

Introduction to CAD — CAM — CGI

Thomas Jörg, Johannes-Kepler-Gymnasium Weil der Stadt

Goal of the lessons

- Teach the students Design Thinking using 3D-printing
- Model basic forms inside a professional CAD-Package
- Explain the relationship between CGI, CAD and CAM
- Utilize CGI-techniques to visualize an object before production
- Use a 3D-Printer to implement a 3D-model
- Exercise the idea of iterative workflows

Essential thoughts



- This lesson is NOT about 3D-printing!
- It USES 3D-printing, which is something different.
- A 3D-printer solely is a tool, which can bring ideas to reality. Therefore it enables something previously impossible.
- This lesson is about creating realizable ideas, which can be brought to life with computer assisted skills.

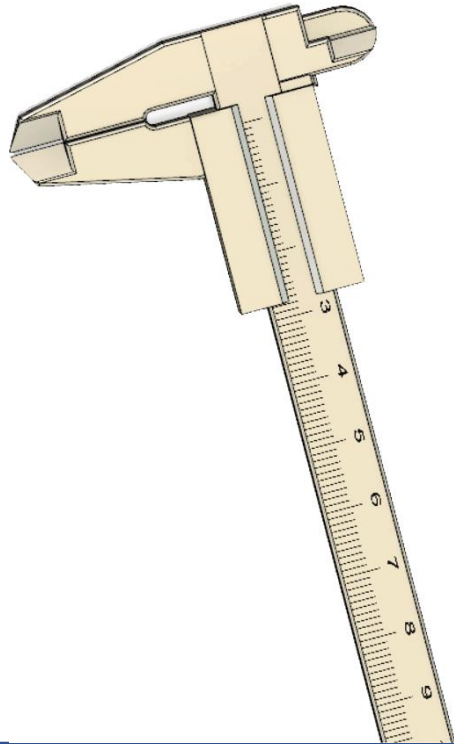


Prerequisites

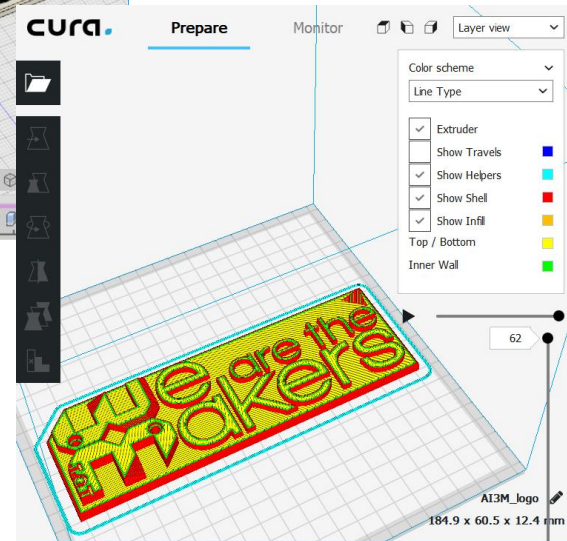
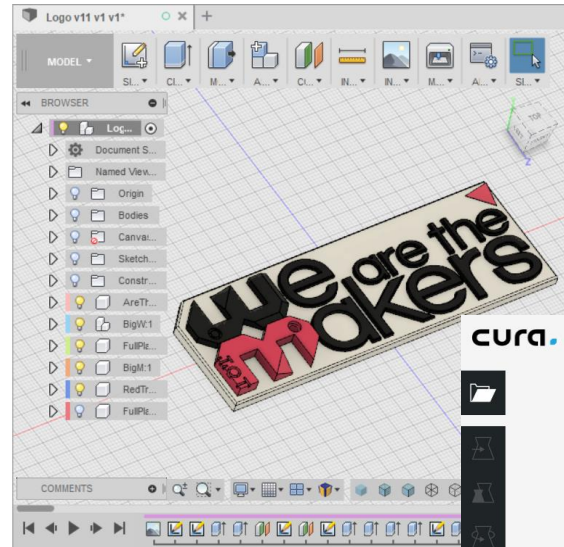
What students will need during the lesson



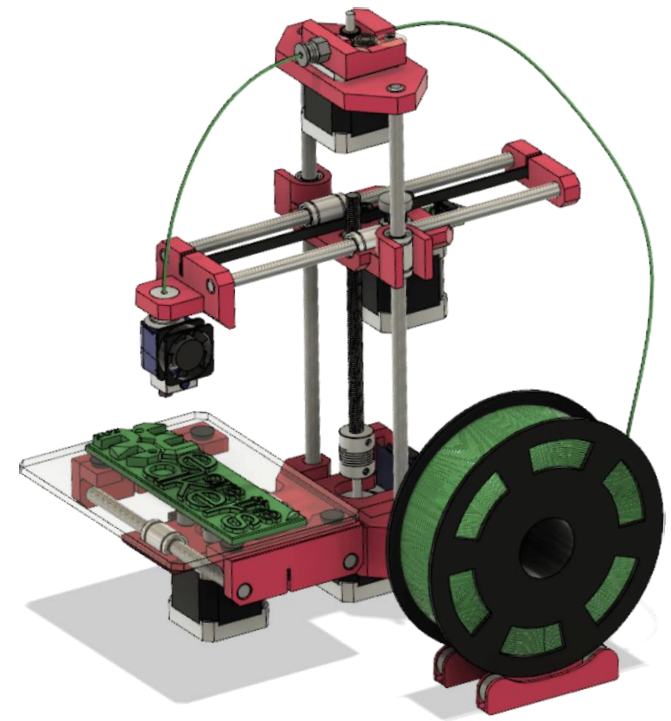
Calipers



Fusion 360
& CURA



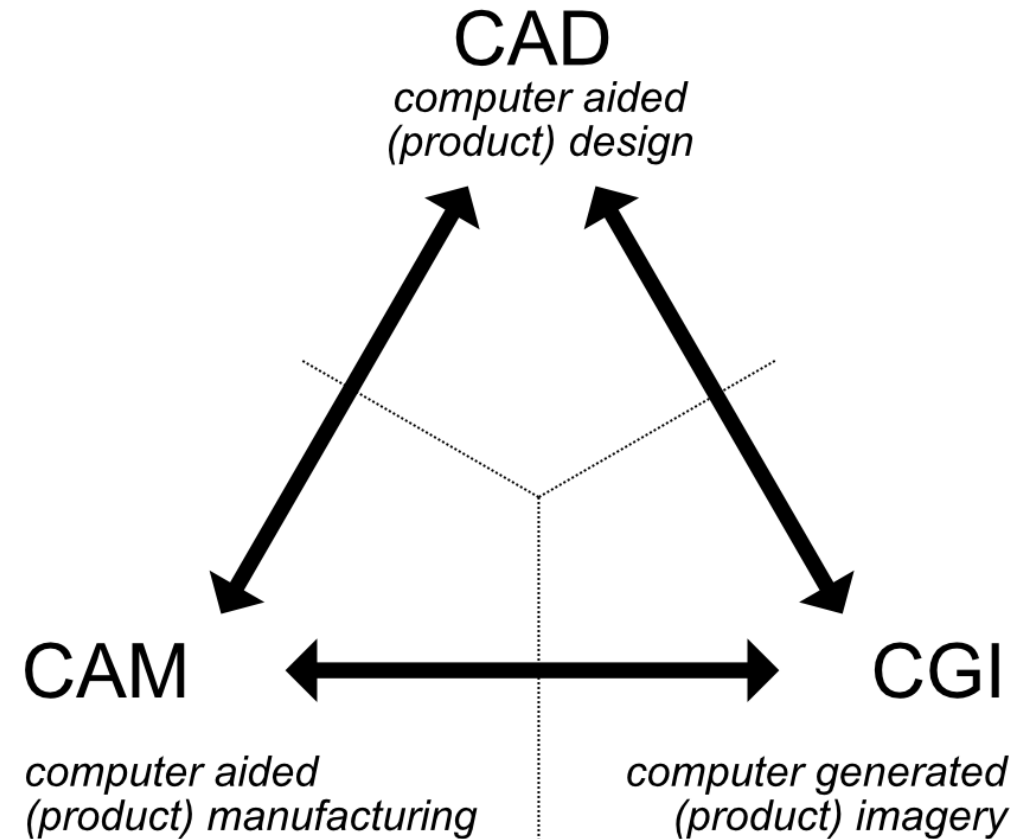
Many 3D printers



Lessons 1&2

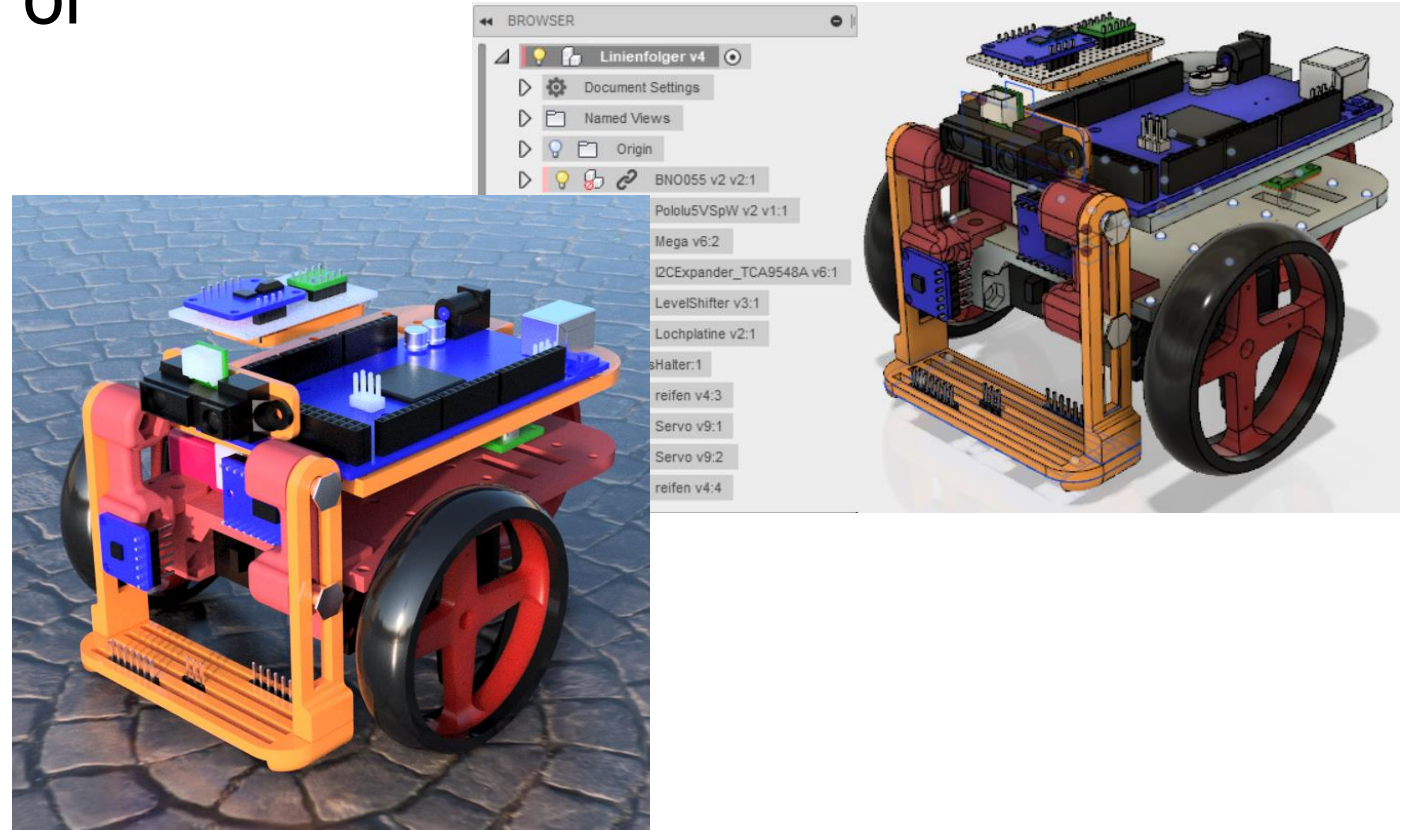
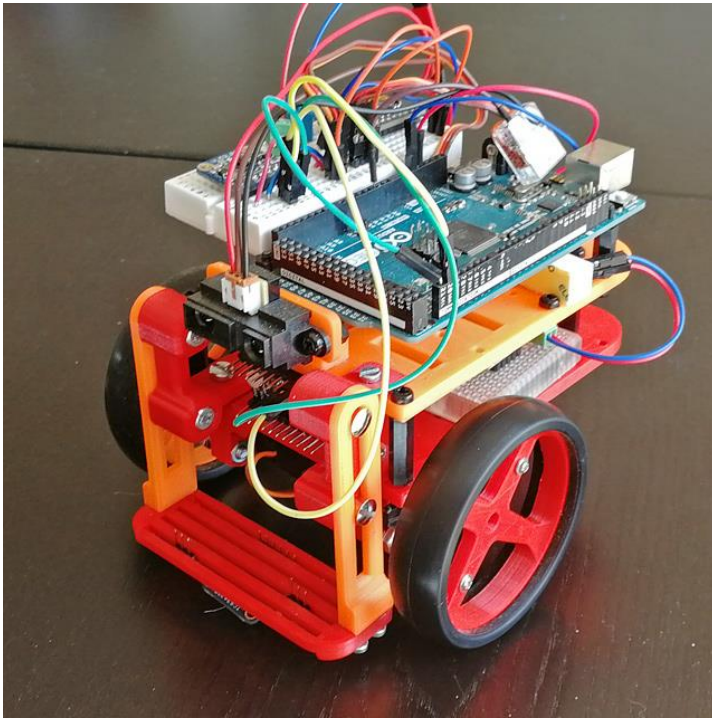
Start here ...

- Define the 3 different domains of CAD and how they fit together.
- Discuss the perception of CGI in workaday life: Movies, Advertising ...



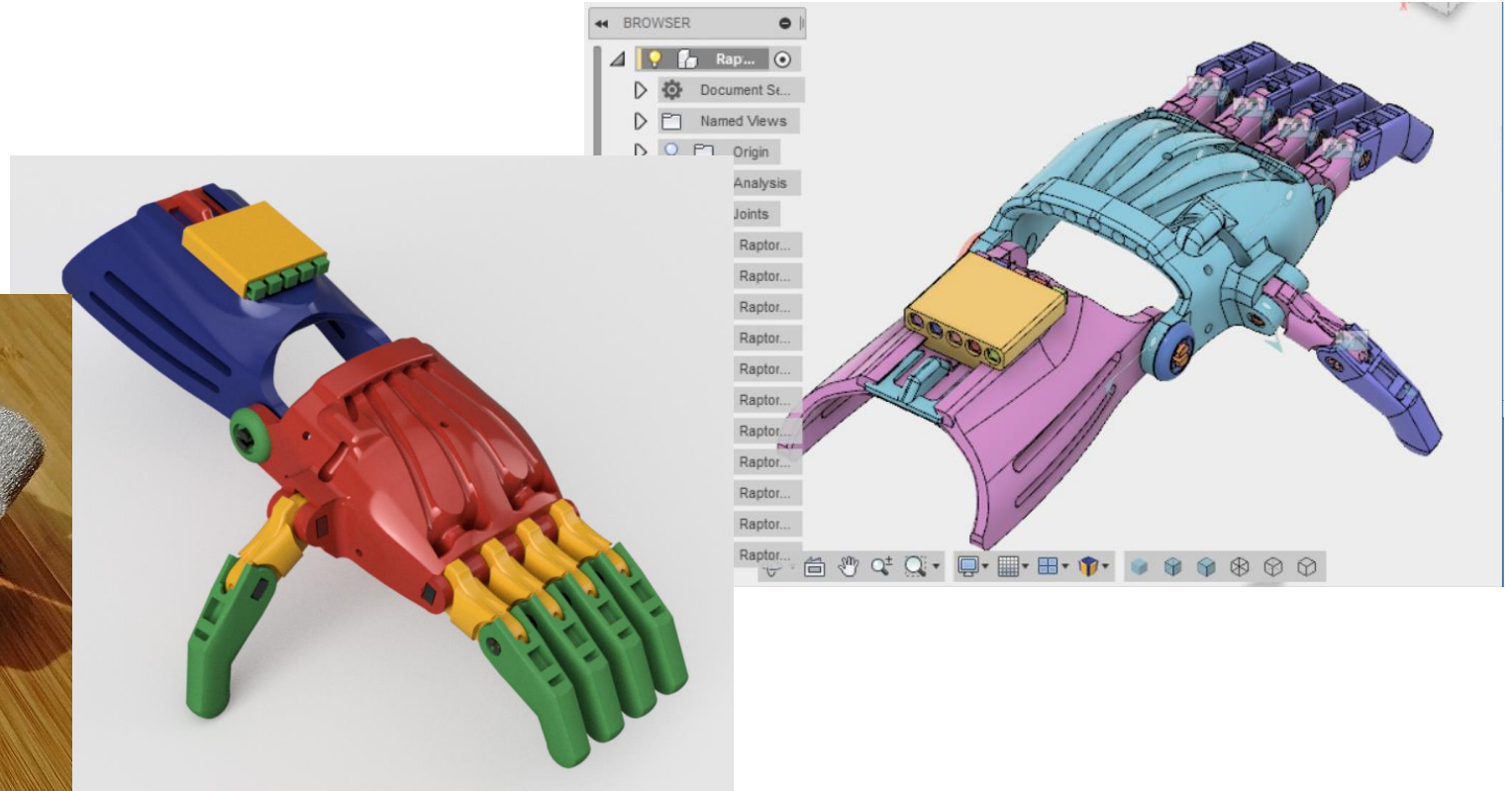
Lessons 1&2

Demonstrating examples of
any 3D-printed models



Lessons 1&2

... or even better:



Lessons 1&2

Intro to Fusion 360: Tutorial of the basic concepts

- **Components** as containers: *Everything's inside a 'bag'*
- **Sketches** as base elements of a model: *3D mostly begins in 2D*
- **Constrained** modeling: *define the models proportions well!*
- **Timeline** concept of modeling: *be prepared for later changes*
- **Top Down**, from coarse to fine: *big forms before details*

Lessons 1&2: CAD-Topics



- Components
- Sketching planes
- Construction planes
- Lines and Arcs
- Rectangles, circles
- 2D-fillets and trims
- Timeline
- Patterns
- Dimensions
- Extrude / PressPull
- Filet / Chamfer
- Combine
- Split body
- Mirroring

Advanced:

- Constraints...
 - ...Horizontal/Vertical
 - ...Dimensional
 - ...Coincident (difficult!)
- Include 3D Geom.

Lessons 1&2



What you can expect: students work examples (*age 14-17 years*)



beginner, age 15, *2 hours of work*



beginner, age 14, *3 hours of work*

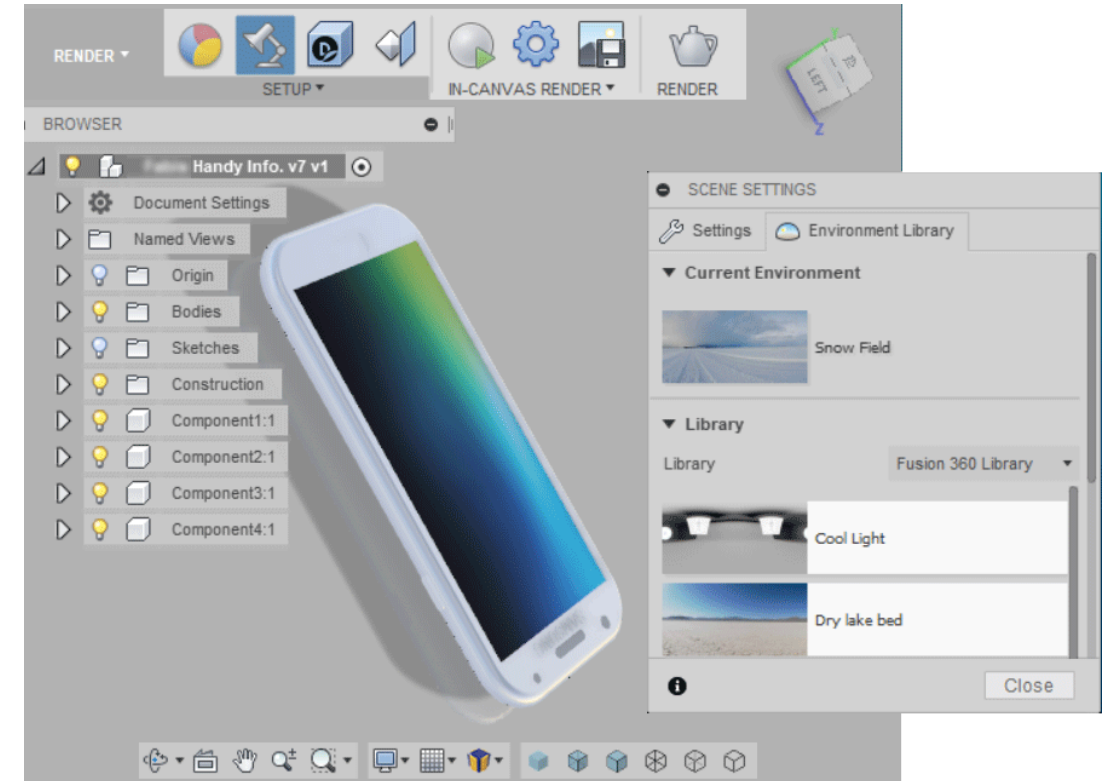


beginner, age 17, *2 hours of work*

Lessons 3&4

Use CGI-techniques to visualize before production:

- What is an HDR-Image?
- What is a shader?
- What are textures?
- How to set up a render scene?
- What is important to see?
- What is the role of light? (basics)



Lessons 3&4



Some examples of students work (*ages between 14-17 years*)



intermediate, age 15, *1 hours of work**



beginner, age 15, *2 hours of work**

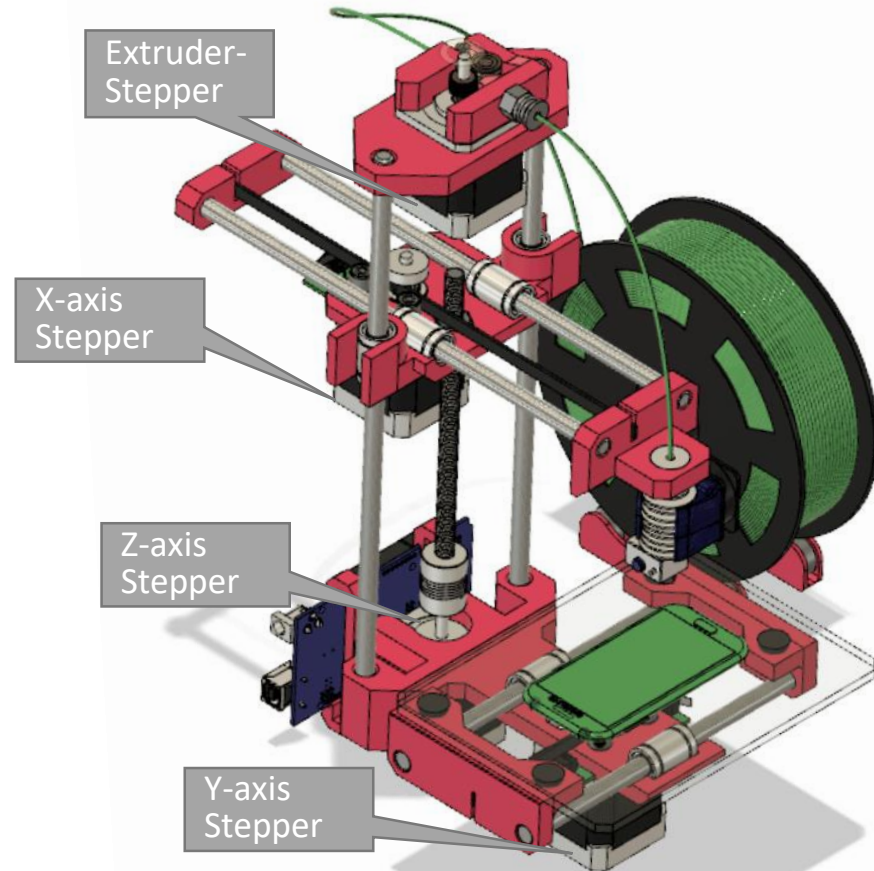
** Explanation: some of the students (20-30%) enjoyed working in the CAD-package very much. They installed the educational version of Fusion360 on their computers at home and practiced in their free time.*

Lessons 5&6

Learning 3D-printing: worksheets



Worksheet «build up of a 3D printer»



Worksheet «Extruder Unit»

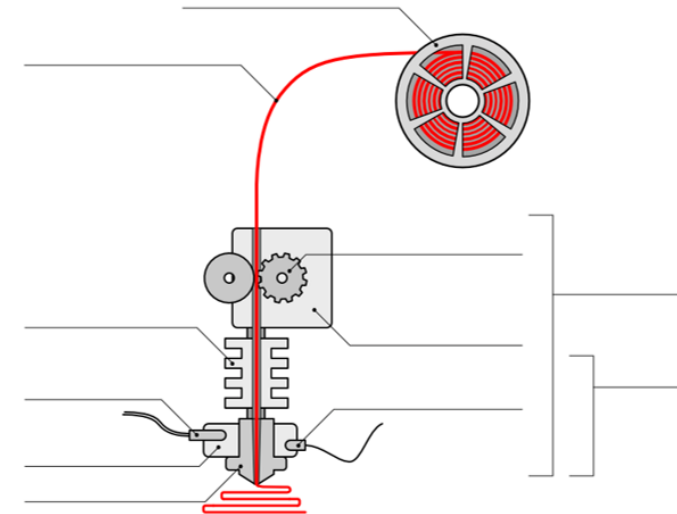
Aufbau und Funktionsweise eines 3D-Druckers

Das Herzstück eines FDM-3D-Druckers ist die sogenannte _____-Einheit. Durch sie wird das stabförmige _____ eingezogen und in der _____-Einheit geschmolzen.

Der Einzug besteht aus zwei wesentlichen Bauteilen: Dem _____ und dem daran fest anmontierten _____, welches den Kunststoff-Stab langsam einzieht.

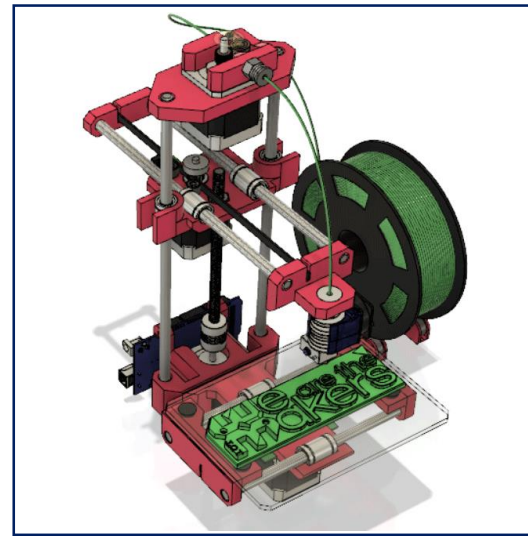
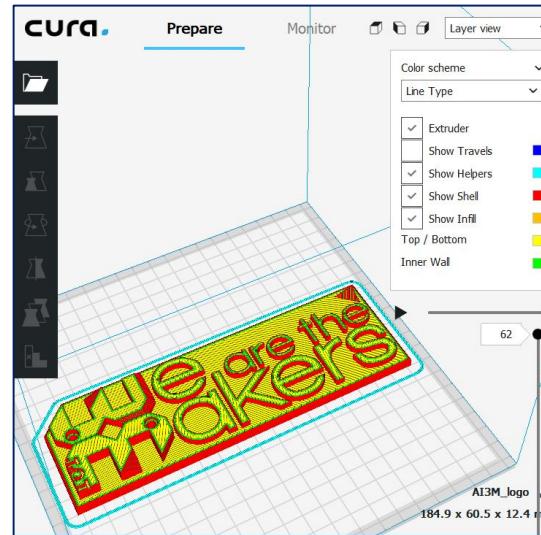
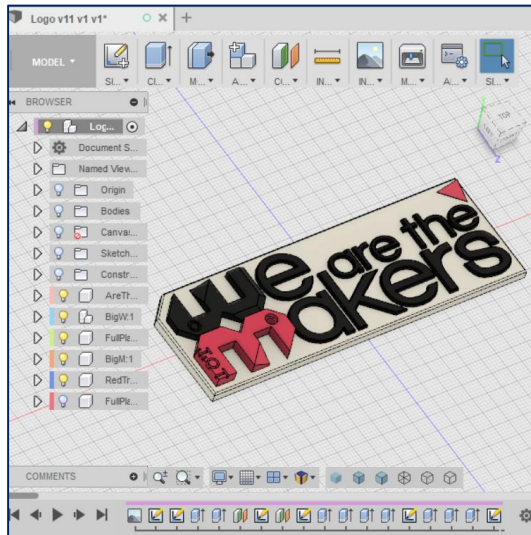
Die untere Einheit wird geheizt mit einem _____ (Temperatur PLA ca. _____ °C). Damit die oberen Teile nicht beschädigt werden, muss mittels der _____ thermisch abgetrennt werden.

Um die Temperatur genau einzuregulieren, überprüft man sie mittels _____. Der heiße und flüssige Kunststoff gelangt schließlich aus der (englischer Fachbegriff) _____, welche typischerweise einen Durchmesser von _____ mm besitzt. Hier gilt: Je feiner der Durchmesser, desto feiner der Druck.



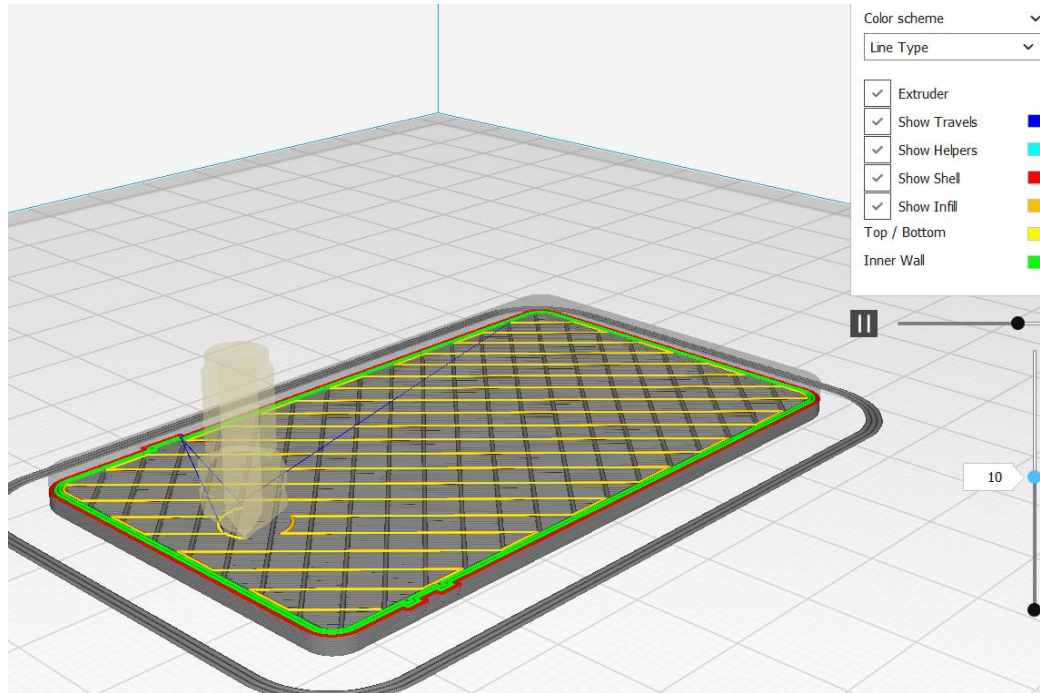
Lessons 5&6

From CAD to CAM: *The CAM-pipeline*

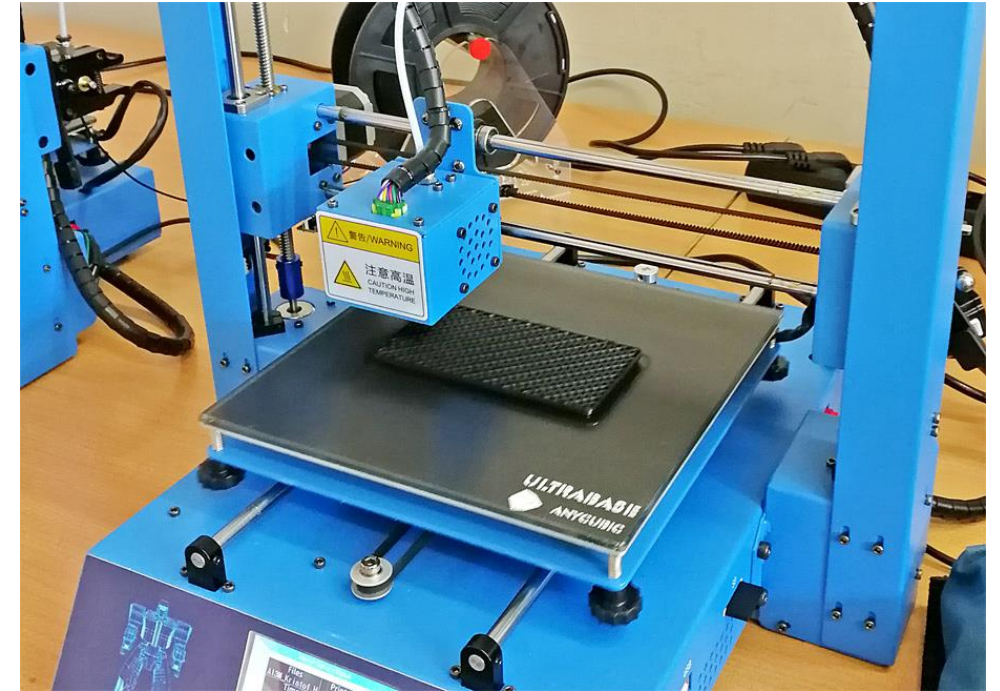


Lessons 5&6

Use the slicing software and the 3D printer



Cura-Software, *simulating the toolpath*

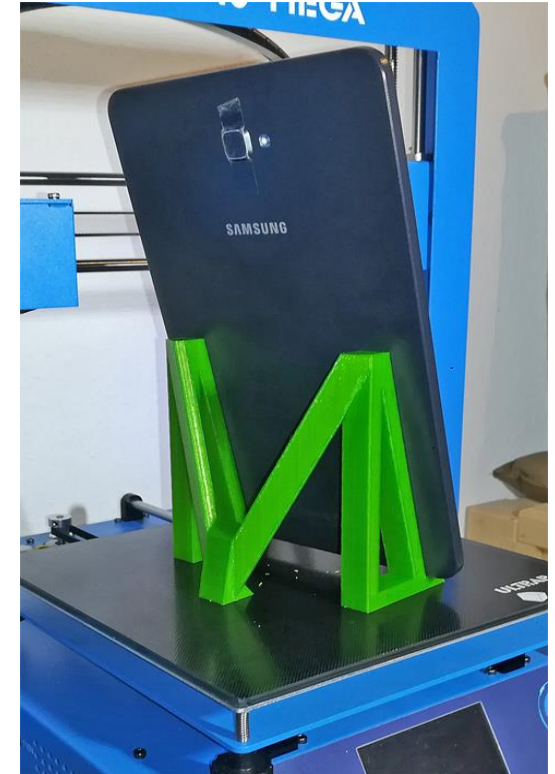
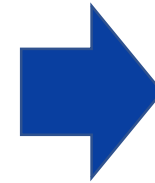
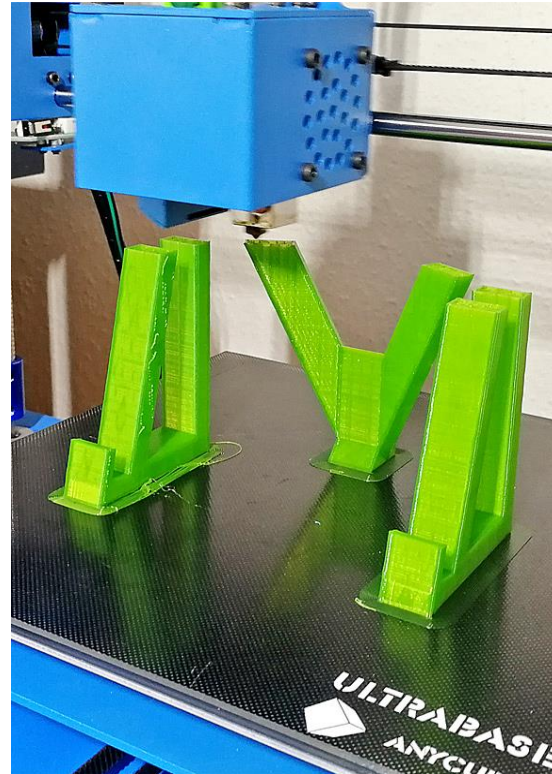
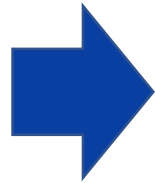
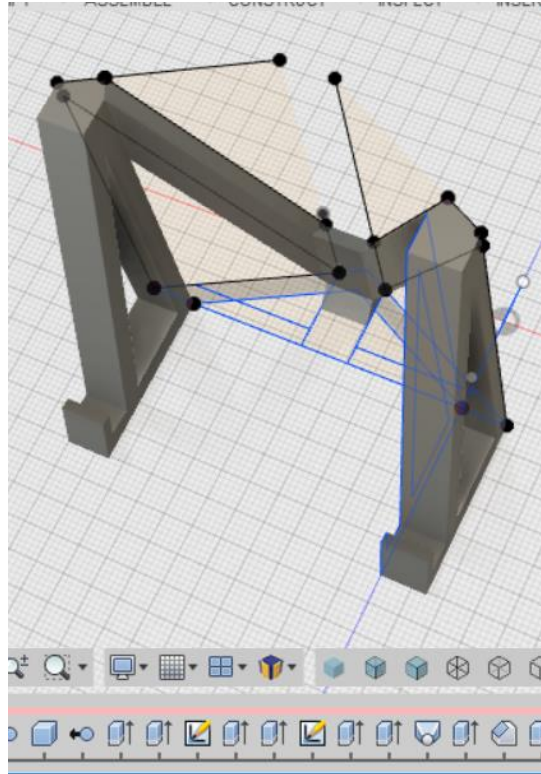


actual printing, *est. 5 hours of printing*

Lessons 7&8



Designing, testing and refining the smartphone stand



intermediate, age 15, *2 hours of work**



Thank you 😊

