

Series title: Tinkercad and 3D printing

Age of participants: 11+

Maximum number of participants per group: 12

Number of hours: 9

Type of track: STEAM, art, design

Brief description of the workshop series:

Create your first spatial design from scratch and learn how to 3D print it.

In this class, students will learn how to use one of the easiest tools for creating 3D designs, Tinkercad. From combining simple solids to precise modeling using calipers, rulers, protractors and other measuring tools - all to create a spatial model of any object. The knowledge gained will be used by those attending the workshop to create future projects - the Tinkercad program runs in a browser and is fully free. There will also be a large portion of practical knowledge about 3D printing.

In addition, during the third meeting all participants will receive a gift in the form of a gadget printed on a 3D printer.

What does the workshop teach?

- what 3D printing is and what it can be used for
- the use of the computer and its capabilities to create spatial designs - the ability to navigate in a 3D environment
- basics of CAD type programs
- basics of 3D modeling
- operation of measuring tools
- how to create spatial designs in Tinkercad software

What skills does the workshop develop?

- advanced computer skills
- knowledge of 3D printing

In addition, the classes develop

- creativity
- spatial observation and perception of the world
- teamwork
- engineering thinking
- sense of self-efficacy

Success criteria:

1. the student knows what additive (incremental) technologies are
2. the student knows what FDM 3D printing is
3. the student knows the basic principles of FDM and SLA printers
4. the student knows what 3D printing is currently used for in industry and everyday life
5. student knows the basic principles related to the correct and safe operation of 3D printers
6. student understands what spatial design is
7. student knows what CAD - computer aided design - is
8. student understands the terms: space, dimensions, 3D, 3W
9. student knows what spatial design is used for
10. student is able to independently log into Autodesk Tinkercad program
11. learner knows the basic functions related to the correct and effective movement in the program: creating a new project, changing the name of the project, working with the camera - rotate the view, zoom in, zoom out, PAN
12. the student is able to independently create a project in Autodesk Tinkercad using the following functions: adding a new object, changing color, grouping (joining and subtracting solids), duplicating and repeating, changing the dimensions of solids, changing the position of objects in the x,y and z axes, changing the dimensions of the workspace
13. the student understands how he/she should prepare the project in a way that allows to print the project - export as a .stl file
14. the learner knows how to continue working in Autodesk Tinkercad after the workshop is over
15. the learner knows how to download a finished spatial design in .STL format

Meeting 1

Duration: 3h

Description.

It's time to take matters into your own hands - we are starting an adventure in the world of 3D modeling! We will learn about the free, browser-based 3D modeling program - Autodesk Tinkercad. The first meeting will be entirely devoted to CAD design: from setting up an account in the program to creating advanced designs using the sophisticated tools built into the program. Get ready for a good dose of new knowledge!

15 min

Welcoming those attending the workshop, ice breaking, introducing the topic of the class. At the end, participants take a seat at the previously prepared computer stations.

30 min

Working with the program. Step-by-step educator presents and explains the following content. Persons participating in the workshop repeat the activities. The educator makes sure that everyone understands the content discussed.

1. logging into the program.
2. Basic functionality of the program: the Circuits module, Codeblock module, 3D Projects module.
3. Creating a new 3D Project.
4. working plane.
5. what does 3D stand for? What are three dimensions?
6. working with the camera: zooming in and out, rotating, panning.
7. Placing objects on the Working Plane - perpendicular.
8. Task: let's set the camera view so that all the vertices of the cuboid are in the center of the screen.
9. working with dimensions.

What is CAD design and what the acronym stands for in the name of some 3D design programs (TinkerCAD, AutoCAD, ZWCAD).

Squares used to change the dimensions of a solid.

Task: What is the difference in the operation of black and white squares responsible for changing the dimensions of a solid? Correct answer: White squares change two dimensions, black squares change one.

The units we use in CAD design.

Changing the height of a solid.

10. Moving solids in three dimensions - including using units.

11. task: we create a house.

The educator demonstrates the correct way to create a design, placing special emphasis on the proper camera work necessary to complete the task correctly. Workshop participants then recreate the process on their own or with the help of the educator.

15 min

Break

It is mandatory for workshop participants to leave the computer stations.

45 min

Working with the program. The educator presents and explains the following content step by step.

Persons participating in the workshop repeat the activities. The educator makes sure that everyone understands the content discussed.

1. Changing the color of individual solids.
2. grouping of objects.
3. Changing colors of grouped objects.
4. duplicate and repeat - we build an estate.
5. duplicate and repeat - we create advanced repetitive structures.
6. Task: Using the knowledge gained, let's build a staircase.
7. Task: Using the knowledge gained, let's build a winding staircase.

15 min

Break

People participating in the workshop obligatorily leave the computer stations.

20 min

Working with the program. The educator presents and explains the content below step by step. Persons participating in the workshop repeat the activities. The educator makes sure that everyone understands the content discussed.

1. changing the name of the project.
2. saving the project.
3. Repetition: creating a new project.
4. Returning to previously created projects.
5. cutting out objects.
6. Changing the size of the Workplane

25 min

Own work of the people participating in the workshop.

The educator presents the topic to be covered by the projects created by the people participating in the workshop. E.g.: home appendage, smartphone stand, clothes rack.

The educator answers questions and helps so that everyone finishes this part of the workshop with a finished project.

15 min

Brief summary of the work and the workshop day.

Each person has about a minute to show the work and describe how the task went from their perspective.

Evaluation - final round

People participating in the workshop list 1 thing that they liked the most in the class. The educator encourages everyone to speak up.

Homework: The educator presents the topic to be covered by the projects created by the participants. It is worth limiting the size of the work area here, e.g. 50x50x50mm.
Putting the workshop room in order.

Meeting 2

Duration: 3h

Description.

This meeting will be fully dedicated to 3D printing!

We will learn what 3D filament printers are. We will go through the whole process together: from downloading .STL files from Autodesk Tinkercad, to Slicer and practice with Zortrax m200 3D printers. Each participant will finish this meeting with a printed object of his or her own design, ready to be picked up on the next workshop day. It's going to happen!

15 min

Welcoming the people participating in the workshop. Introduction of the topic of the workshop.

Participants take a seat at the previously prepared computer stations. We discuss the homework assignment. We ask the question: were there difficulties, problems with something?

At the end of this part of the workshop, we go to the 3D printing station(s).

However, we do not log out of Tinkercad.

20 min

Story of 3D printing.

The educator presents the machine(s) in the form of an interactive lecture, encouraging those attending to actively join in the discussion.

He asks questions such as:

- How does the 3D printer work?
- What is the filament?
- How does the 3D printer know what to print?
- What can be printed?

In this part of the workshop, it is a good idea to use previously printed objects. This will make it easier for those attending to visualize the multitude of applications for which 3D printing can be used.

The educator then talks about other types of 3D printers currently available on the market and the possibilities they offer.

We return to the computer stations.

10 min

Working with Tinkercad software. The educator presents and explains the following content step by step.

People participating in the workshop repeat the steps. The educator makes sure that everyone understands the content discussed.

1. what is an .STL file?
2. repetition: renaming the project

3. what should be kept in mind when creating a project for 3D printing?

- Objects must be grouped together
- The color of the objects does not matter
- Dimensions must be correct

4 Export .STL files from Tinkercad and save them to your computer.

15 min

Break

It is mandatory for those participating in the workshop to leave the computer stations.

45 min

Working with a program like Slicer.

Depending on your 3D printer, before the workshop we make sure that we have the latest Slicer dedicated to the machine installed on the computers.

Depending on the level of sophistication and age of the group, the presentation of the content should be chosen so that the level of complexity is understandable and accessible.

The educator presents and explains the following content step by step.

Those participating in the workshop repeat the activities. The educator makes sure that everyone understands the content discussed.

1. what is a slicer?
2. what is g-code / z-code?
3. working with the camera.
4. going to the Thingiverse.com website.
5. what is this website?
6. download a file named: XYZ 20mm Calibration Cube
<https://www.thingiverse.com/thing:1278865>
7. import the xyzCalibration_cube.stl file into the slicer.
8. Placing the object in the printer's working field: moving, rotating.
9. selection of the correct filament.
10. layer height.
11. printing speed.
12. nozzle diameter
13. generation of G-code
14. save the G-code program on the medium appropriate for your machine: USB flash drive, SD card or send via wi-fi directly to the machine.

15 min

Break

It is mandatory for those participating in the workshop to leave the computer stations.

30 min

Working with the machine.

1. basics of operating the machine: screen, dial, touchscreen display.

2. loading and changing the filament.
3. health and safety when working with 3D printers.
4. selection and launch of the project prepared in advance.

Depending on the number of machines you have: during the class we run some of the prints, then the instructor after the class prints the remaining projects of the participants - so that at the beginning of the last day of the cycle each person participating in the workshop received a printed object designed by him.

15 min

Brief summary of the work and the workshop day.

Evaluation - final round

Individuals participating in the workshop list 1 thing they liked best about the class. The educator encourages everyone to speak up.

Putting the workshop room in order.

Meeting 3

Duration: 3h

Description.

This meeting will be dedicated to further gaining knowledge in 3D design and printing. There will also be time to work on your own - both with Tinkercad and 3D printers. This is a day of concrete projects!

5 min

Welcoming those attending the workshop. Presentation of the topic and the agenda. Participants take a seat at the previously prepared stations.

40 min

Working with the program. The educator presents and explains the following content step by step.

Persons participating in the workshop repeat the activities. The educator makes sure that everyone understands the content discussed.

1. advanced actions using the Workplane.
2. the Align tool
3. the Ruler tool
4. the Note tool
5. the Blocks and Bricks module
6. shape generators

15 min

Break

It is mandatory for those participating in the workshop to leave the computer stations.

45 min

Own work of persons participating in the workshop.

Under the watchful eye of the Educator, people participating in the workshop design objects and prepare files for 3D printing - .gcode / .zcode.

The Educator answers ongoing questions and randomly repeats the content presented during the previous days, for example: tell me, what is the layer height?

15 min

Break

People participating in the workshop obligatorily leave the computer stations.

30 min

Continuation of the workshop participants' own work.

The educator makes every effort for each person participating in the workshop to create a spatial design and prepare a program for a 3D printer.

Depending on the number of machines you have: during the class we run some of the prints, then the educator prints the remaining projects of the people participating after the class.

15 min

Summary of the workshop day and the entire workshop series.

People participating in the workshop list 2 things they enjoyed most about all the activities.

Educator encourages everyone to speak up.

Educator announces how and when those participating in the workshop will be able to pick up the 3D prints they designed.

Putting the workshop room in order.

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