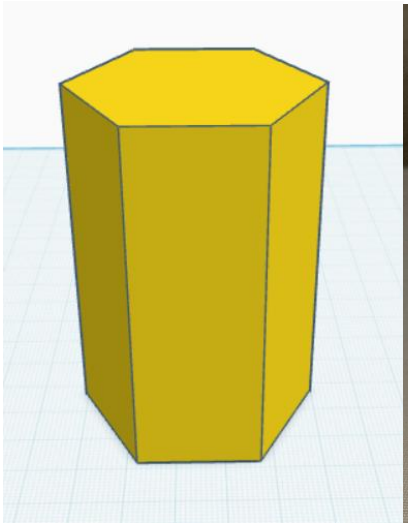
---

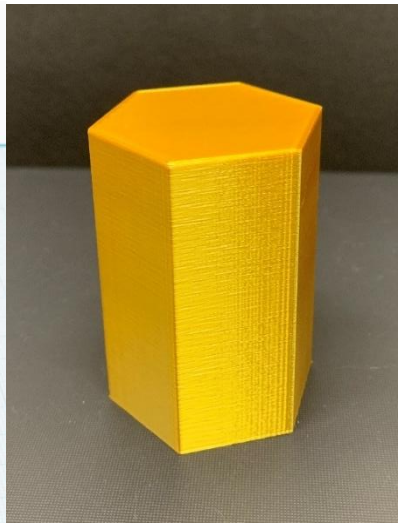
Tips and advice

- **Fill density:** For a firmer model, choose a 20-50% fill.
- **Checking the printer:** Make sure the print bed is clean and properly aligned.

Conclusion

By the end of this lesson, you will have a finished model of a regular hexagonal prism that is ready to be printed. This skill is the basis for creating more complex 3D models. You can use the printed regular hexagonal prism as a teaching aid, building part or decoration.





Methodological sheet number 10

10. PYTHAGOREAN THEOREM

Lesson objectives: How to create a model of a didactic tool depicting the Pythagorean theorem in Tinkercad and prepare it for 3D printing. Learn how to create a 3D model of a didactic tool, export it to the correct format and prepare it for printing.

The model contains a right triangle and three cuboids corresponding to the contents of its sides.

https://youtu.be/tzk4t63bJx4

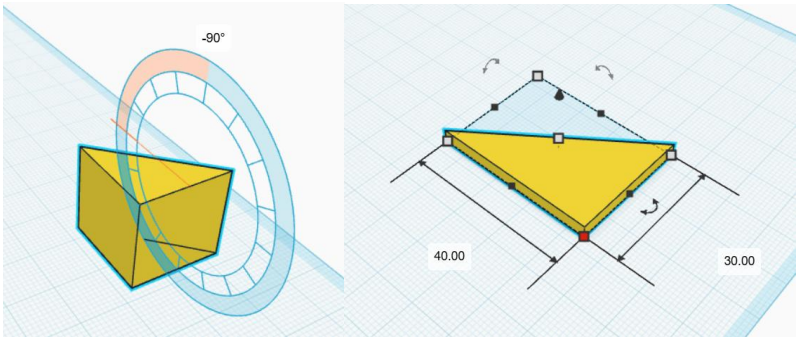
Procedure

1. Log in to Tinkercad and create a new project

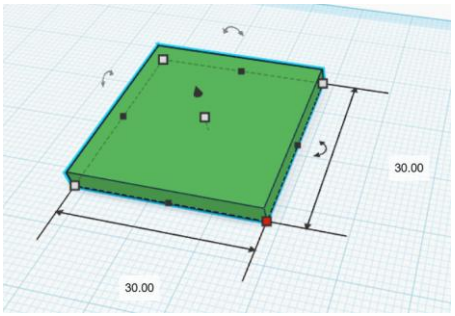
1. Open Tinkercad in your browser.
2. Log in to your account or create a new account.
3. Click Create **New Design**.
4. Name the project – e.g. "Pythagorean theorem".

2. Modelling of the object, procedure according to YouTube:

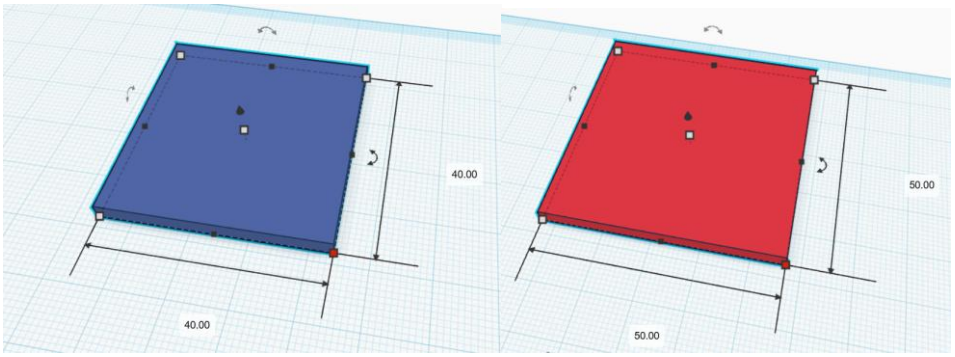
1. In the right panel of the **BASIC SHAPES** toolbar**,** find the **WEDGE** shape and drag it onto the desktop.
2. Rotate the object along the Z axis to -90°.
3. Click on the object and adjust its dimensions to **30 x 40 x 3 mm**.



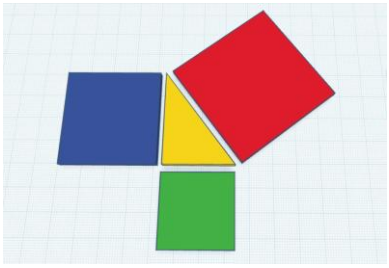
4. From the right panel of the **BASIC SHAPES** toolbar, drag a **BOX** shape onto the workspace.
5. Click on the object and adjust its dimensions to **30 x 30 x 3 mm**.



6. Make 2 more blocks measuring **40 x 40 x 3 mm** and **50 x 50 x 3 mm**.



7. Place the cuboids next to the sides of the right triangle so that they match the contents of each side.



8. You can use the **Group tool** (**Ctrl+G**) to group objects.
9. Make sure that all objects are level and their dimensions match the input.
10. Click the **EXPORT** button in the top right (you can export both one object and several at the same time).
11. Select the **STL** format (standard format for 3D printing).

3. Preparing the file for printing

1. Upload the STL file to the prepress software (e.g., Ultimaker Cura, PrusaSlicer, or another slicer according to your printer).
2. Set the print parameters (e.g. layer height, fill density, print speed, etc.).
3. Check the layer preview in the slicing software.

4. Model printing

1. Save the prepared file in **G-code format** and transfer it to a 3D printer.
2. Follow the manufacturer's instructions to start printing on the printer.

Time required (for the entire model)

Activities	Estimated time
Login and set up a project	2-5 minutes
Model creation	15-20 minutes
Export and Prepare for Printing	10 minutes
Printing (depends on model size and fill density)	25-35 minutes

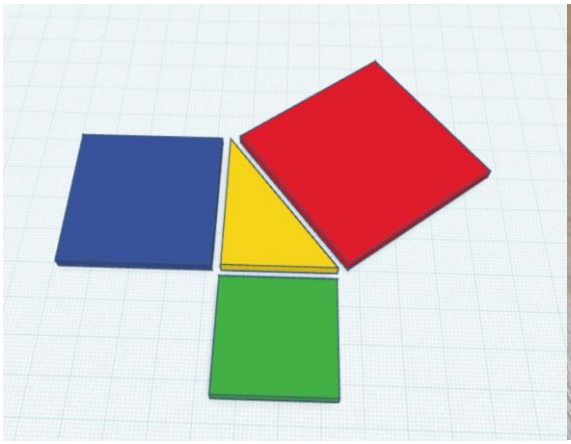
---

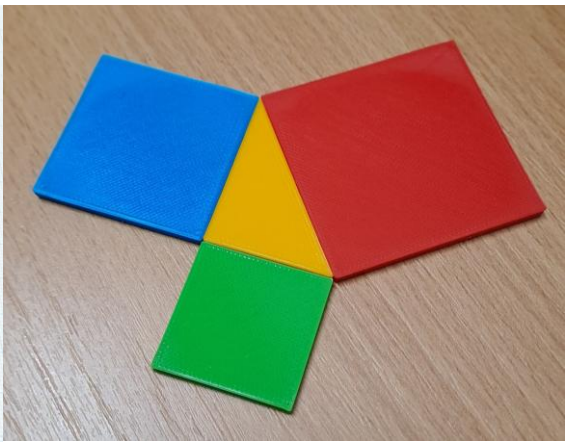
Tips and advice

- **Fill density:** For a firmer model, choose a 20-50% fill.
- **Checking the printer:** Make sure the print bed is clean and properly aligned.

Conclusion

After completing this lesson, you will have a ready-to-print model of the Pythagorean theorem didactic tool. You can use the printed model as a teaching aid.





Methodological sheet number 11

11. TANGRAM

Lesson objectives: How to create a model of the Tangram didactic tool/game in Tinkercad and prepare it for 3D printing. Learn how to create a 3D model of the game, prepare it for printing and export it to the correct format.

https://youtu.be/Ygbxe2TZXiQ

A brief introduction to Tangram

Tangram is an old Chinese jigsaw puzzle consisting of **7 geometric pieces**:

- 2 large right triangles
- 1 middle triangle
- 2 small triangles
- 1 square
- 1 rhombus

These pieces come from a single square, which is divided by precise cuts.

Procedure

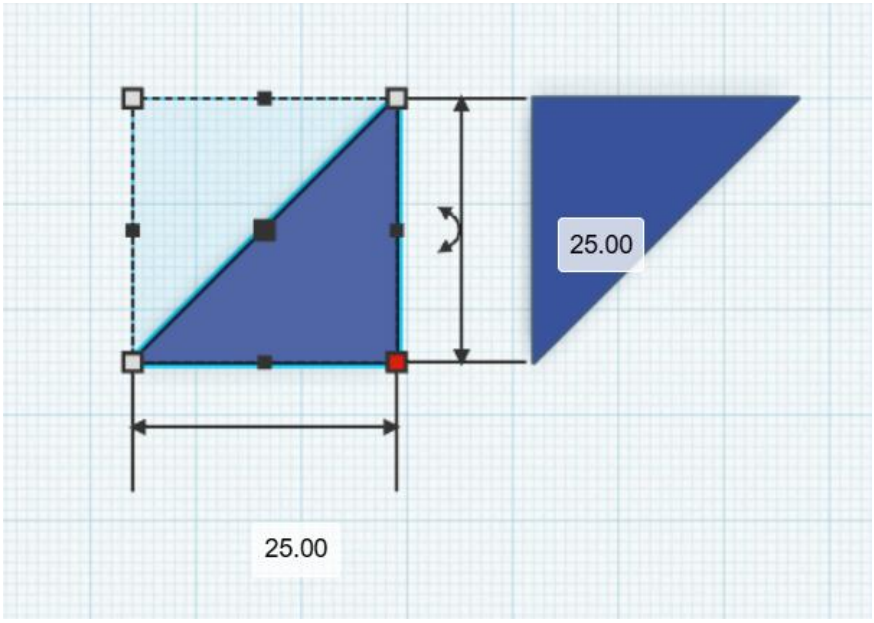
1. Log in to Tinkercad and create a new project

1. Open Tinkercad in your browser.
2. Log in to your account or create a new account.
3. Click Create **New Design**.
4. Give the project a name – e.g. "Tangram".

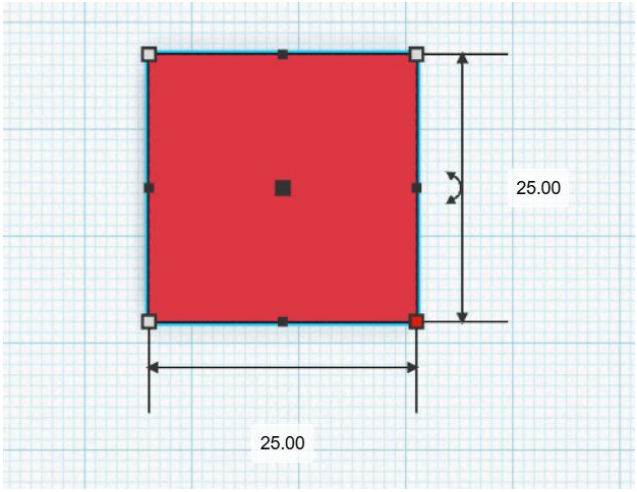
2. Modelling of the object, procedure according to YouTube:

1. Model the rhombus:

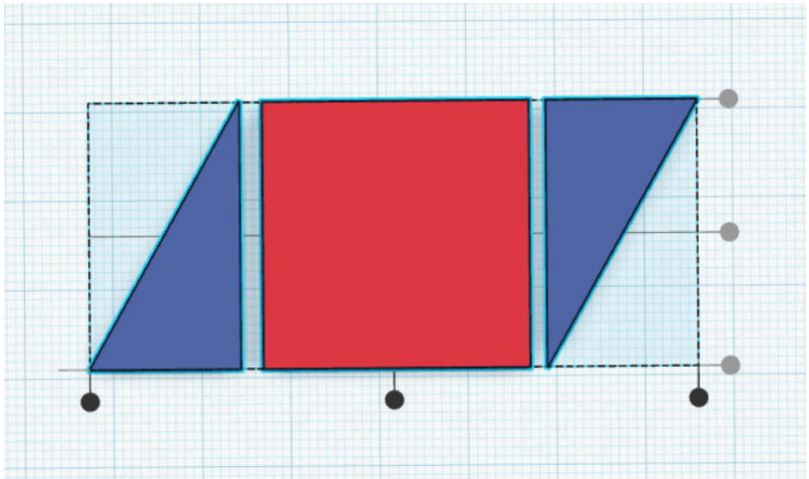
1. In the right panel of the **BASIC SHAPES** toolbar, find the **WEDGE** shape.
2. Left click the shape onto the workspace.
3. Rotate the shape along the Z axis to 90°.
4. Click on the object and adjust its dimensions to **25 x 25 x 3 mm**.
5. Copy the shape and place the wedges against each other (tips against each other).



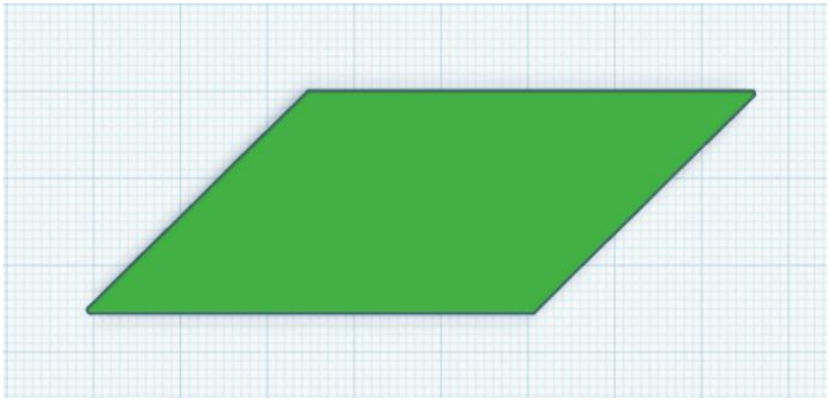
6. From the right panel of the **BASIC SHAPES** toolbar, drag a BOX shape to the canvas and adjust its dimensions to **25 x 25 x 3 mm**.



7. Place the **BOX** shape between the **WEDGE** shapes, align the objects using the **Align Tool**.



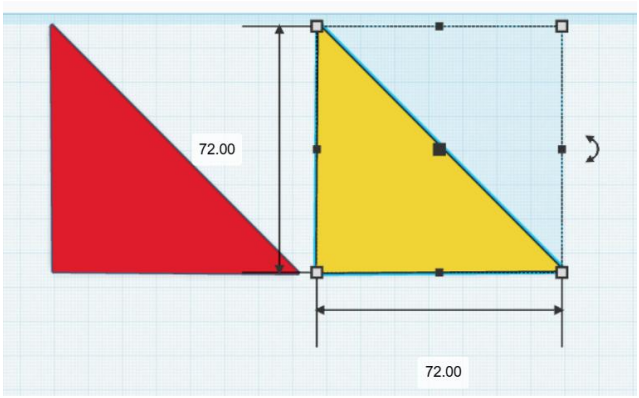
8. Place all the shapes next to each other so that there is no space between them.
9. Use **the Group tool (Ctrl+G)** to group objects.

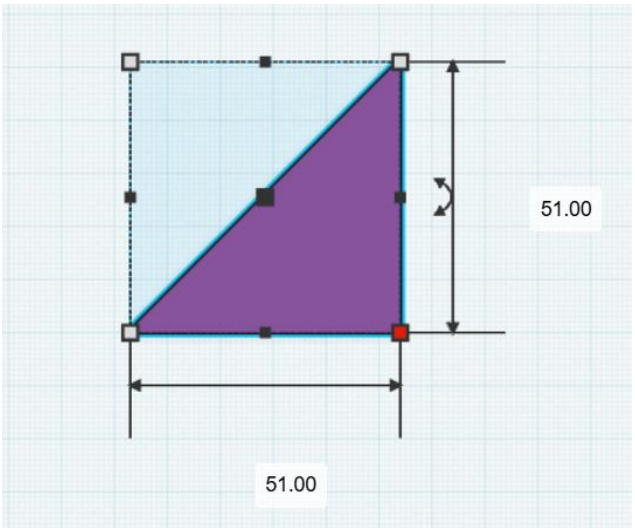


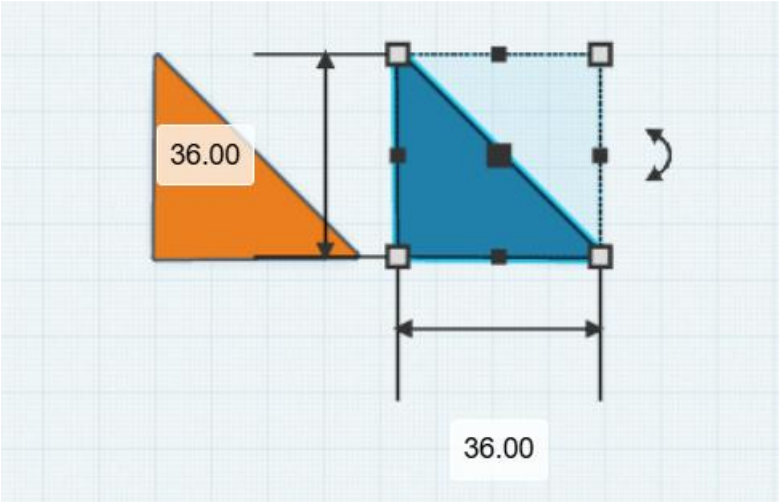
10. Click on the object, select a custom color, and adjust its height to **60 mm**.

2. Model 5 right triangles with the following dimensions:

2 triangles:	**72 x 72 x 3 mm**
1 triangle:	**51 x 51 x 3 mm**
2 triangles:	**36 x 36 x 3 mm**

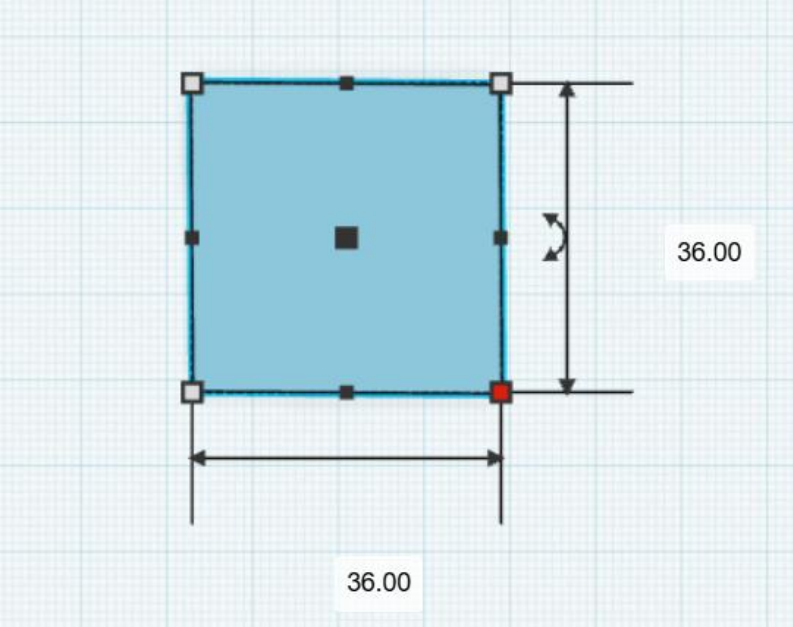






3. Model a square with dimensions:

36 x 36 x 3 mm



1. Check the sizes of all the pieces and their placement on the work surface; the object must not be in the air. To check, put the parts close together to create a square, but **for printing, there must be space between the pieces**.
2. Click the **EXPORT** button on the top right.
3. Select the **STL** format (standard format for 3D printing).

3. Preparing the file for printing

1. Upload the STL file to the prepress software (e.g., Ultimaker Cura, PrusaSlicer, or another slicer according to your printer).
2. Set the print parameters (e.g. layer height, fill density, print speed, etc.).
3. Check the layer preview in the slicing software.

4. Model printing

1. Save the prepared file in **G-code format** and transfer it to a 3D printer.
2. Follow the manufacturer's instructions to start printing on the printer.

Time required

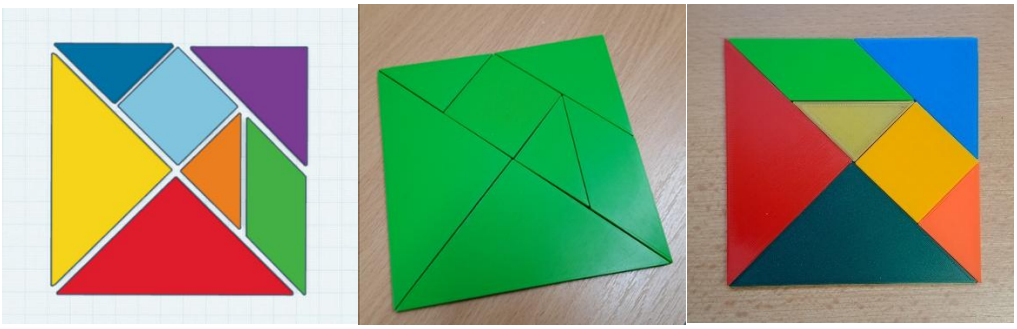
Activities	Estimated time
Login and set up a project	2-5 minutes
Model creation	20-25 minutes
Export and Prepare for Printing	10-15 minutes
Print	50 minutes

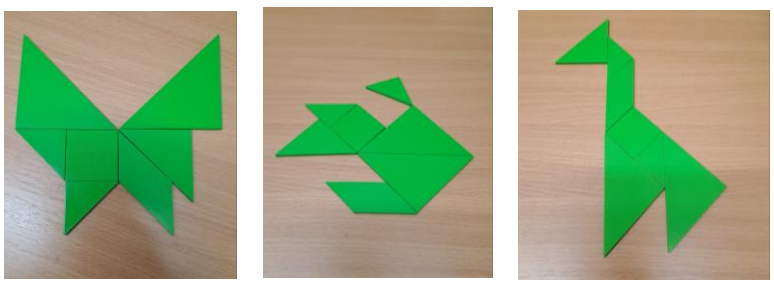
Tips and advice

- **Fill density:** For a firmer model, choose a 20-50% fill.
- **Checking the printer:** Make sure the print bed is clean and properly aligned.

Conclusion

After completing this lesson, you will have a ready-made model of the Tangram didactic tool, which is ready to print. This skill is the basis for creating more complex 3D models. The result is a functional didactic tool that can be used in mathematics when teaching geometry or other activities. Colourful geometric pieces support logical thinking, creativity, fine motor skills and spatial imagination.





Methodological sheet number 12

12. PHYSICAL QUANTITIES

Lesson objectives: How to create a model of a didactic tool of physical quantities in Tinkercad and prepare it for 3D printing. Learn how to create a 3D model of the tool, prepare it for printing and export it to the correct format.

https://youtu.be/La6CwjM5MIg

A brief introduction to the didactic aid

The physical quantity tool consists of **10 rectangles and 10 squares**.

Procedure

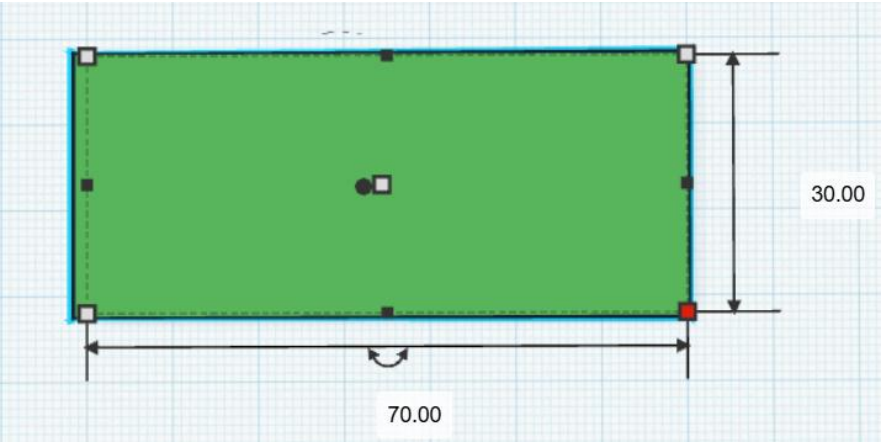
1. Log in to Tinkercad and create a new project

1. Open Tinkercad in your browser.
2. Log in to your account or create a new account.
3. Click Create **New Design**.
4. Give the project a name – e.g. "Physics Aid".

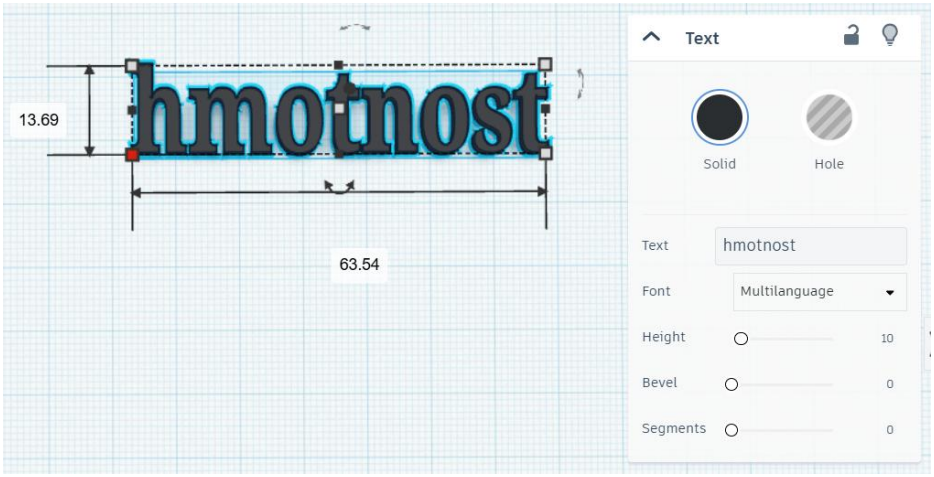
2. Modelling of the object, procedure according to YouTube:

1. Model the rectangle and add text to it:

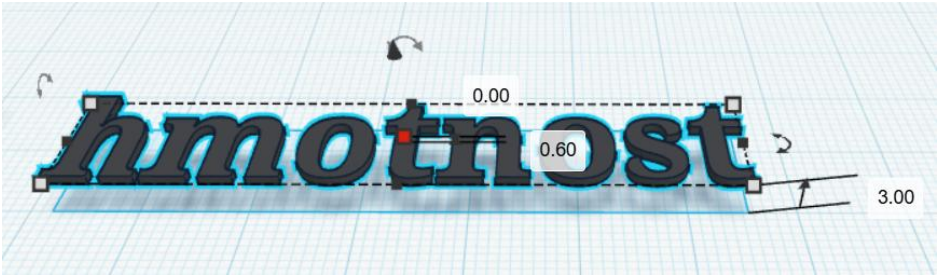
1. From the right panel of the **BASIC SHAPES** toolbar, drag the **BOX** shape to the canvas and adjust its dimensions to **70 x 30 x 3 mm**.



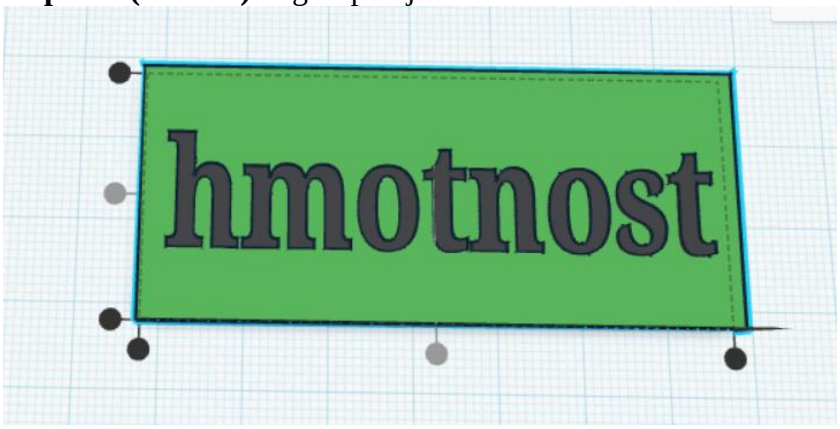
2. From the right panel of the **BASIC SHAPES toolbar,** drag the **TEXT** shape to the workspace and edit the text to your own "weight" in the menu that opens.
3. Place the text on a rectangle and adjust the size of the text appropriately. To change the size of the text evenly, drag around the corner with the left mouse button and hold down the **Shift key**.

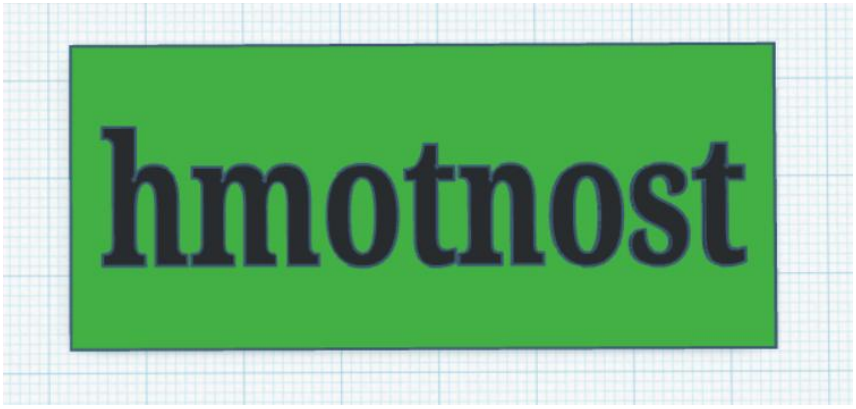


4. Adjust the text height to **0.6 mm**. Select a distance above the work surface of **3 mm**.

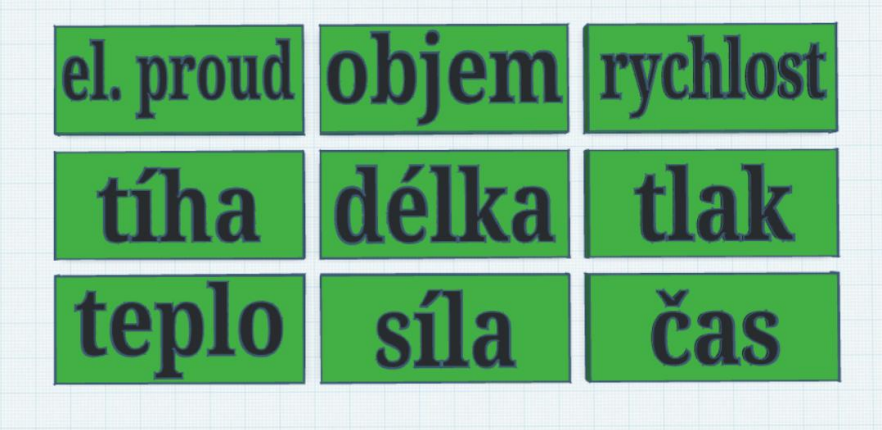


5. Align objects using the **Align Tool**.
6. Use **the Group tool (Ctrl+G)** to group objects.



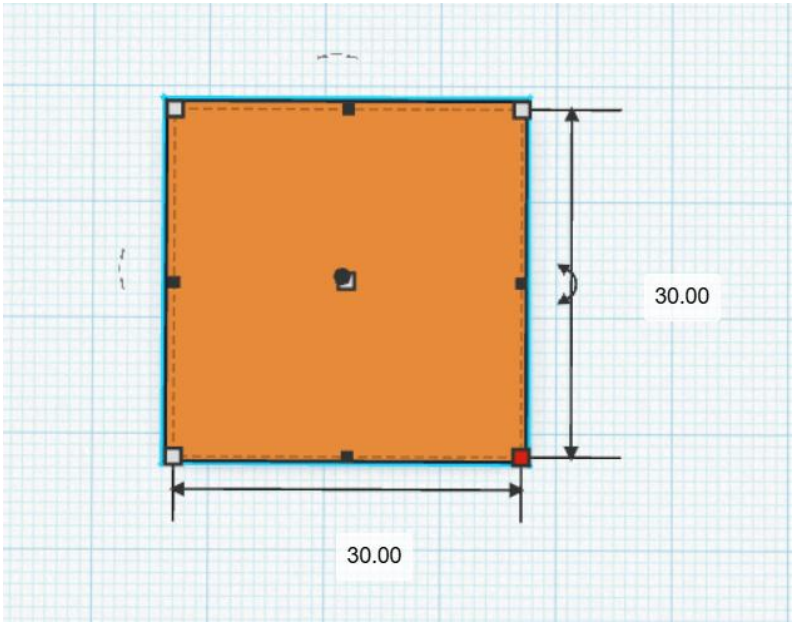


7. Make the next 9 pieces in the same way.

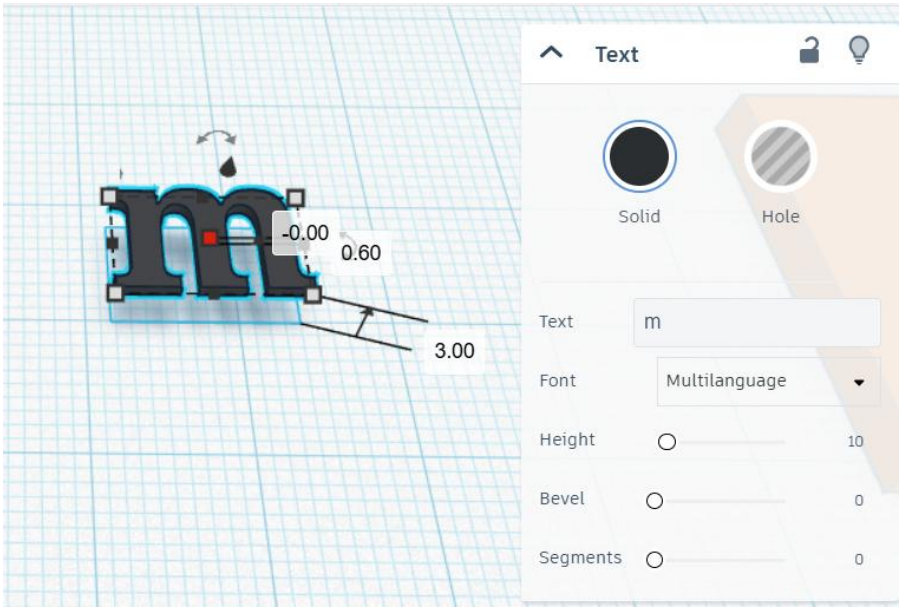


2. Model the square and add text to it:

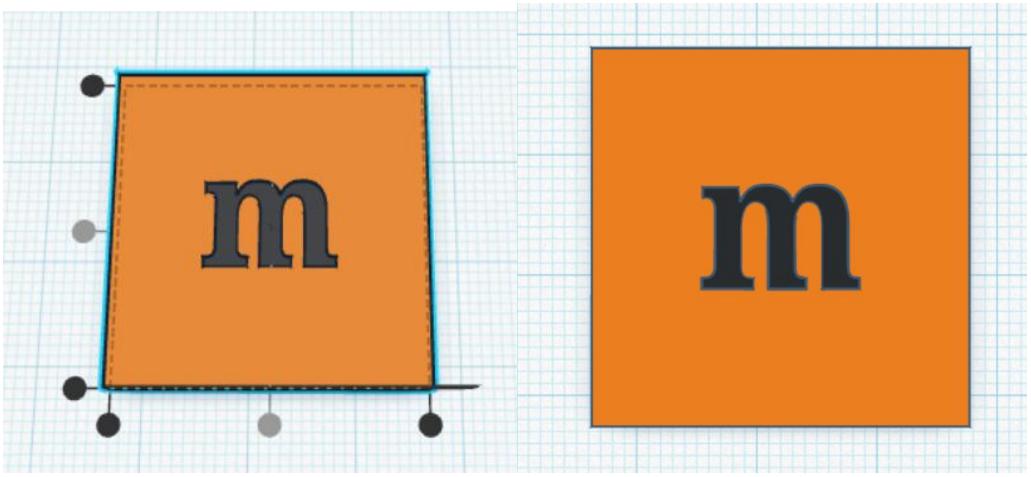
1. From the right panel of the **BASIC SHAPES** toolbar, drag the **BOX** shape to the canvas and adjust its dimensions to **30 x 30 x 3 mm**.



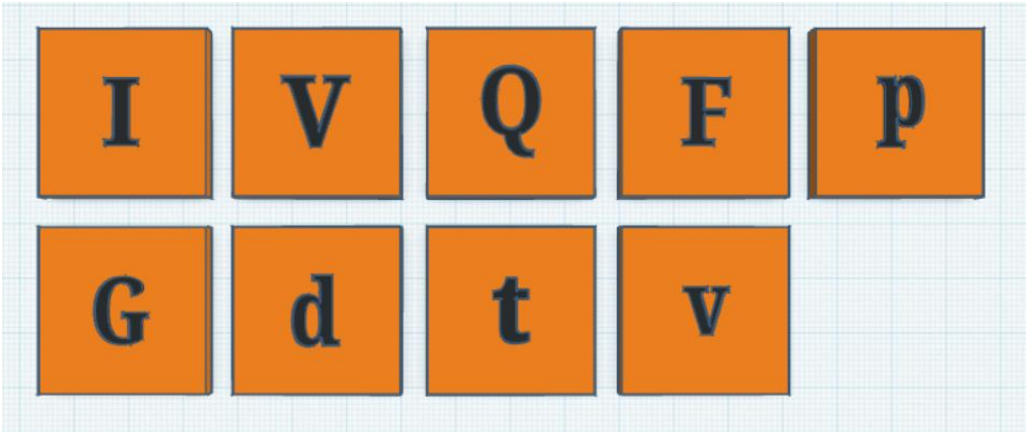
2. From the right panel of the **BASIC SHAPES** toolbar, drag the **TEXT** shape to the workspace and edit the text to your own "m" in the menu that opens.
3. Place the text in a square and adjust the size of the text appropriately. To change the size of the text evenly, drag around the corner with the left mouse button and hold down the **Shift key**.
4. Adjust the text height to **0.6 mm**. Select a distance above the work surface of **3 mm**.

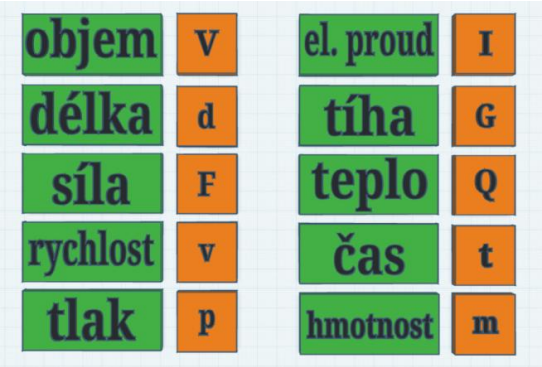


5. Align objects using the **Align Tool**. Use **the Group tool (Ctrl+G)** to group objects.



6. Make the next 9 pieces in the same way.





7. Check the size of all the pieces and their location on the work surface, the object must not be in the air.
8. Printing can be both monochrome and multi-color.
9. Click the **EXPORT** button on the top right.
10. Select the **STL** format (standard format for 3D printing).

3. Preparing the file for printing

1. Upload the STL file to the prepress software (e.g., Ultimaker Cura, PrusaSlicer, or another slicer according to your printer).
2. Set the print parameters (e.g. layer height, fill density, print speed, etc.).
3. Check the layer preview in the slicing software.

4. Model printing

1. Save the prepared file in **G-code format** and transfer it to a 3D printer.
2. Follow the manufacturer's instructions to start printing on the printer.

Time required

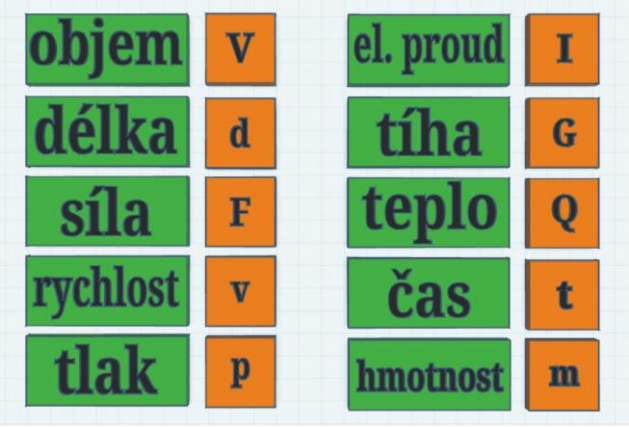
Activities	Estimated time
Login and set up a project	2-5 minutes
Model creation	20-25 minutes
Export and Prepare for Printing	10-15 minutes
Print (all parts)	2 h. 50 min.

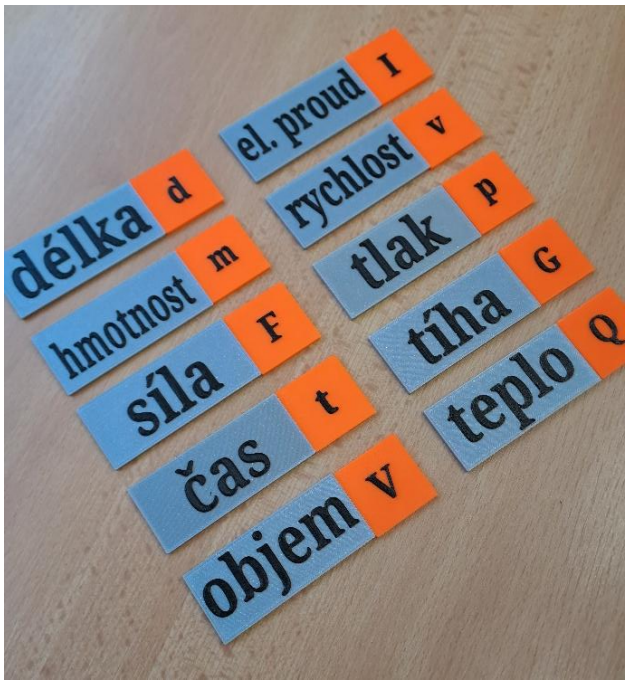
Tips and advice

- **Fill density:** For a firmer model, choose a 20-50% fill.
- **Checking the printer:** Make sure the print bed is clean and properly aligned.

Conclusion

After completing this lesson, you will have a ready-made model of a didactic tool of a physical quantity, which is ready to be printed. This skill is the basis for creating more complex 3D models. The result is a functional didactic tool that can be used in teaching mathematics and physics. The activity is suitable for practicing physical quantities and their units in the form of a game.





Methodological sheet number 13

13. FRACTIONS

Lesson objective: How to create a model of a didactic tool fractions in Tinkercad and prepare it for 3D printing. Learn how to create a 3D model of the tool, prepare it for printing and export it to the correct format.

https://youtu.be/iIF3-8Xyja4

A brief introduction to the didactic aid

The tool consists of sets of pieces representing fractions. Each piece represents a part of the whole (e.g. ½, ¼).

Procedure

1. Log in to Tinkercad and create a new project

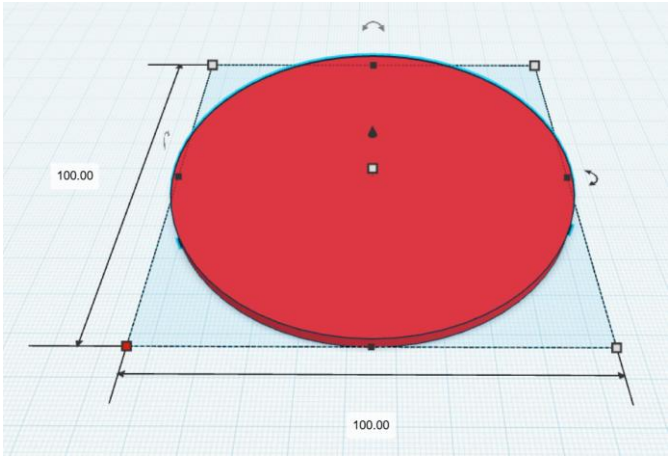
1. Open Tinkercad in your browser.
2. Log in to your account or create a new account.
3. Click Create **New Design**.
4. Give the project a name – e.g. "Fractions".

2. Modelling of the object, procedure according to YouTube:

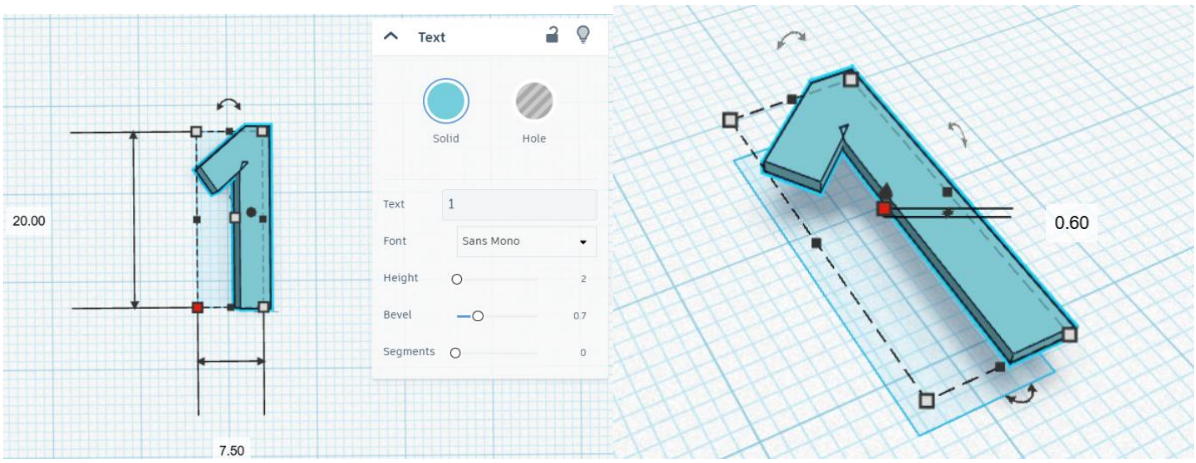
FRACTION ONE WHOLE

Model the cylinder and add text to it:

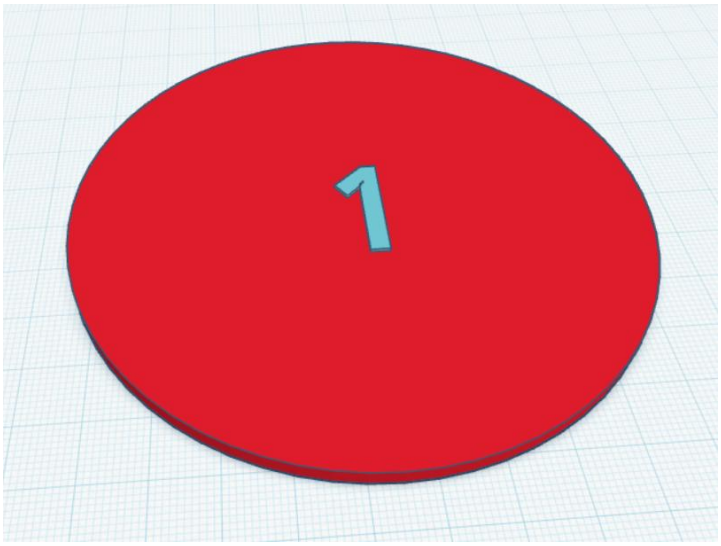
1. From the right panel of the **BASIC SHAPES** toolbar, drag the **CYLINDER** shape to the canvas and adjust its dimensions to **100 x 100 x 3 mm, Sides: 128** (smoother circle).



2. From the right panel of the **BASIC SHAPES t**oolbar, drag the **TEXT** shape to the workspace and edit the text to your own - "1" in the menu that opens.
3. Adjust the text height to **0.6 mm**. Select a distance above the work surface of **3 mm**.



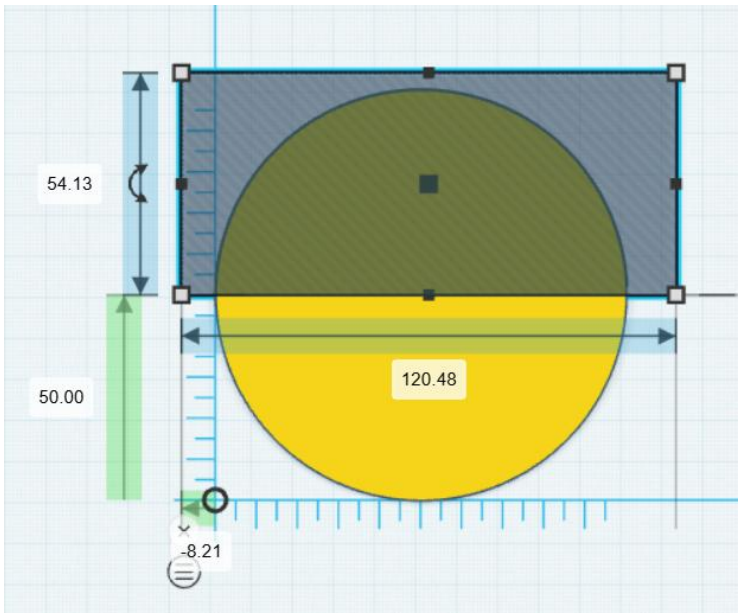
4. Move the text to the cylinder and align the objects using the **Align Tool**.
5. Use the **Group tool (Ctrl+G)** to group objects.

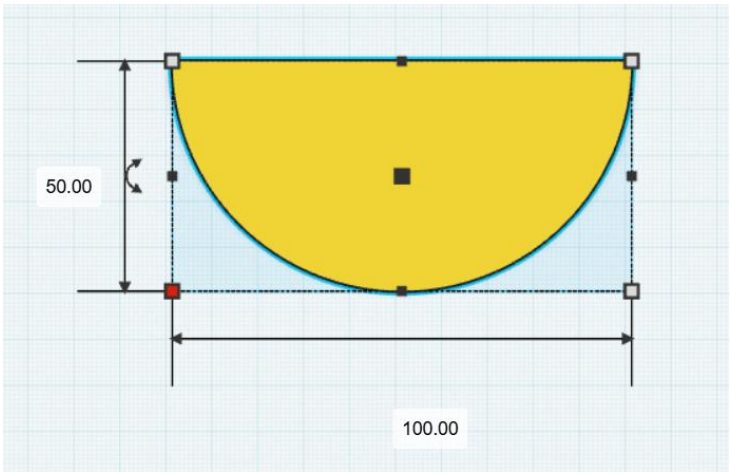


FRACTION ONE HALF

1. Model the cylinder:

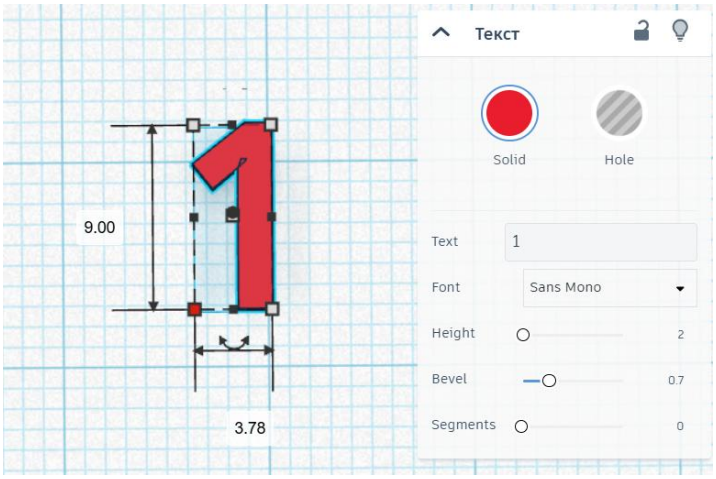
1. From the right panel of the **BASIC SHAPES** toolbar, drag the **CYLINDER** shape to the canvas and adjust its dimensions to **100 x 100 x 3 mm, Sides: 128**.
2. From the right panel of the **BASIC SHAPES** toolbar, drag a **BOX** shape to the canvas, set it as a **Hole**, and position it to divide the cylinder into 2 equal parts. Use **the Group** tool (**Ctrl+G**) to group objects.

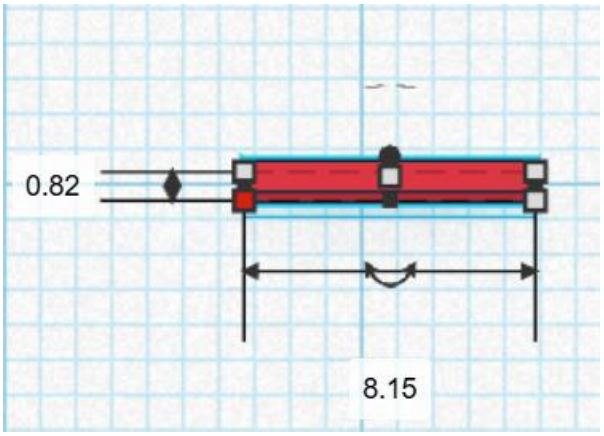


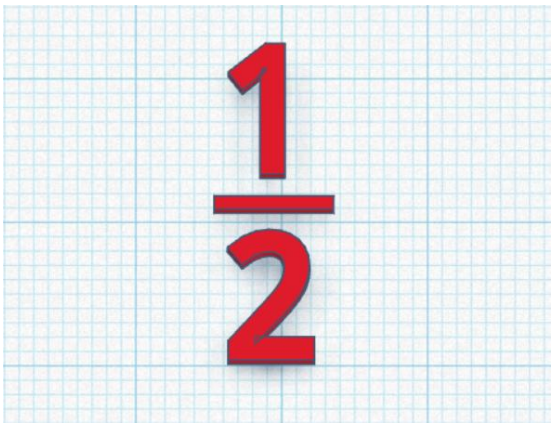


2. Model the text and place it on the cylinder:

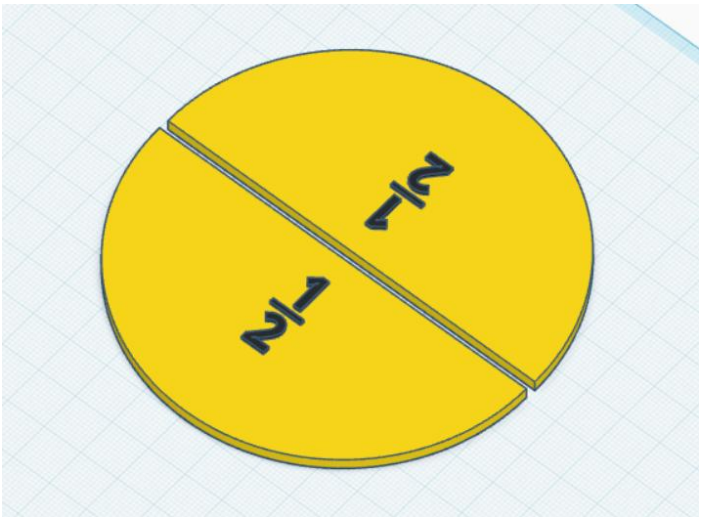
1. From the right panel of the **BASIC SHAPES** toolbar, drag the **TEXT** shape to the workspace and edit the text to your own - "1" in the menu that opens.
2. Adjust the text height to **0.6 mm**. Select a distance above the work surface of **3 mm**.





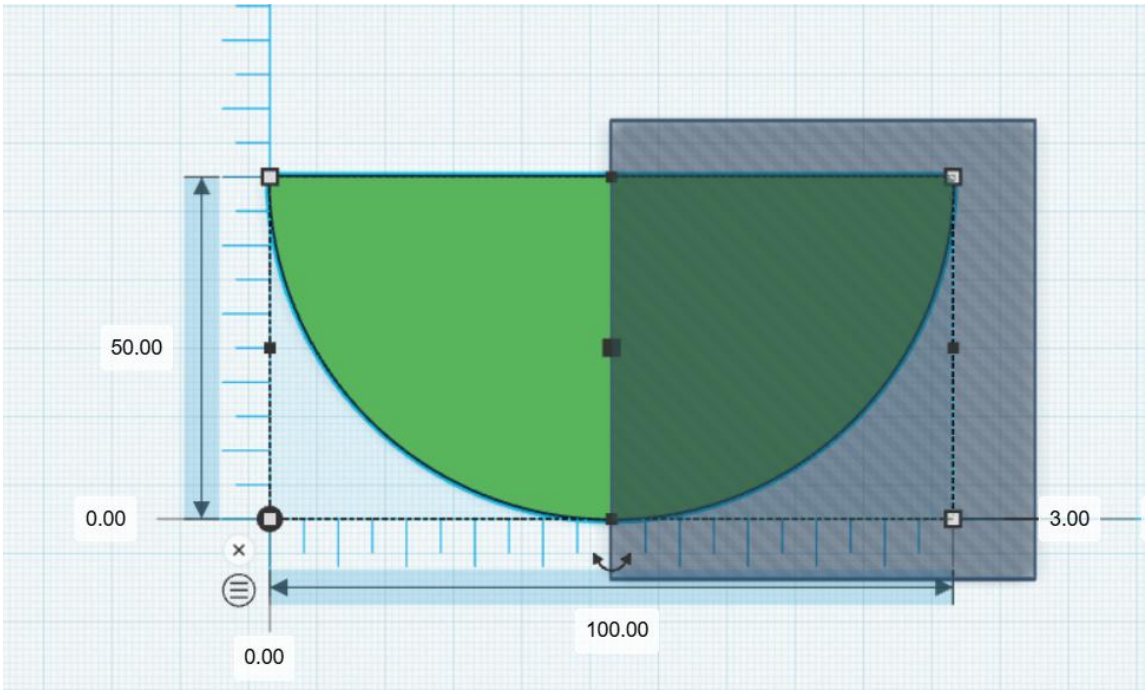


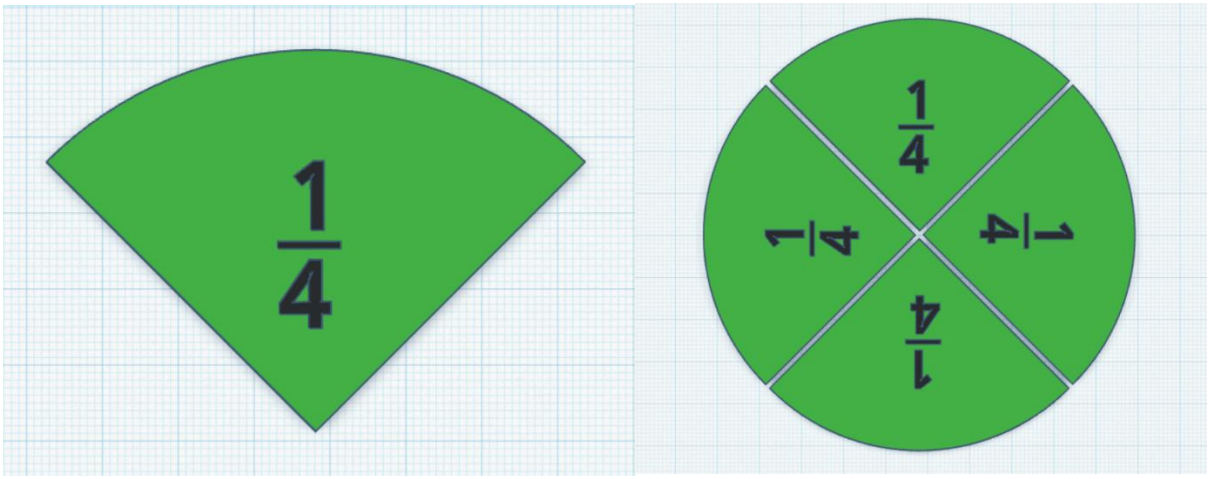
3. Do the same with the texts "-" and "2".
4. Move texts to the split cylinder and align objects using the **Align Tool**. Use the **Group tool (Ctrl+G)** to group objects.
5. Duplicate the model and you will get a second modeled tool.



FRACTION ONE QUARTER

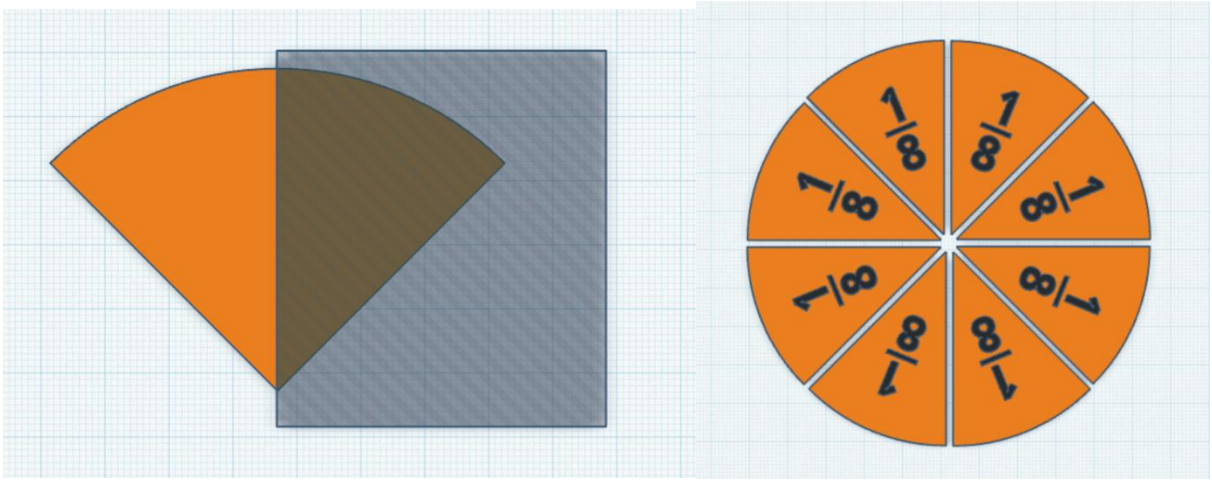
1. Model a cylinder in the same way, cut it so that one quarter remains, add text. Duplicate the model 3 times and place all the parts on the desktop to form a wheel.





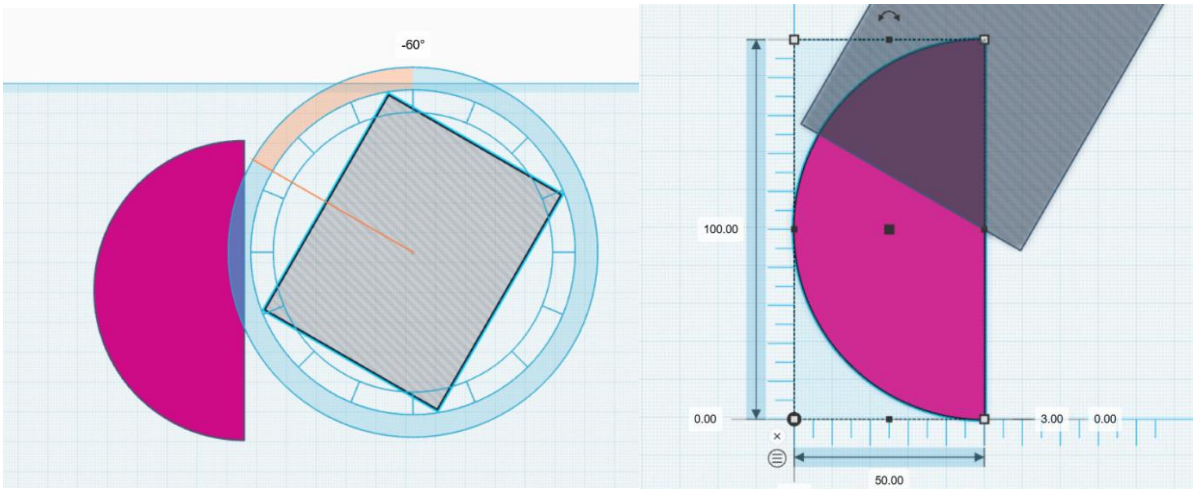
FRACTION ONE-EIGHTH

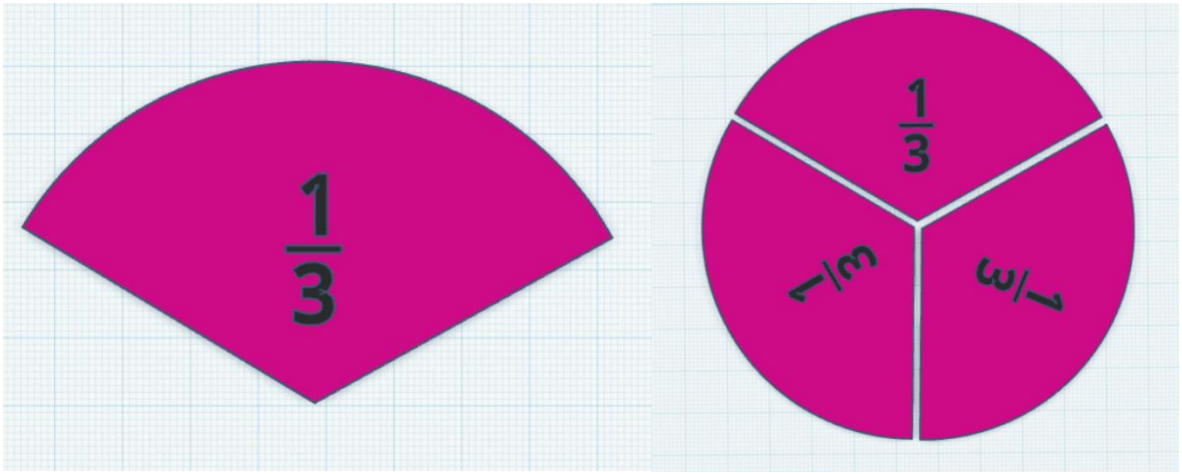
1. Model the fraction 1/8 from the ¼ division, which you divide into two halves.



FRACTION ONE THIRD

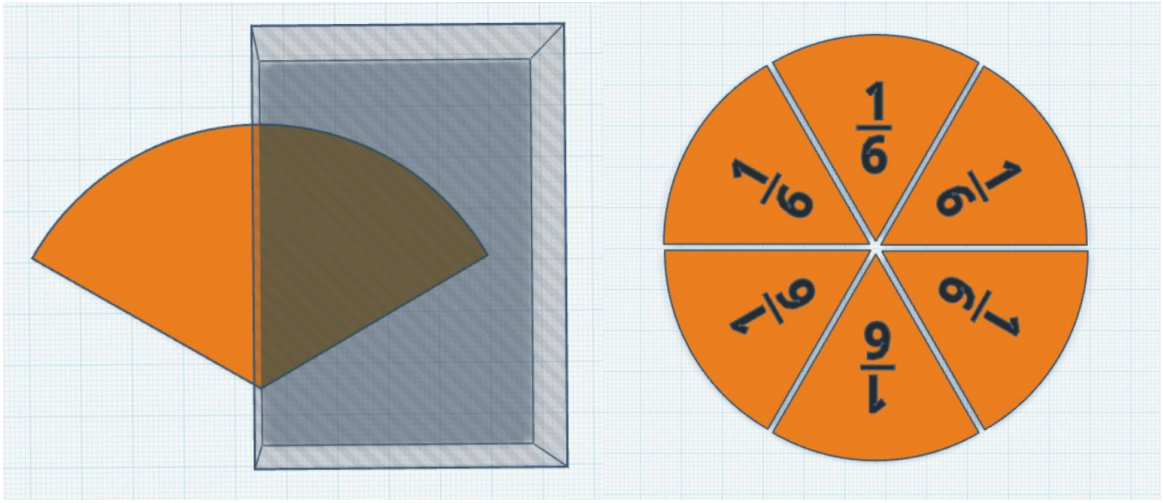
1. Model the fraction 1/3 from the ½ division. Set the **BOX** shape as a **Hole**, rotate it along the Z axis to the right to 60° and position its edge so that it passes through the center of the second piece. Use the **Group** tool (**Ctrl+G**) to group objects. Add texts. Duplicate the model 2x and place all the parts on the desktop to form a wheel.



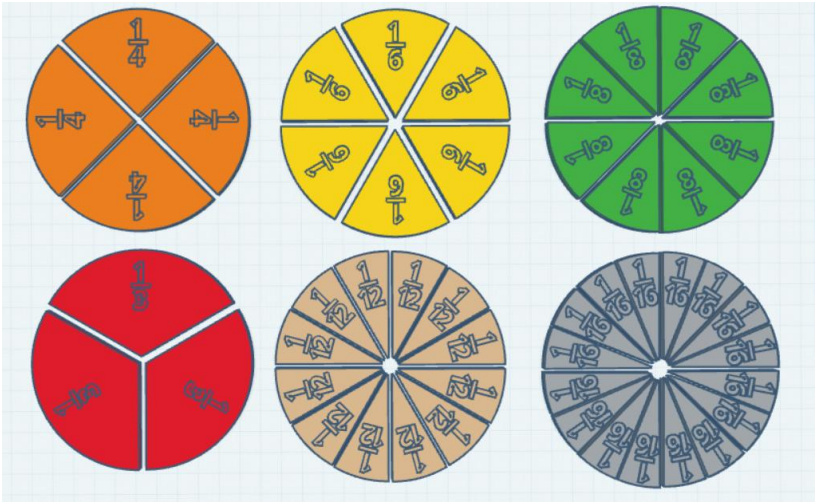


FRACTION ONE SIXTH

1. Model the fraction 1/6 from the 1/3 division, which you divide into two halves.



2. In the same way, you can model other fractions as needed.



3. Check the size of all the pieces and their location on the desktop, the objects must not be in the air.

4. Printing can be both monochrome and multi-color.
5. Click the **EXPORT** button on the top right.
6. Select the **STL** format (standard format for 3D printing).

3. Preparing the file for printing

1. Upload the STL file to the prepress software (e.g., Ultimaker Cura, PrusaSlicer, or another slicer according to your printer).
2. Set the print parameters (e.g. layer height, fill density, print speed, etc.).
3. Check the layer preview in the slicing software.

4. Model printing

1. Save the prepared file in **G-code format** and transfer it to a 3D printer.
2. Follow the manufacturer's instructions to start printing on the printer.

Time required

Activities	Estimated time
Login and set up a project	2-5 minutes
Model creation	20-25 minutes
Export and Prepare for Printing	10-15 minutes
Printing (all parts of one aid)	45–55 min.

Tips and advice

- **Fill density:** For a firmer model, choose a 20-50% fill.
- **Checking the printer:** Make sure the print bed is clean and properly aligned.

Conclusion

After completing this lesson, you will have a ready-made model of the Fractions didactic tool, which is ready to print. The result is a functional didactic tool that can be used in mathematics teaching. The created fractions serve as an illustrative tool that supports the understanding of abstract mathematical concepts. At the same time, the aid can be further modified, expanded and used in various types of teaching.

Methodological sheet number 14

14. CYLINDER NETWORK

Lesson objectives: How to create a model of a didactic tool network cylinder in Tinkercad and prepare it for 3D printing. Learn how to create a 3D model of the tool, prepare it for printing and export it to the correct format.

https://youtu.be/UYJubyEsX5o

A brief introduction to the didactic aid

The cylinder net tool consists of 3 parts:

- cylinder shell – rectangle with dimensions: cylinder height × base circumference
- two circular bases – identical circles

When modelling a mesh in Tinkercad, the goal is to create these parts as flat shapes that can be used as an illustrative aid after printing. Cylinder dimensions: base with a diameter of 40 mm and a height of 80 mm.

Procedure

1. Log in to Tinkercad and create a new project

1. Open Tinkercad in your browser.
2. Log in to your account or create a new account.
3. Click Create **New Design**.
4. Give the project a name – e.g. "Cylinder Network".

2. Modelling of the object, procedure according to YouTube:

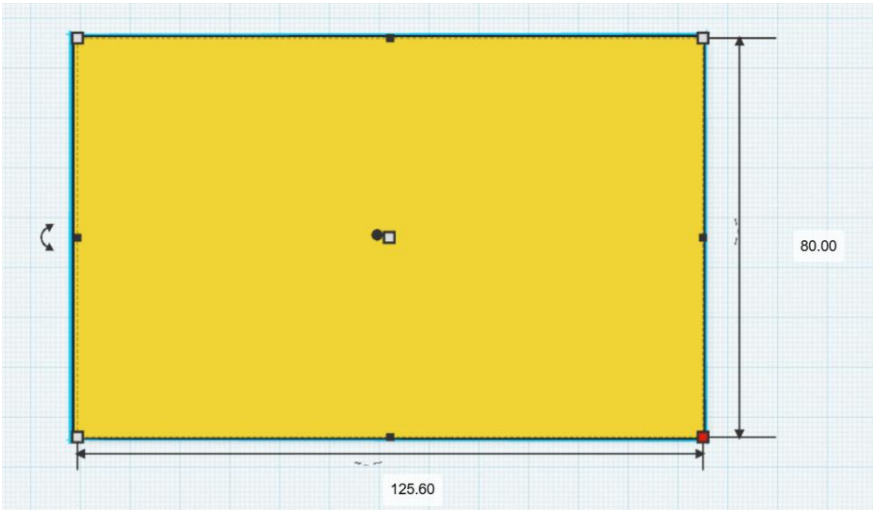
The cylinder shell is a rectangle that:

- **height** = cylinder height (e.g. 80 mm)
- **width** = perimeter of the base = π × diameter

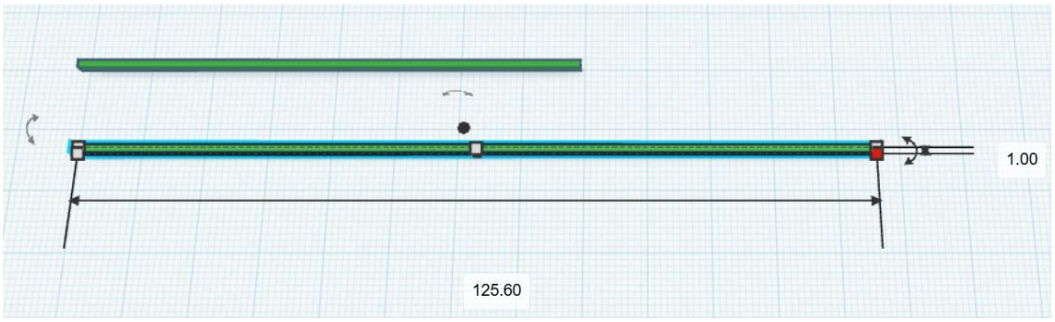
E.g. for a diameter of 40 mm: circumference ≈ 3.14 × 40 = **125.6 mm**

1. Model the rectangle and add text to it:

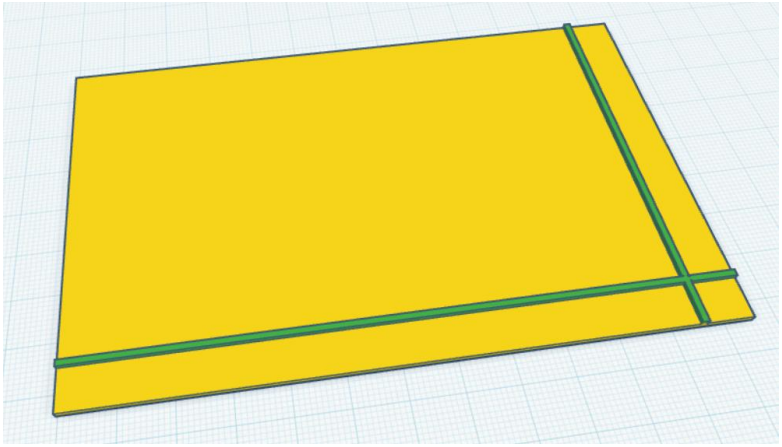
1. From the right panel of the **BASIC SHAPES** toolbar, drag the **BOX** shape to the canvas and adjust its dimensions to **125.6 x 80 x 1 mm**.



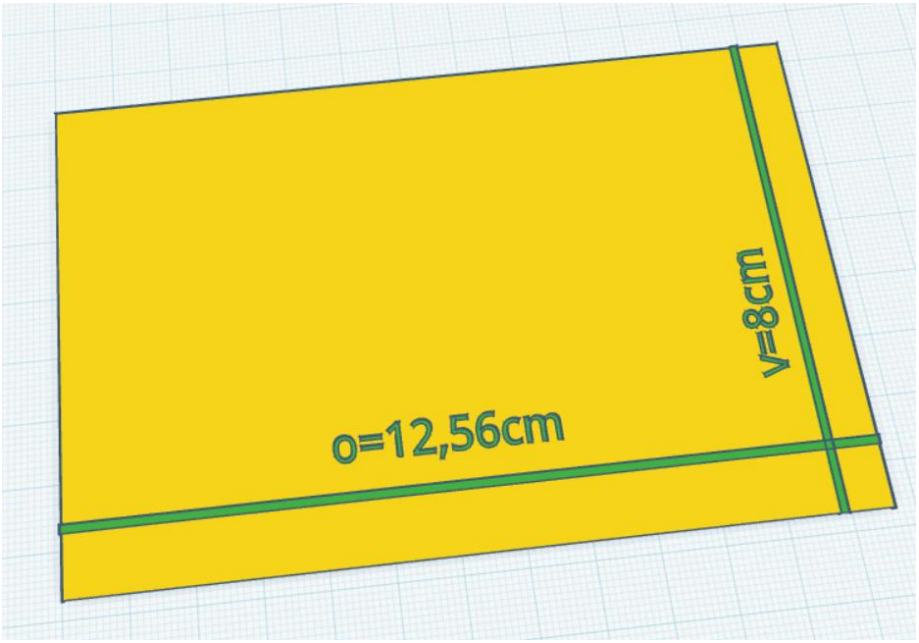
2. From the **BOX** shape, create 2 prisms measuring **125.6 x 1 x 1 mm** and **80 x 1 x 1 mm**. Select a distance above the work surface of **1 mm.**



3. Place them on a rectangle to indicate the height and circumference of the cylinder base.
4. Align objects using the **Align Tool**. Use the **Group tool (Ctrl+G)** to group objects.

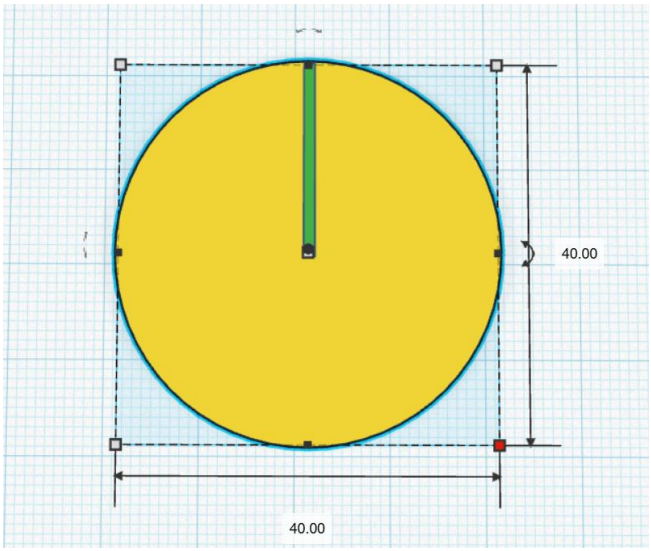


5. From the right panel of the **BASIC SHAPES** toolbar, drag the **TEXT** shape to the workspace and edit the text to your own in the menu that opens “o=12.56 cm." Adjust the height of the text to **1 mm**. Select a distance above the work surface of **1 mm**.
6. Adjust the size of the text appropriately. To resize it evenly, drag around the corner of the text with the left mouse button and hold down the **Shift key**.



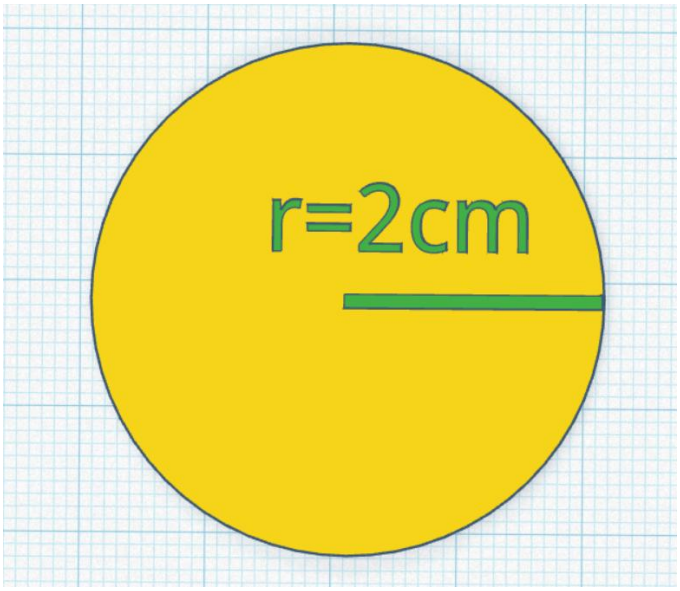
2. Model 2 circular bases – identical circles with the text: r – radius, S – centre:

1. From the right panel of the **BASIC SHAPES** toolbar, drag the **CYLINDER** shape onto the canvas, adjust its dimensions to **40 x 40 x 1 mm**, and model a **20 x 1 x 1 mm** rectangle to mark the radius from the center of the circle.

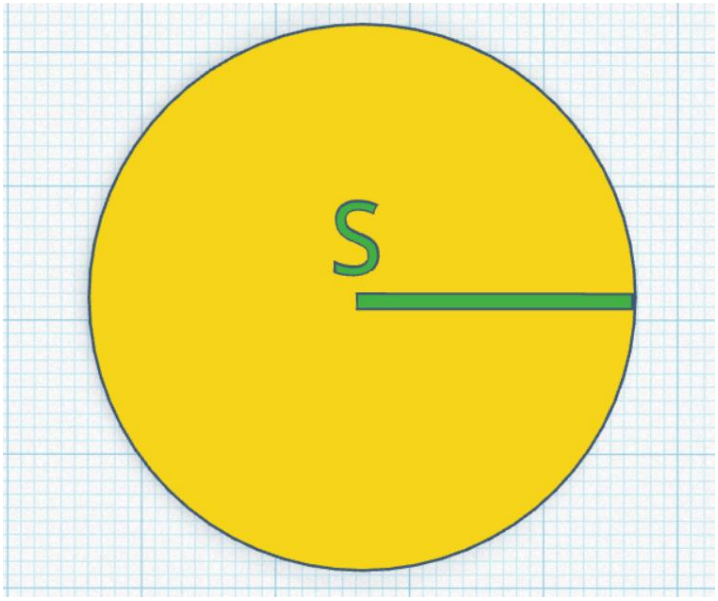


2. From the right panel of the **BASIC SHAPES** toolbar, drag the **TEXT** shape to the workspace and edit the text to your own in the menu that opens – "r=2 cm".

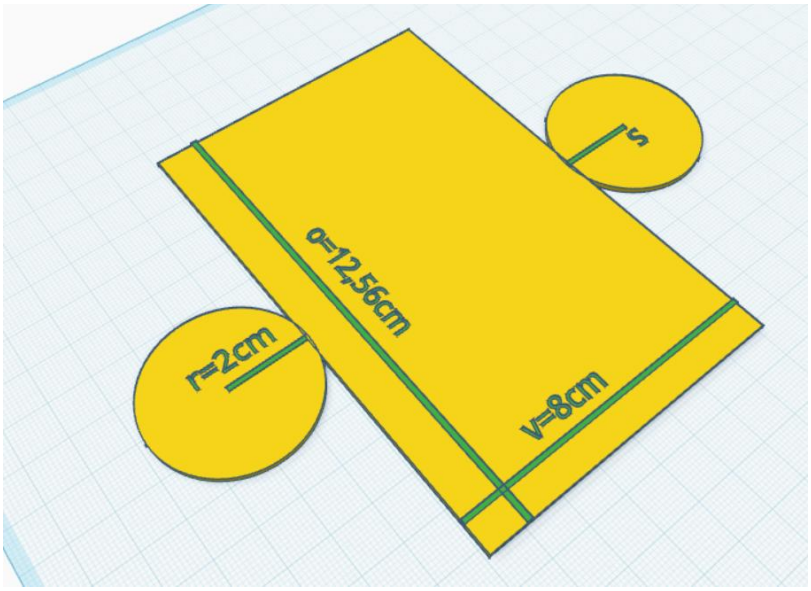
3. Adjust the size of the text so that the text is placed on a circle. Adjust the height of the text to **1 mm**. Select a distance above the work surface of **1 mm**. Use the **Group tool (Ctrl+G)** to group objects.



4. Make the second part of the circular base in the same way and mark the center of the circle with the letter **S**.



5. Place a rectangle between the two circles so that they overlap slightly.



6. Check the size of all the pieces and their location on the desktop, the objects must not be in the air. Make sure that all parts are the same thickness (1 mm).
7. Printing can be both monochrome and multi-colour.
8. Make sure that the cylinder mesh is aligned and ready for export.
9. Click the **EXPORT** button on the top right.
10. Select the **STL** format (standard format for 3D printing).

3. Preparing the file for printing

1. Upload the STL file to the prepress software (e.g., Ultimaker Cura, PrusaSlicer, or another slicer according to your printer).
2. Set the print parameters (e.g. layer height, fill density, print speed, etc.).
3. Check the layer preview in the slicing software.

4. Model printing

1. Save the prepared file in **G-code format** and transfer it to a 3D printer.
2. Follow the manufacturer's instructions to start printing on the printer.

Time required

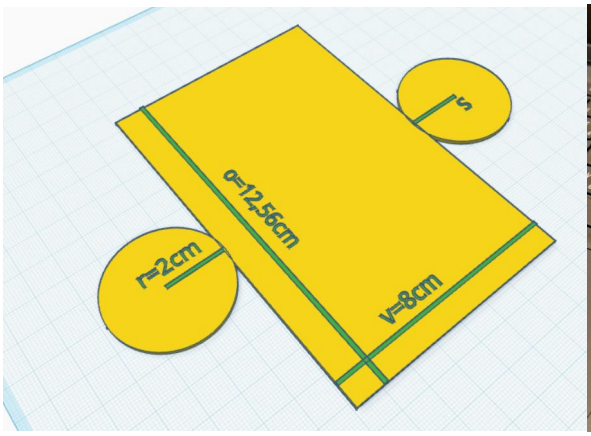
Activities	Estimated time
Login and set up a project	2-5 minutes
Model creation	20 minutes
Export and Prepare for Printing	10 minutes
Print	30 min.

Tips and advice

- **Fill density:** For a firmer model, choose a 20-50% fill.
- **Checking the printer:** Make sure the print bed is clean and properly aligned.

Conclusion

After completing this lesson, you will have a ready-made model of the didactic tool Mesh Cylinder, which is ready to print. This skill is the basis for creating more complex 3D models. The result is a functional didactic tool that can be used in teaching mathematics in the teaching of spatial geometry. The tool supports the understanding of the relationship between the circumference of the circle and the cylinder shell. Thanks to it, pupils will better understand how bodies work. Surface or perimeter calculations thus cease to be abstract for them.



Methodological sheet number 15

15. READING RULER

Lesson objectives: How to create a model of a didactic reading aid ruler in Tinkercad and prepare it for 3D printing. Learn how to create a 3D model of the tool, prepare it for printing and export it to the correct format.

https://youtu.be/zgk-_81xWX4

A brief introduction to the didactic aid

A reading ruler is an aid that helps students focus on one line of text. It usually has:

- **viewing window** (e.g. 7-15 mm high)
- **a frame** that covers the surrounding text.
- pleasant, rounded edges for handling.

Procedure

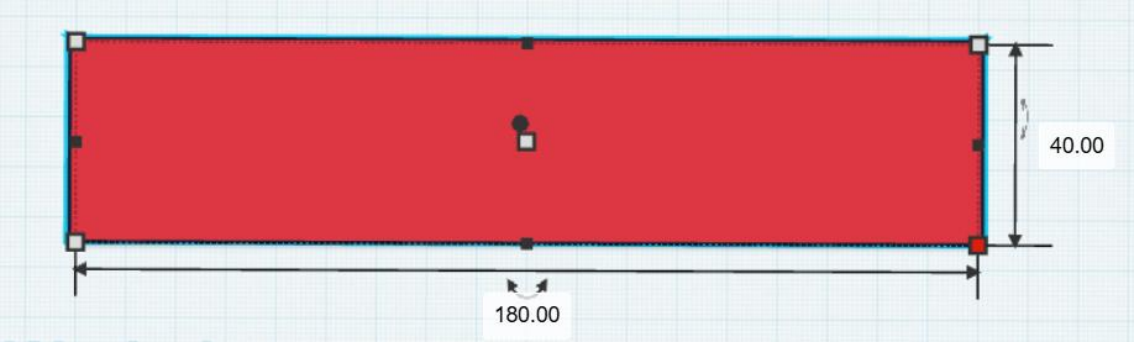
1. Log in to Tinkercad and create a new project

1. Open Tinkercad in your browser.
2. Log in to your account or create a new account.
3. Click Create **New Design**.
4. Give the project a name – e.g. "Reading ruler".

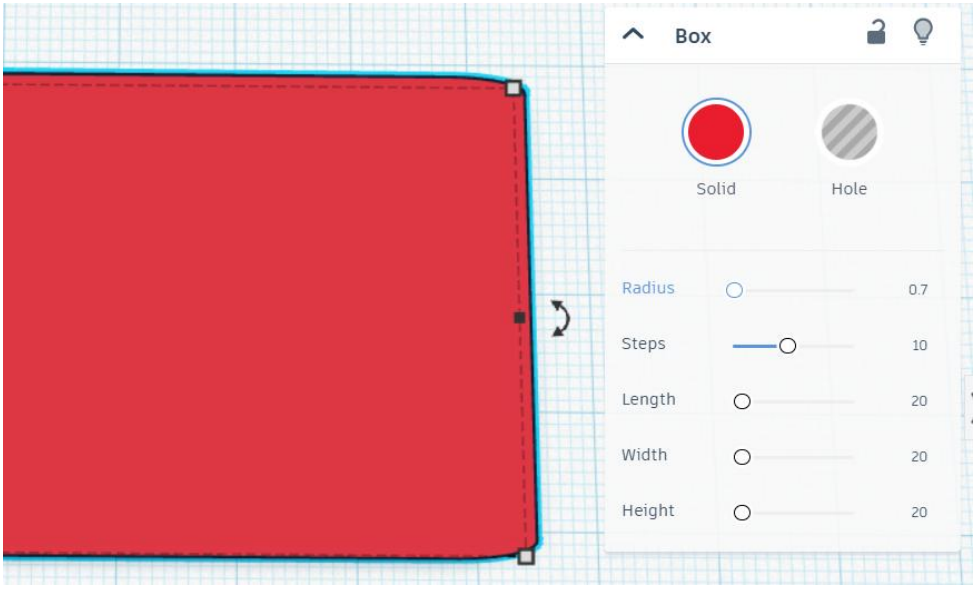
2. Modelling of the object, procedure according to YouTube:

1. Model the rectangle (ruler baseboard) and the viewing window:

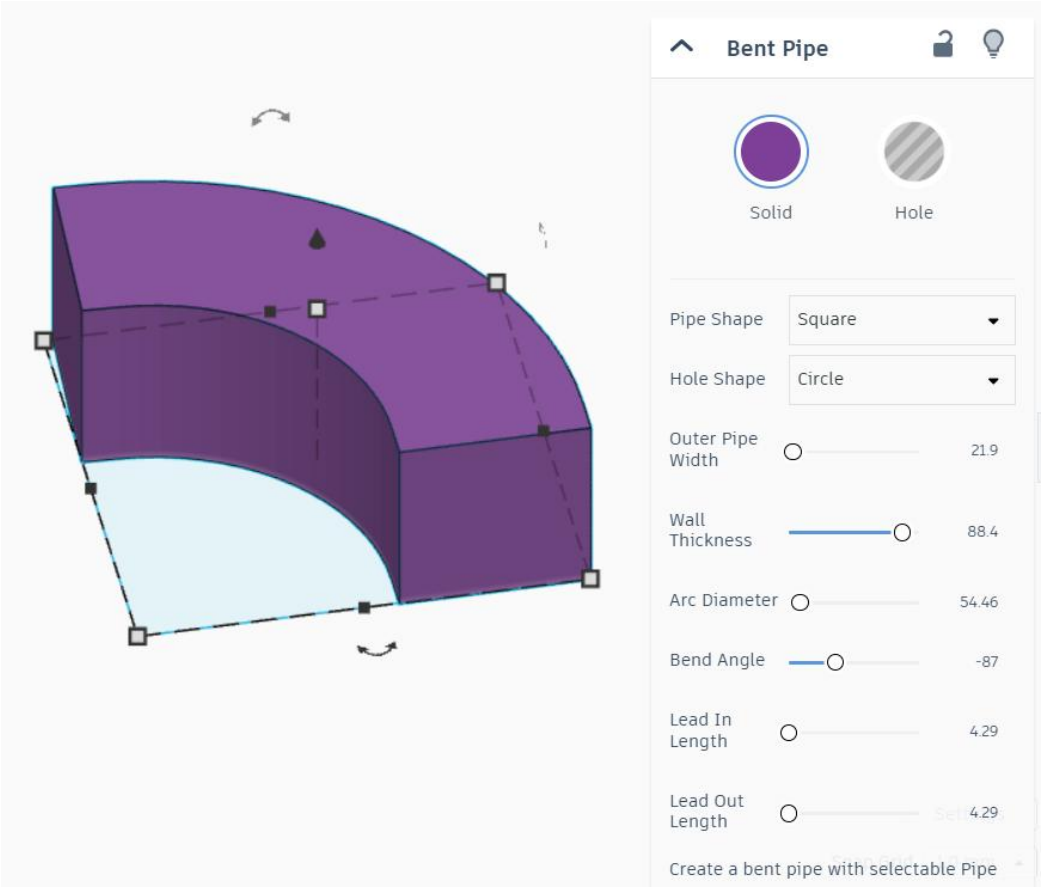
1. From the right panel of the **BASIC SHAPES** toolbar, drag a **BOX** shape to the canvas and adjust its dimensions to **180 x 40 x 2 mm**.

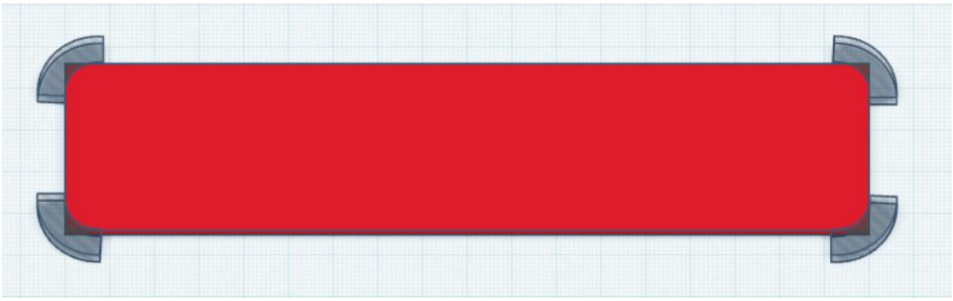


2. There are two ways to create rounded edges:
   a) In the menu that opens, adjust the **Radius** parameter to **0.7**.

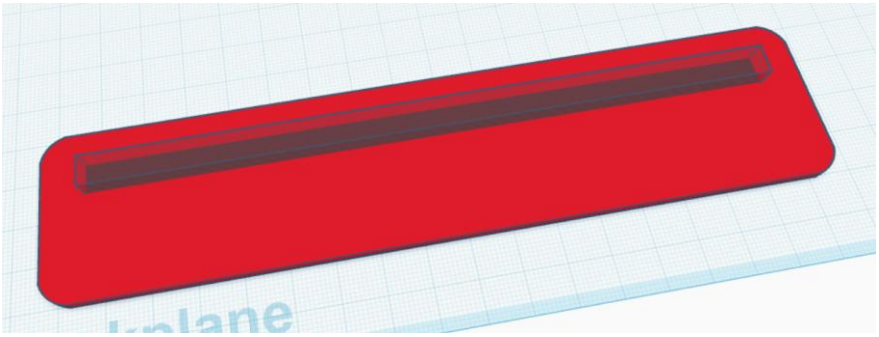


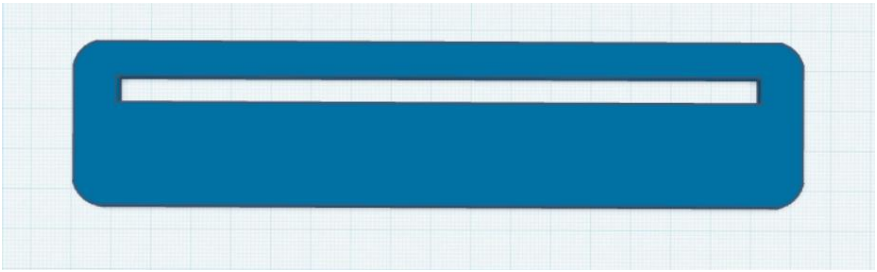
b) Select a **BENT PIPE** shape from the **SHAPE GENERATORS** menu, edit its parameters, set it as a **Hole**, copy it 3 times, place it on the edges of the ruler baseboard, and use the **Group tool (Ctrl + G)** to group the objects to create rounded edges.





3. Form a rectangle of **160 x 7 x 20 mm** from the **BOX** shape and set it as a **Hole**. Place it on the baseboard so that it is at the top of the ruler. Align objects using the **Align Tool**. Use the **Group tool (Ctrl+G)** to group objects to create an opening.

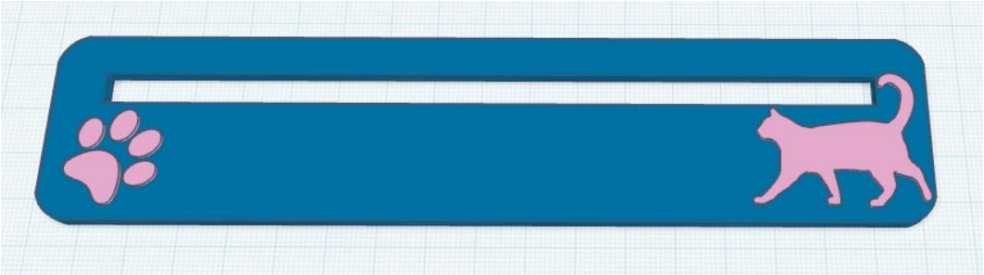




2. You can add a picture or motivational word to the ruler:

1. Download the svg image from the Internet. Select the image and add it to the Tinkercad desktop by pressing the **IMPORT** button.

2. Adjust the size of the image appropriately and place them on the ruler according to your imagination.
3. Adjust the height to **0.6 mm**. Select a distance above the work surface of **2 mm**. Use **the Group tool (Ctrl+G)** to group objects.



4. You can add more images in the same way.
5. Check the size of all the pieces and their location on the desktop, the objects must not be in the air. Make sure all parts are the correct thickness.
6. Printing can be both monochrome and multi-color.
7. Click the **EXPORT** button on the top right.
8. Select the **STL** format (standard format for 3D printing).

3. Preparing the file for printing

1. Upload the STL file to the prepress software (e.g., Ultimaker Cura, PrusaSlicer, or another slicer according to your printer).
2. Set the print parameters (e.g. layer height, fill density, print speed, etc.).
3. Check the layer preview in the slicing software.

4. Model printing

1. Save the prepared file in **G-code format** and transfer it to a 3D printer.
2. Follow the manufacturer's instructions to start printing on the printer.

Time required

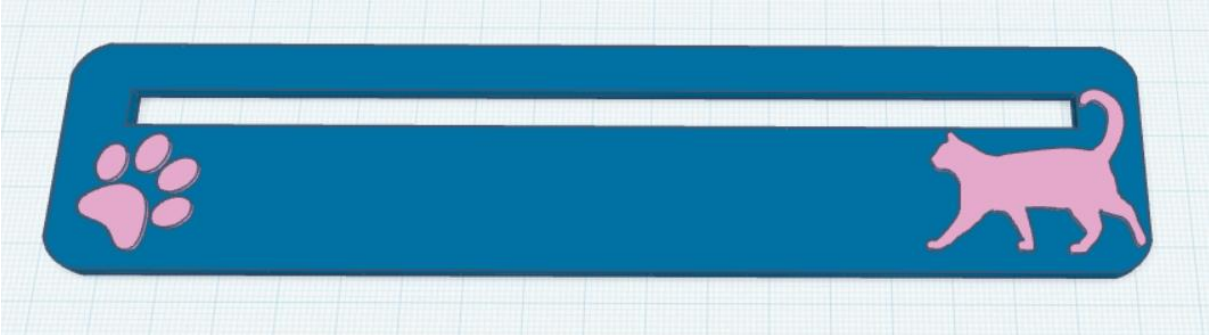
Activities	Estimated time
Login and set up a project	2-5 minutes
Model creation	25 minutes
Export and Prepare for Printing	10 minutes
Print	30 min.

Tips and advice

- **Fill density:** For a firmer model, choose a 20-50% fill.
- **Checking the printer:** Make sure the print bed is clean and properly aligned.

Conclusion

After completing this lesson, you will have a ready-made model of the didactic reading aid that is ready to print. This skill is the basis for creating more complex 3D models. The result is a functional didactic tool that helps pupils concentrate on one line of text. It is suitable for beginning readers, pupils with attention deficit disorders or dyslexia and thus allows them to read more fluently.



Methodological Sheet No. 16

16. DOMINO GAME

Lesson objective: How to create a model of a domino game in Tinkercad and prepare it for 3D printing. Learn how to create a 3D model of a domino stone, prepare it for printing and export it to the correct format.

https://youtu.be/Y_rTr69KC1g

A brief introduction to the game

Dominoes is a puzzle game consisting of rectangular stones that are divided into 2 halves. Each half contains a certain number of dots (0-6). The standard set contains **28 stones**. Each stone has: a uniform dimension, dividing line in the middle, dots marked with relief (raised or hollowed out).

Procedure

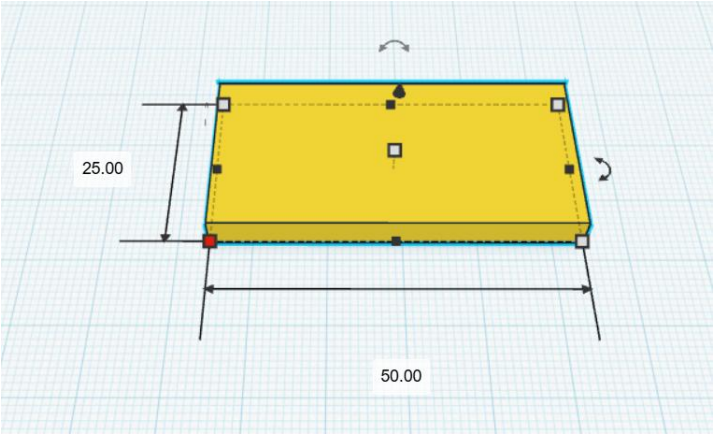
1. Log in to Tinkercad and create a new project

1. Open Tinkercad in your browser.
2. Log in to your account or create a new account.
3. Click Create **New Design**.
4. Name the project – e.g. "Domino".

2. Modelling of the object, procedure according to YouTube:

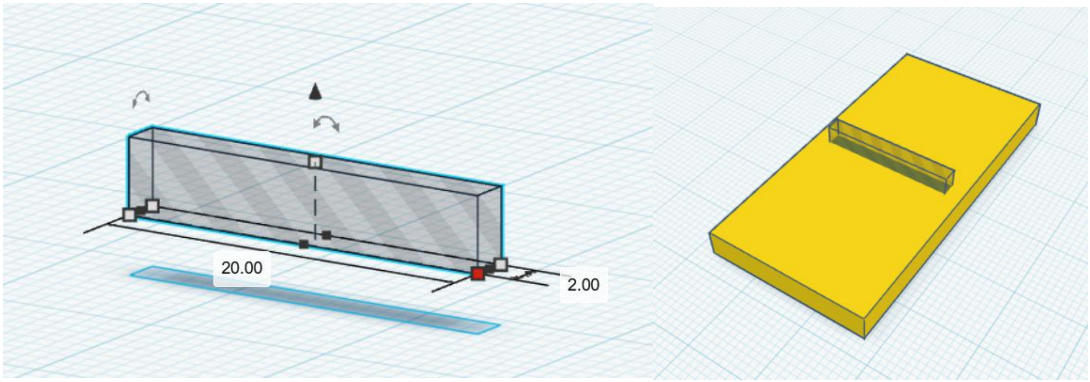
1. Model a rectangle with a dividing line that divides it in half:

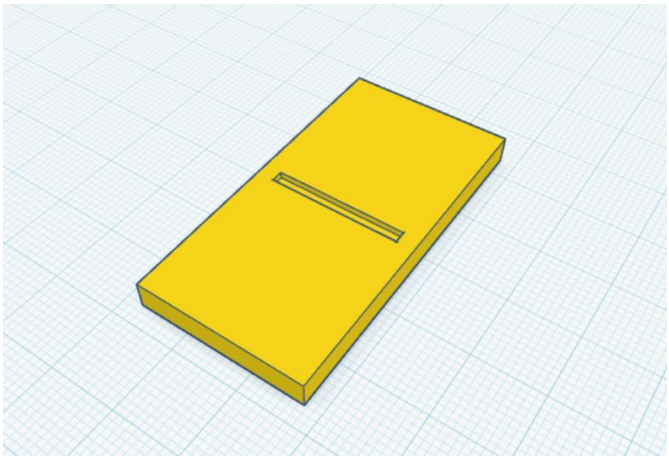
1. From the right panel of the **BASIC SHAPES** toolbar, drag the **BOX** shape to the canvas and adjust its dimensions to **50 x 20 x 4 mm**. Round the edges as needed using the **Radius** parameter (1-2 mm).



2. Create a dividing line by modeling a prism measuring **20 x 2 x 10 mm** from the shape of the **BOX** as a **Hole**. Select a distance above the work surface of **3 mm**.

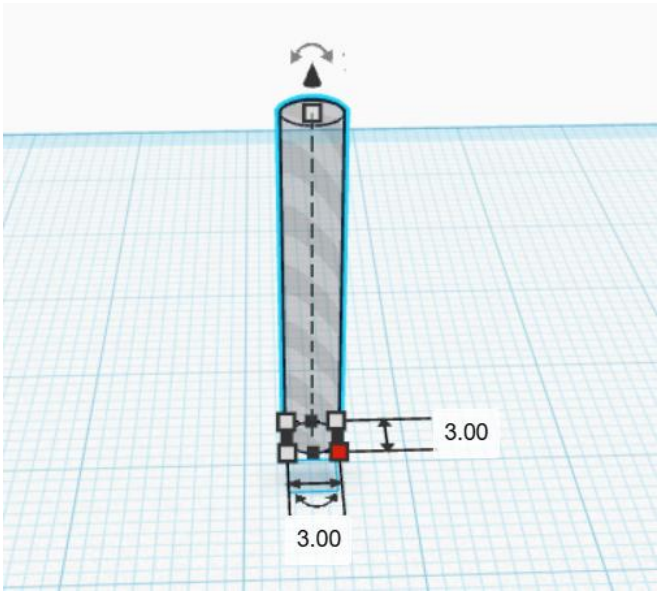
3. Place it in the middle of the stone. Align objects using the **Align Tool**. Use the **Group** tool (**Ctrl+G**) to group objects.



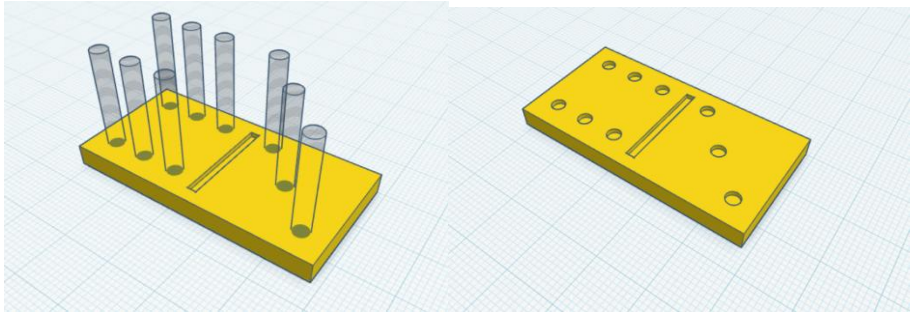


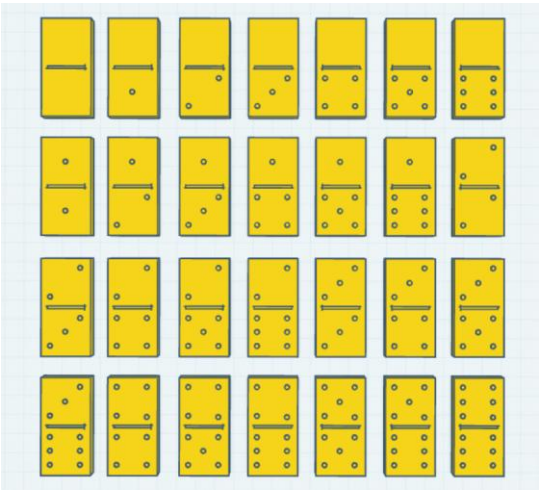
2. Creating Dots:

1. From the right panel of the **BASIC SHAPES t**oolbar, drag a **CYLINDER** shape to the workspace, set it as a **Hole**, and adjust its dimensions to **3 x 3 x 20 mm**. Select a distance above the work surface of **3 mm**.
2. Arrange the dots (**CYLINDER)** in a domino pattern (0-6).
3. Duplicate and align the dots using the **Align Tool**. Use the **Group** tool (**Ctrl+G**) to group objects.



4. Create 1 stone as a template for the next 27 pieces. Edit only the dots – the basic shape will remain the same. The standard set includes combinations: 0-0, 0-1, 0-2 ... up to 6–6.





5. Check the size of all the pieces and their location on the desktop, the objects must not be in the air.
6. Printing can be both monochrome and multi-color.
7. Click the **EXPORT** button on the top right.
8. Select the **STL** format (standard format for 3D printing).

3. Preparing the file for printing

1. Upload the STL file to the prepress software (e.g., Ultimaker Cura, PrusaSlicer, or another slicer according to your printer).
2. Set the print parameters (e.g. layer height, fill density, print speed, etc.).
3. Check the layer preview in the slicing software.

4. Model printing

1. Save the prepared file in **G-code format** and transfer it to a 3D printer.
2. Follow the manufacturer's instructions to start printing on the printer.

Time required

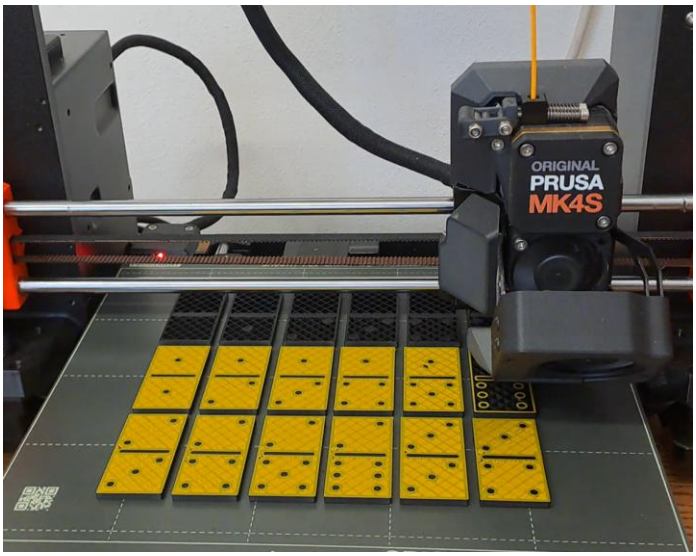
Activities	Estimated time
Login and set up a project	2-5 minutes
Model creation	40-50 minutes
Export and Prepare for Printing	10-15 minutes
Print (all parts)	4 hours

Tips and advice

- **Fill density:** For a firmer model, choose a 20-50% fill.
- **Checking the printer:** Make sure the print bed is clean and properly aligned.

Conclusion

After completing this lesson, you will have a finished model of a domino game that is ready to print. This skill is the basis for creating more complex 3D models. The resulting game is fully functional, durable and can serve as a long-term didactic tool at school and at home.




DOMINO
3D printing project
The Czech Republic - Iceland

Methodological sheet number 17

17. IRREGULAR VERBS

Lesson objectives: How to create a model of the irregular verbs didactic tool in Tinkercad and prepare it for 3D printing. Learn how to create a 3D model of the tool, prepare it for printing and export it to the correct format.

https://youtu.be/rNn4mTVpqrM

A brief introduction to the didactic aid

The irregular verbs utility can take various forms. Verb cards are most often used. The number of flashcards and variants of verbs is not limited. Pupils sort the cards, put together fours or play memory games.

Each card contains:

- infinitive (e.g. *to be*)
- past tense (e.g. *was, were*)
- past participle (e.g. *been*)
- translation (e.g. *být*)

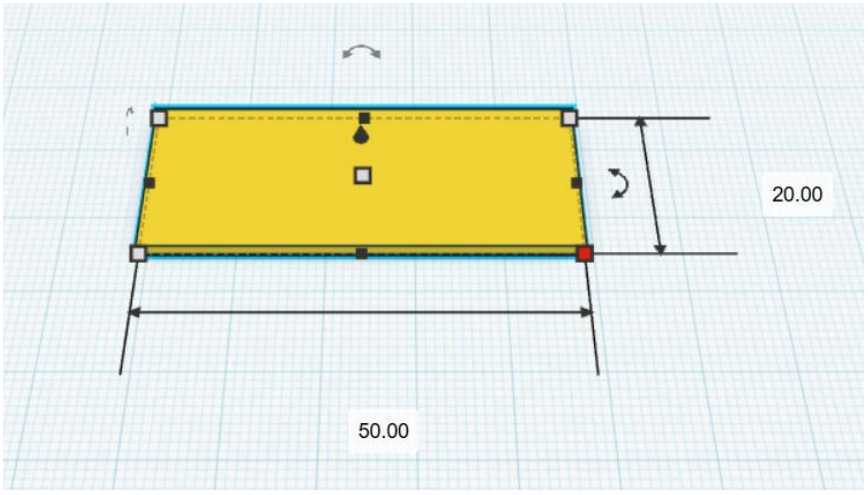
Procedure

1. Log in to Tinkercad and create a new project

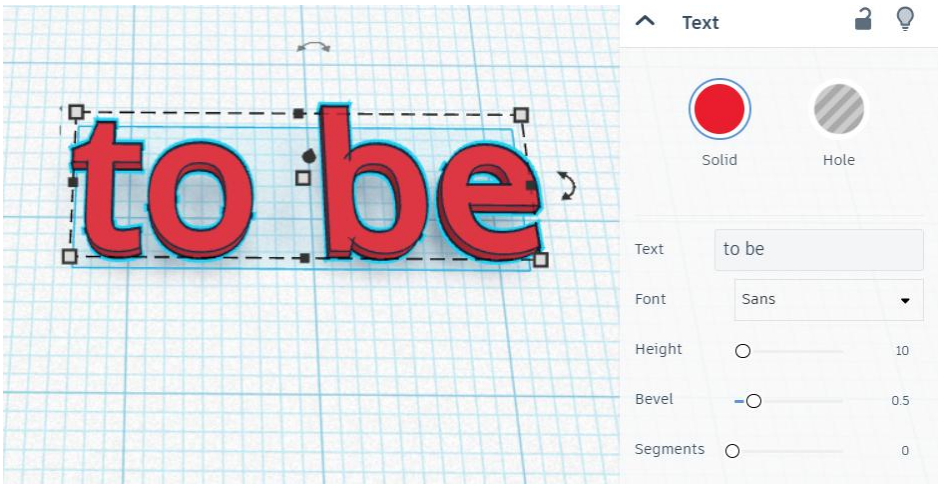
1. Open Tinkercad in your browser.
2. Log in to your account or create a new account.
3. Click Create **New Design**.
4. Name the project – e.g. "Irregular verbs".

2. Modelling of the object, procedure according to YouTube:

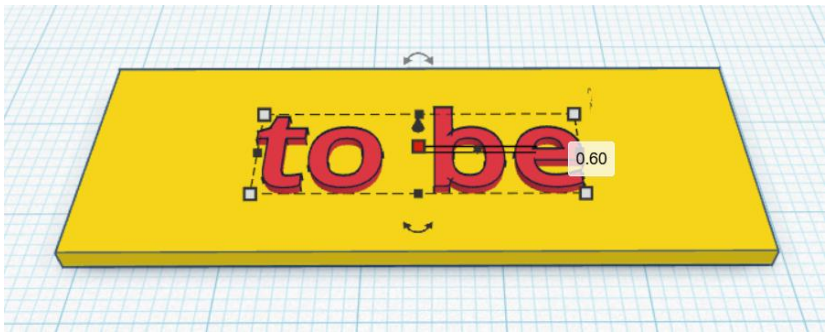
1. From the right panel of the **BASIC SHAPES to**olbar, drag a **BOX** shape to the canvas and adjust its dimensions to **50 x 20 x 1.4 mm**. You can round the edges as needed using the **Radius** parameter (1-2 mm).



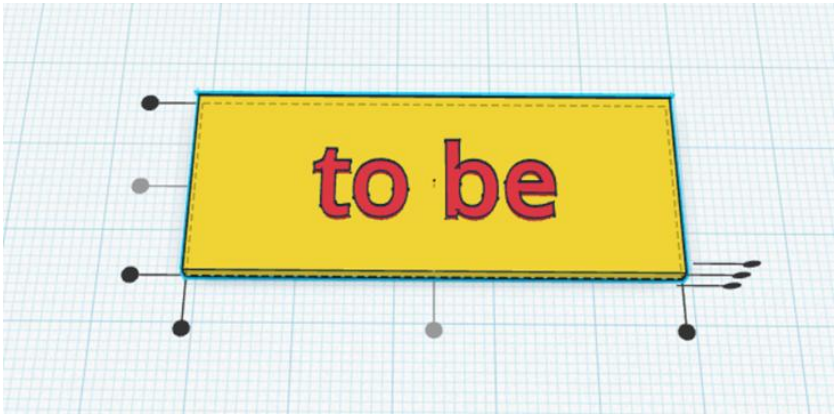
2. From the right panel of the **BASIC SHAPES** toolbar, drag a **TEXT** shape to the workspace and edit the text to your own – "to be" in the menu that opens.
3. Adjust the size of the text so that the text is placed on a rectangle. To resize it evenly, drag around the corner of the text with the left mouse button and hold down the **Shift key**.

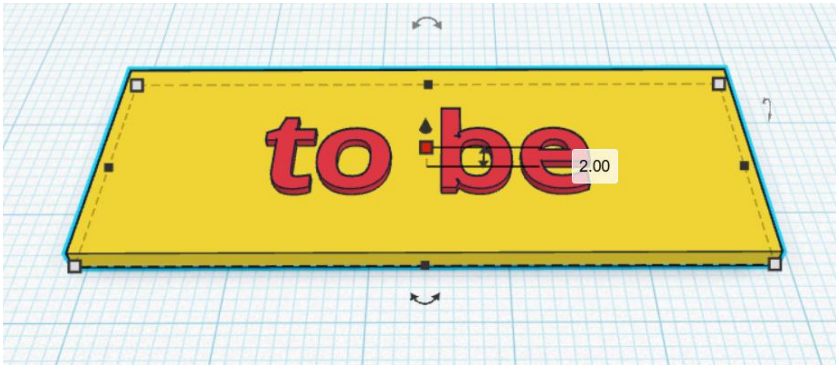


4. Adjust the text height to **0.6 mm.** Select **1.4 mm** for a distance above the work surface.

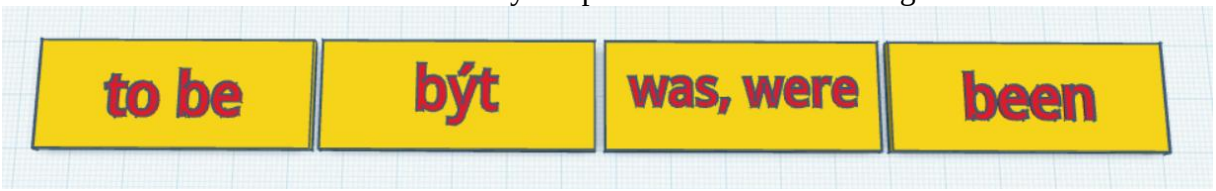


5. Align objects using the **Align Tool**. Use the **Group tool (Ctrl+G)** to group objects. **The height of the entire model must be 2 mm**.



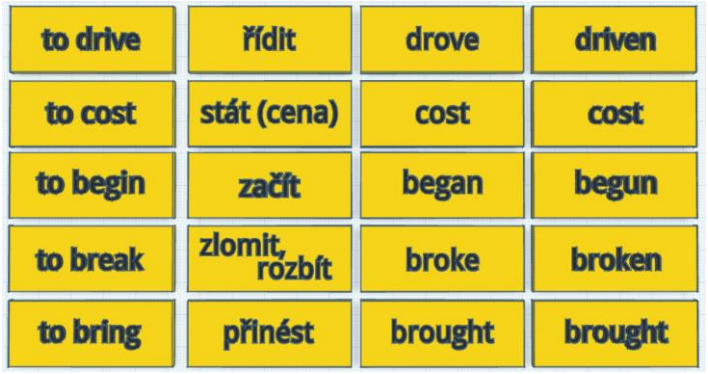


6. Do the other verb forms in the same way. Duplicate the card and change the text.



7. Select 10-20 irregular verbs. Create four cards for each and make the full set.

to be	být	was, were	been
to become	stát se	became	become
to cut	stříhat, řezat	cut	cut
to do	dělat	did	done
to drink	pít	drank	drunk



8. Check the size and height of all the pieces and their location on the work surface, the objects must not be in the air.
9. Printing can be both monochrome and multi-color.
10. Click the **EXPORT** button on the top right.
11. Select the **STL** format (standard format for 3D printing).

3. Preparing the file for printing

1. Upload the STL file to the prepress software (e.g., Ultimaker Cura, PrusaSlicer, or another slicer according to your printer).
2. Set the print parameters (e.g. layer height, fill density, print speed, etc.).
3. Check the layer preview in the slicing software.

4. Model printing

1. Save the prepared file in **G-code format** and transfer it to a 3D printer.
2. Follow the manufacturer's instructions to start printing on the printer.

Time required

Activities	Estimated time
Login and set up a project	2-5 minutes
Model creation	50-80 minutes
Export and Prepare for Printing	10-15 minutes
Print (all 40 episodes)	2 h. 30 min.

Tips and advice

- **Fill density:** For a firmer model, choose a 20-50% fill.
- **Checking the printer:** Make sure the print bed is clean and properly aligned.

Conclusion

After completing this lesson, you will have a ready-made model of the irregular verbs didactic tool, which is ready to print. This skill is the basis for creating more complex 3D models. The result is a simple, effective didactic tool that connects language learning with digital creation. The educational tool supports English language learning, develops memory, logical thinking and creativity and can be used in the long term both at school and at home.

Methodological sheet number 18

18. CUBE NETWORK

Lesson objective: How to create a model of the didactic tool cube network in Tinkercad and prepare it for 3D printing. Learn how to create a 3D model of the tool, prepare it for printing and export it to the correct format.

https://youtu.be/TTXERwkIxS0

A brief introduction to the didactic aid

Model the cube grid from 6 crooked pyramids and tabs between them for easy folding. All the pieces are arranged in such a way that they can be folded into a spatial solid.

Note: You can also use 6 squares to create a mesh, but this will not allow you to compose the mesh. For easy folding, all edges of the squares must be cut at an angle of less than 45°.

Procedure

1. Log in to Tinkercad and create a new project

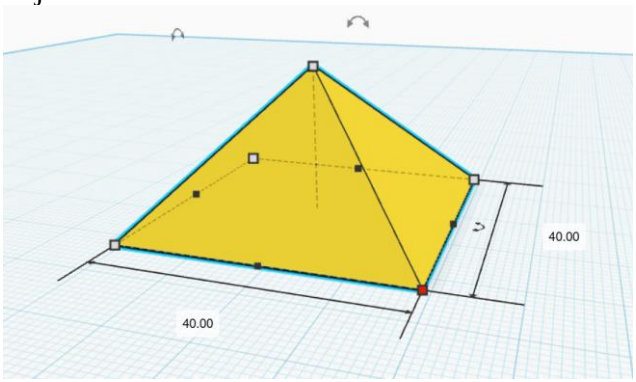
1. Open Tinkercad in your browser.
2. Log in to your account or create a new account.
3. Click Create **New Design**.
4. Give the project a name – e.g. "Cube network".

2. Modelling of the object, procedure according to YouTube:

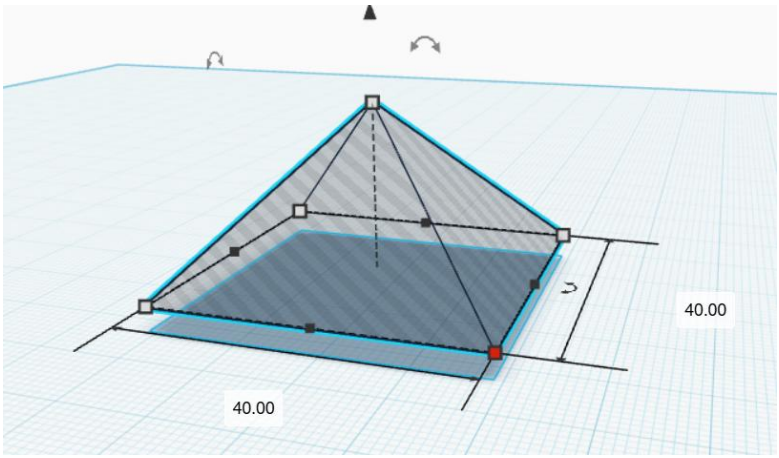
For example, a net for a cube measuring **40 x 40 x 40 mm**.

1. Model the crooked pyramid and bookmark:

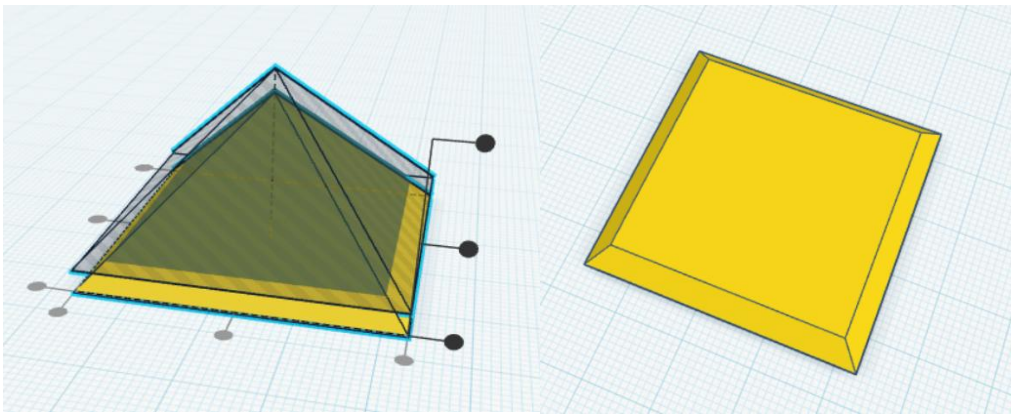
1. From the right panel of the **BASIC SHAPES** toolbar, drag the **PYRAMID** shape to the canvas and adjust its dimensions to **40 x 40 x 20 mm**.



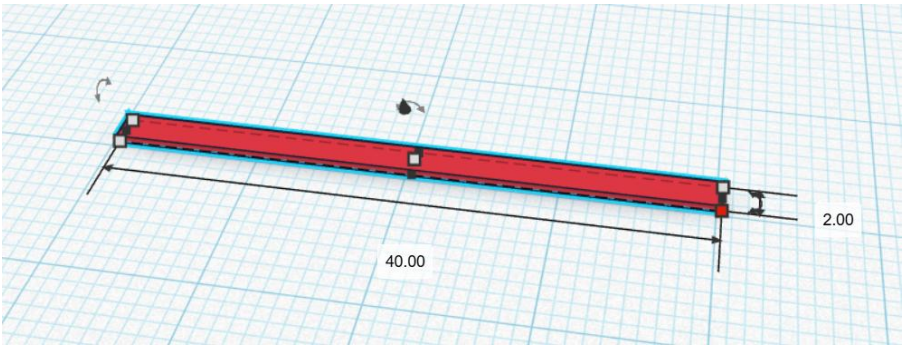
2. Duplicate the shape and add the **Hole** property to it. Select a distance above the work surface of **3 mm**.



3. Place the shapes on top of each other. Align objects using the **Align Tool**. Use the **Group** tool (**Ctrl+G**) to group objects.

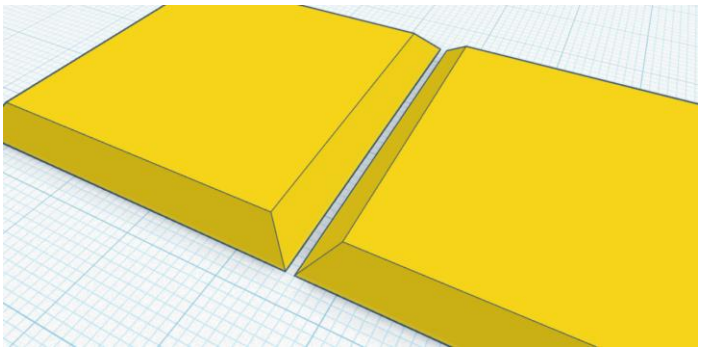


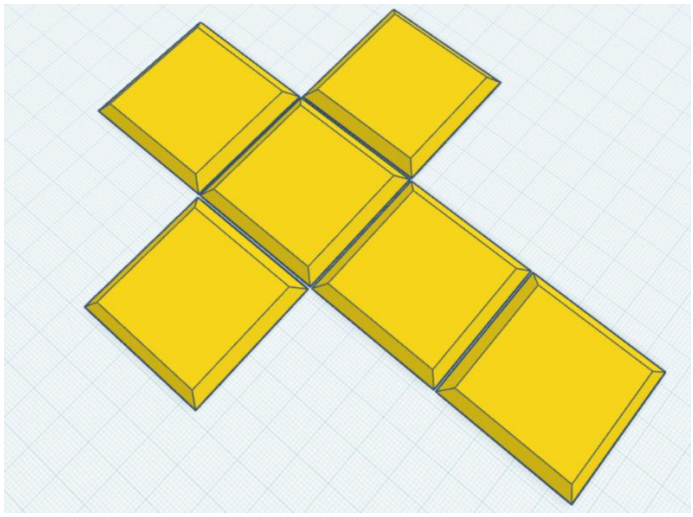
4. From the **BOX** shape, create a prism (bookmark) with dimensions of **40 x 2 x 0.4 mm**.



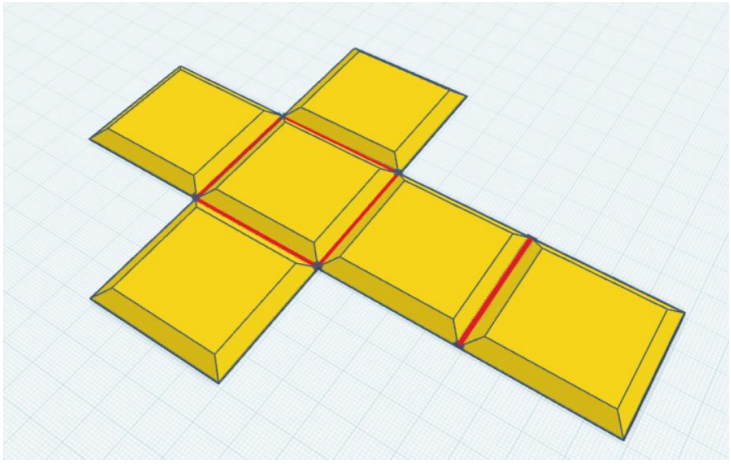
2. Assembling the cube mesh:

1. Duplicate the crooked pyramid 5 times and place them on the work surface as shown. Leave **1 mm** space between the pyramids. Align the objects using the **Align Tool**.

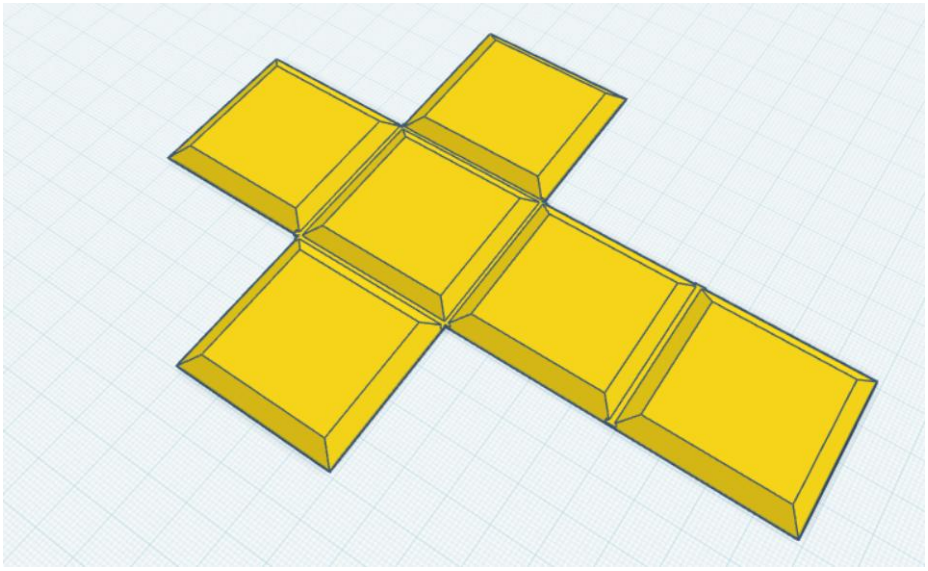




2. Duplicate the bookmark 4x and place them between the pyramids. Align objects using the **Align Tool**.



3. Use the **Group** tool (**Ctrl+G**) to group objects.



4. Check the size of all the pieces and their location on the desktop, the objects must not be in the air.
5. Make sure the mesh is aligned.
6. Click the **EXPORT** button on the top right.
7. Select the **STL** format (standard format for 3D printing).

3. Preparing the file for printing

1. Upload the STL file to the prepress software (e.g., Ultimaker Cura, PrusaSlicer, or another slicer according to your printer).
2. Set the print parameters (e.g. layer height, fill density, print speed, etc.).
3. Check the layer preview in the slicing software.

4. Model printing

1. Save the prepared file in **G-code format** and transfer it to a 3D printer.
2. Follow the manufacturer's instructions to start printing to the printer.

Time required

Activities	Estimated time
Login and set up a project	2-5 minutes
Model creation	20 minutes
Export and Prepare for Printing	10 minutes
Print	40 min.

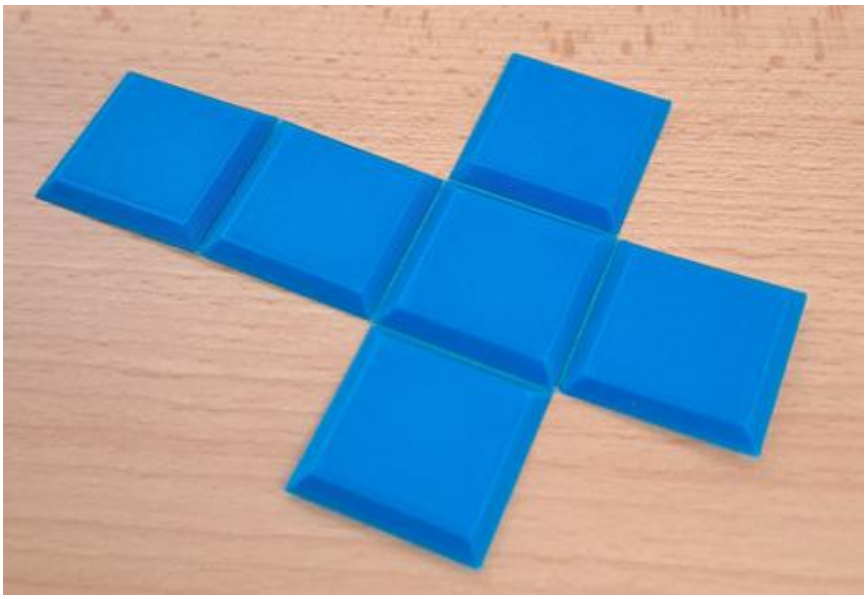
Tips and advice

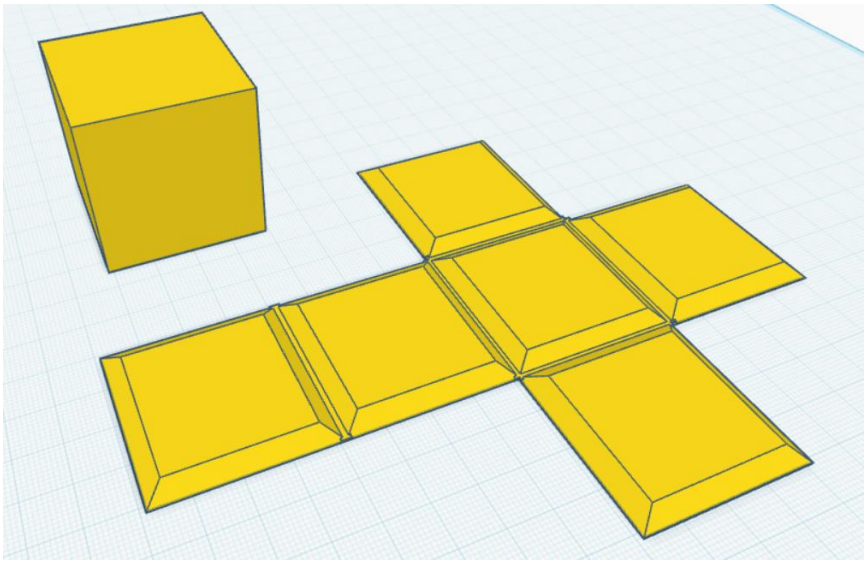
- **Fill density:** For a firmer model, choose a 20-50% fill.

- **Checking the printer:** Make sure the print bed is clean and properly aligned.

Conclusion

After completing this lesson, you will have a ready-made model of the didactic tool grid cube, which is ready to print. This skill is the basis for creating more complex 3D models. The result is a functional didactic tool that can be used in mathematics when teaching spatial geometry. The tool supports understanding how a 2D mesh transitions into a 3D solid. Thanks to it, pupils better understand how bodies work. Surface or perimeter calculations thus cease to be abstract for them.





19. PrusaSlicer – preparation of the model for 3D printing

https://youtu.be/BI4jcPdDgYo

After creating a 3D model in Tinkercad, you must prepare the object for printing. This is done using the PrusaSlicer software, which loads the STL file and converts it into a print file in G-code format. In PrusaSlicer, set the printer, material, print quality, or supports and fill. Then transfer the resulting file to a 3D printer.