3D PRINTING training material -from file to Yoda-

Școala Gimnaziala Nr. 1 Brănești, Ilfov, Romania

Co-funded by the Erasmus+ Programme of the European Union

Why FDM 3D printing?

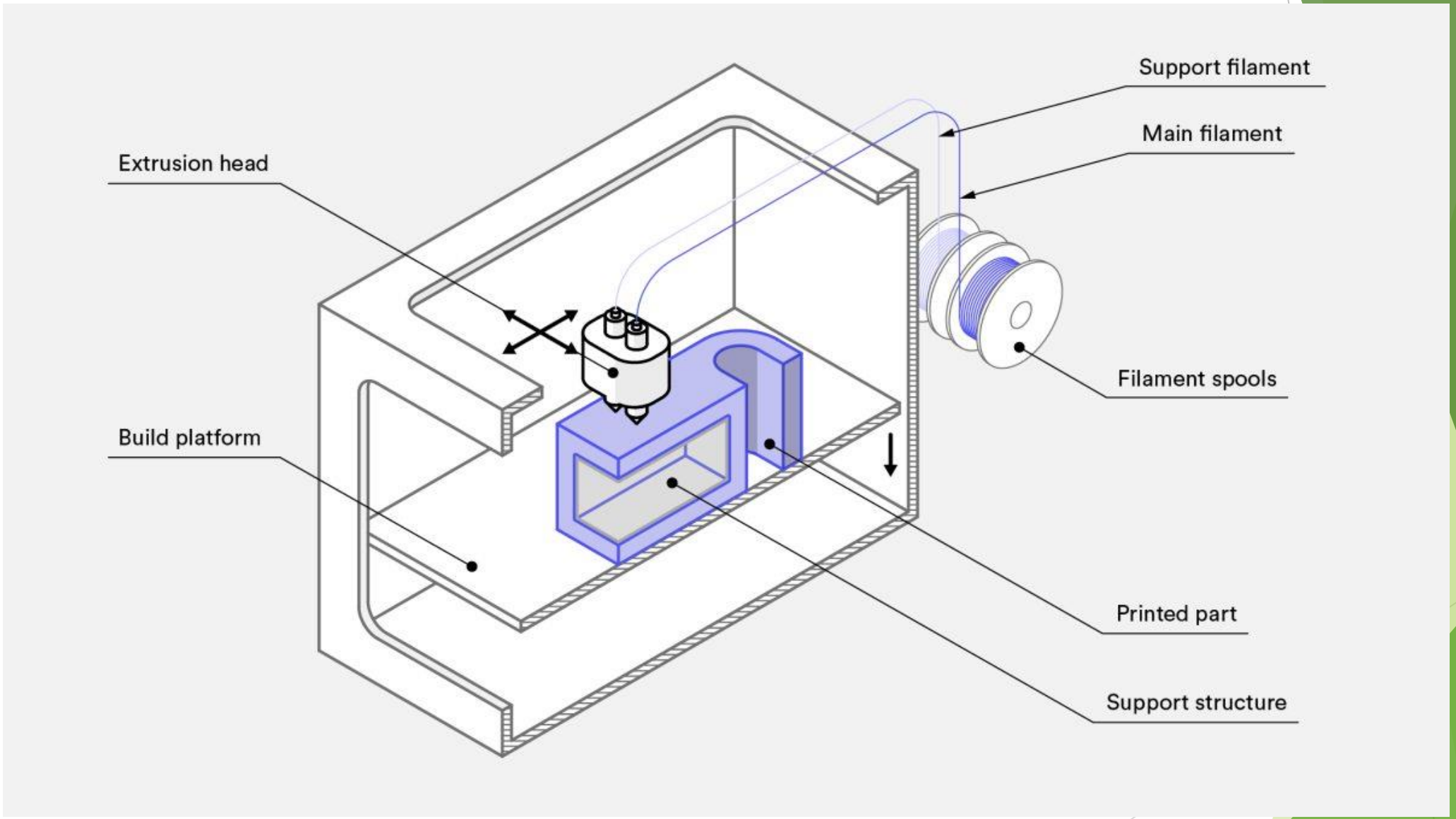
- Fused Deposition Modeling, also known as FDM 3D printing, is an affordable 3D printing technique and an excellent choice for quick, low-cost prototyping.

FDM materials

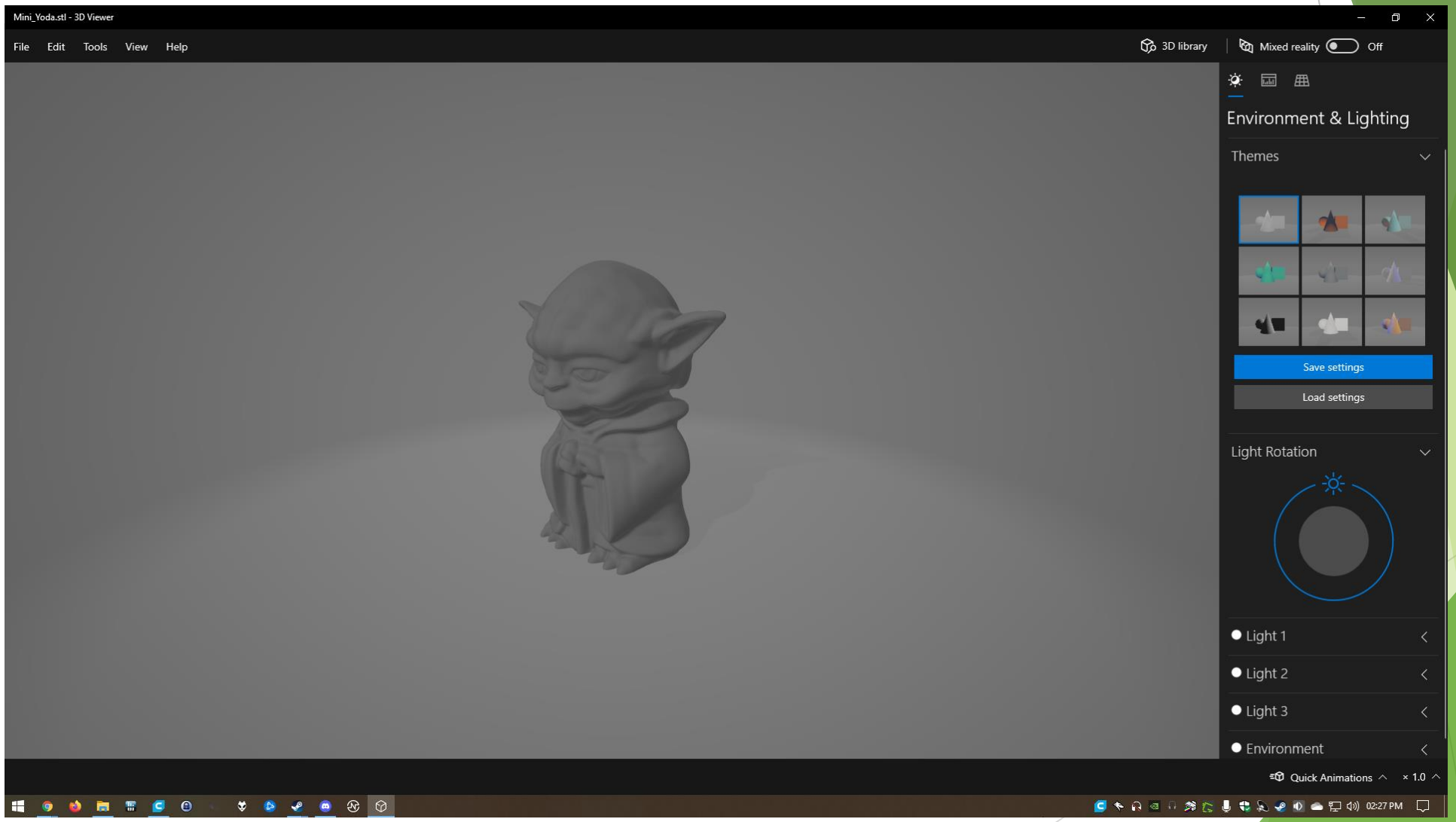
- Fused deposition modeling (FDM) is also known as fused filament fabrication (FFF), an additive manufacturing process. In FDM, an object is built by selectively depositing melted material in a predetermined path, layer by layer. The materials used are thermoplastic polymers, which come in a filament form.

How does FDM work?

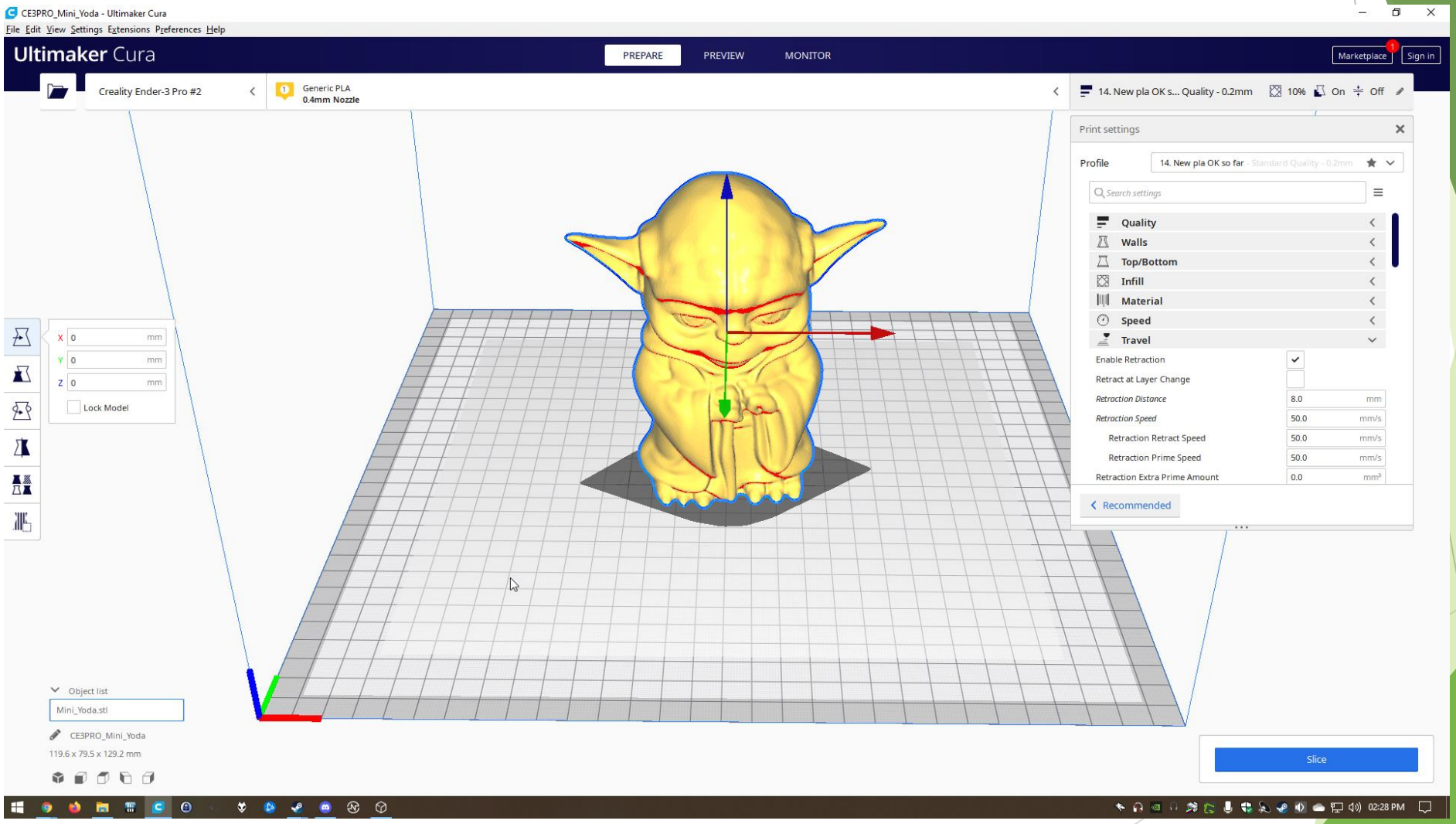
- The FDM fabrication process works by first loading a spool of thermoplastic filament into the printer. Once the nozzle has reached the desired temperature, the filament is fed into the extrusion head and nozzle, where it melts.
- The extrusion head is attached to a three-axis system that allows it to move in the x-, y- and z- directions. Melted material is extruded in thin strands and deposited layer by layer in predetermined locations, where it cools and solidifies. Fans can be attached to the extrusion head to accelerate the cooling.
- To fill an area, multiple passes are required, similar to coloring in a rectangle with a marker. When a layer is finished, the build platform moves down (or in some machine setups, the extrusion head moves up) and a new layer is deposited. This process is repeated until the part is complete.


Support filament
Main filament
Extrusion head
Filament spools
Build platform
Printed part
Support structure

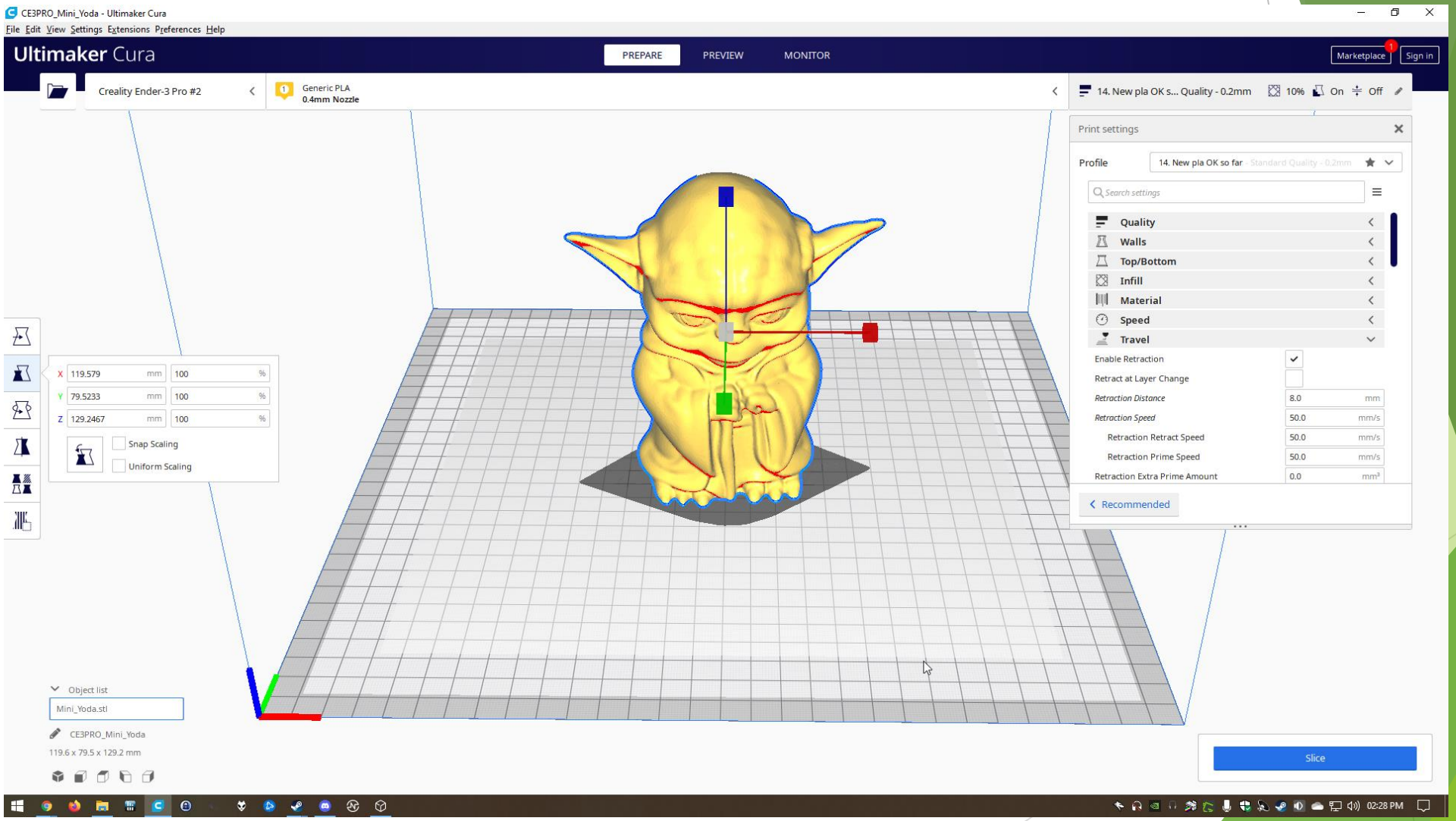
1. The base STL file



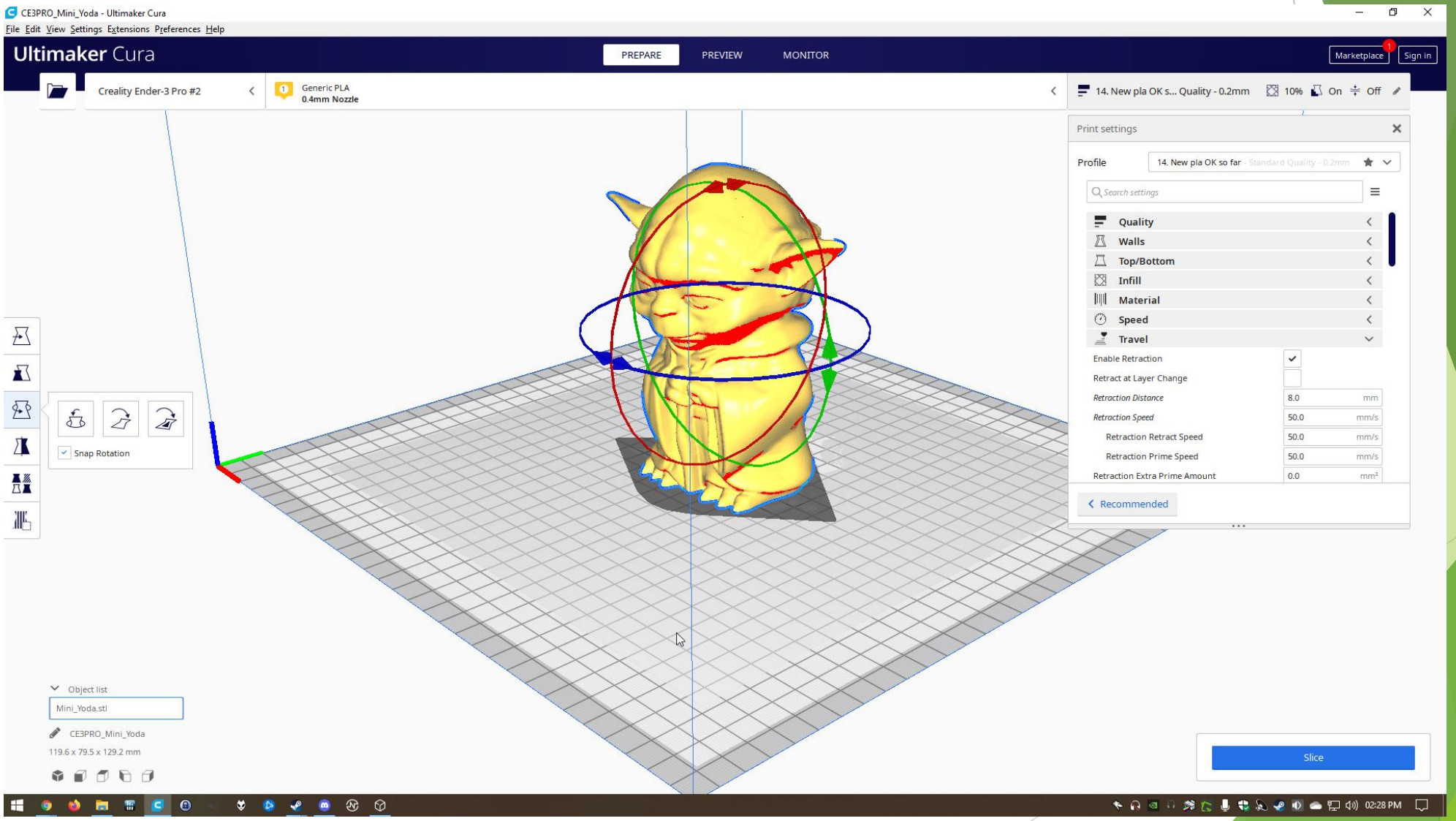
2. Position


CE3PRO_Mini_Yoda - Ultimaker Cura
File Edit View Settings Extensions Preferences Help
Ultimaker Cura
PREPARE
PREVIEW
MONITOR
Marketplace
Sign in
Creality Ender-3 Pro #2
Generic PLA
0.4mm Nozzle
14. New pla OK s... Quality - 0.2mm
10%
On
Off
Print settings
Profile
14. New pla OK so far
Search settings
Quality
Walls
Top/Bottom
Infill
Material
Speed
Travel
Enable Retraction
Retract at Layer Change
Retraction Distance
8.0
mm
Retraction Speed
50.0
mm/s
Retraction Retract Speed
50.0
mm/s
Retraction Prime Speed
50.0
mm/s
Retraction Extra Prime Amount
0.0
Recommended
X
0
mm
Y
0
mm
Z
0
mm
Lock Model
Object list
Mini_Yoda.stl
CE3PRO_Mini_Yoda
119.6 x 79.5 x 129.2 mm
Slice
02:28 PM

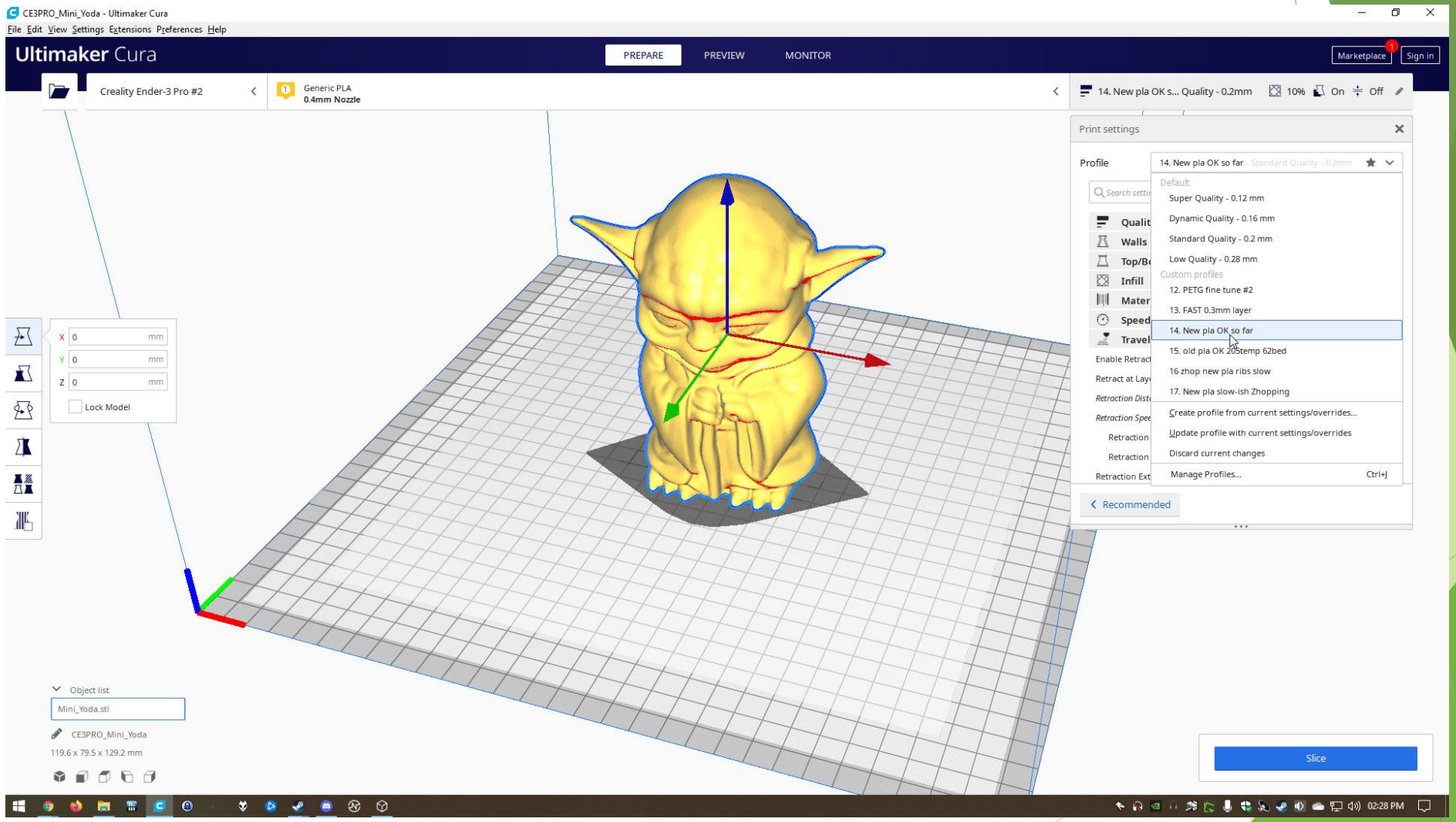
3. Scaling


CE3PRO_Mini_Yoda - Ultimaker Cura
File Edit View Settings Extensions Preferences Help
Ultimaker Cura
PREPARE
PREVIEW
MONITOR
Marketplace
Sign in
Creality Ender-3 Pro #2
Generic PLA
0.4mm Nozzle
14. New pla OK s... Quality - 0.2mm
10%
On
Off
Print settings
Profile
14. New pla OK so far
Search settings
Quality
Walls
Top/Bottom
Infill
Material
Speed
Travel
Enable Retraction
Retract at Layer Change
Retraction Distance
Retraction Speed
Retraction Retract Speed
Retraction Prime Speed
Retraction Extra Prime Amount
Recommended
X 119.579 mm 100 %
Y 79.5233 mm 100 %
Z 129.2467 mm 100 %
Snap Scaling
Uniform Scaling
Object list
Mini_Yoda.stl
CE3PRO_Mini_Yoda
119.6 x 79.5 x 129.2 mm
Slice
02:28 PM

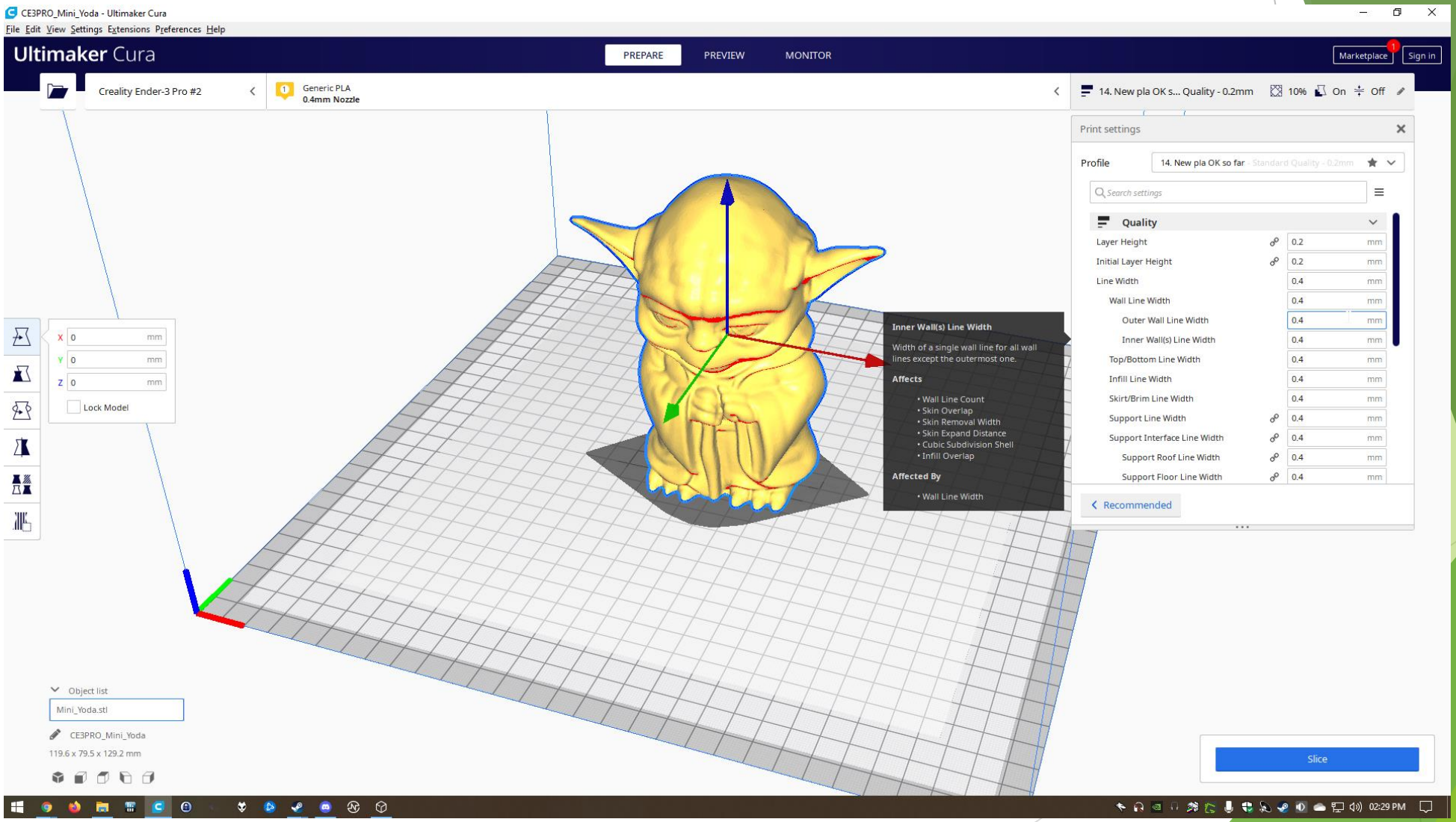
4. Rotation


CE3PRO_Mini_Yoda - Ultimaker Cura
File Edit View Settings Extensions Preferences Help
Ultimaker Cura
PREPARE
PREVIEW
MONITOR
Marketplace
Sign in
Creality Ender-3 Pro #2
Generic PLA
0.4mm Nozzle
14. New pla OK s... Quality - 0.2mm
10%
On
Off
Print settings
Profile
14. New pla OK so far - Standard Quality - 0.2mm
Search settings
Quality
Walls
Top/Bottom
Infill
Material
Speed
Travel
Enable Retraction
Retract at Layer Change
Retraction Distance
8.0
mm
Retraction Speed
50.0
mm/s
Retraction Retract Speed
50.0
mm/s
Retraction Prime Speed
50.0
mm/s
Retraction Extra Prime Amount
0.0
mm³
Recommended
Snap Rotation
Object list
Mini_Yoda.stl
CE3PRO_Mini_Yoda
119.6 x 79.5 x 129.2 mm
Slice
02:28 PM

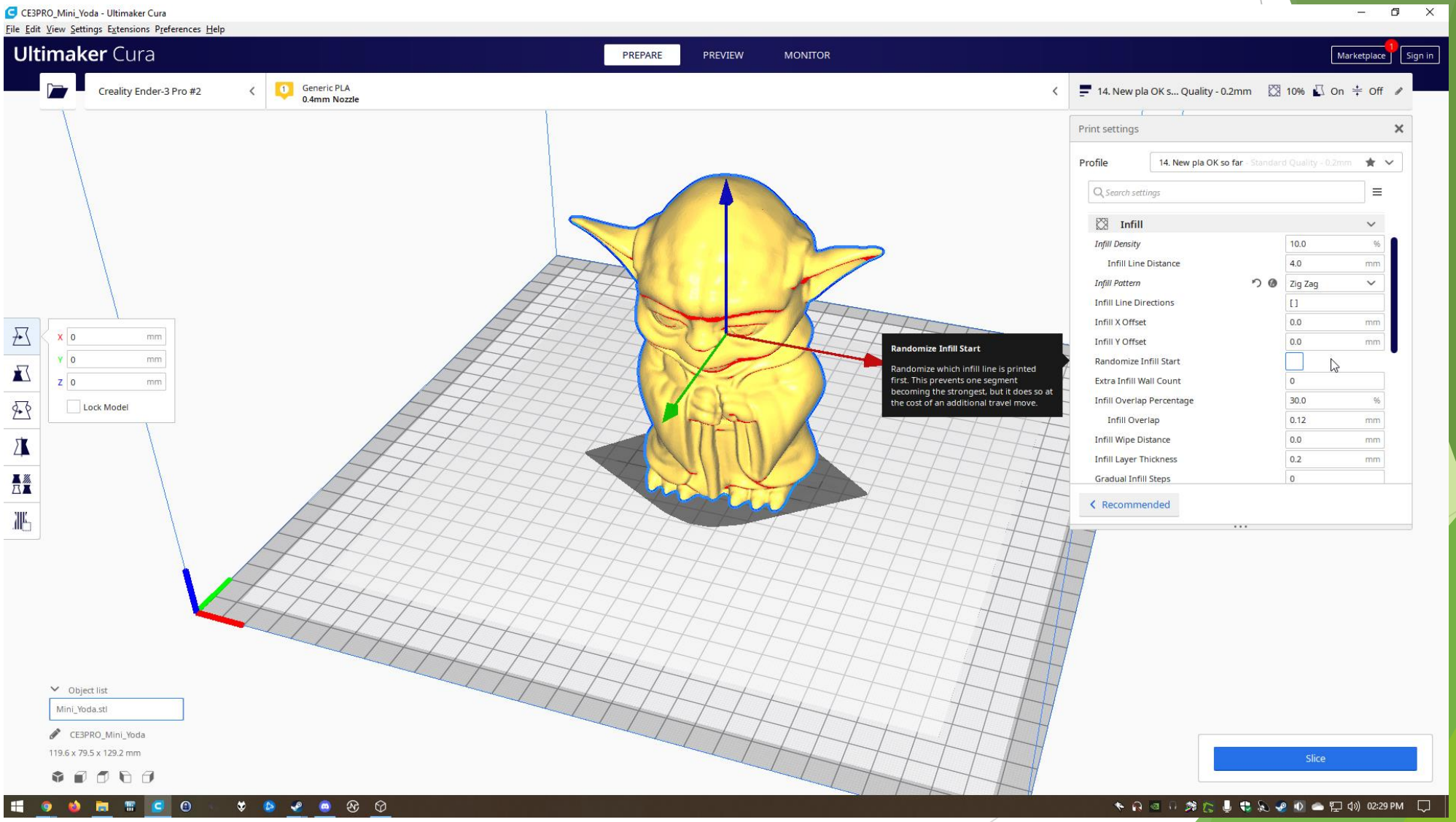
5. Ultimaker Cura profiles selection



7. Quality settings

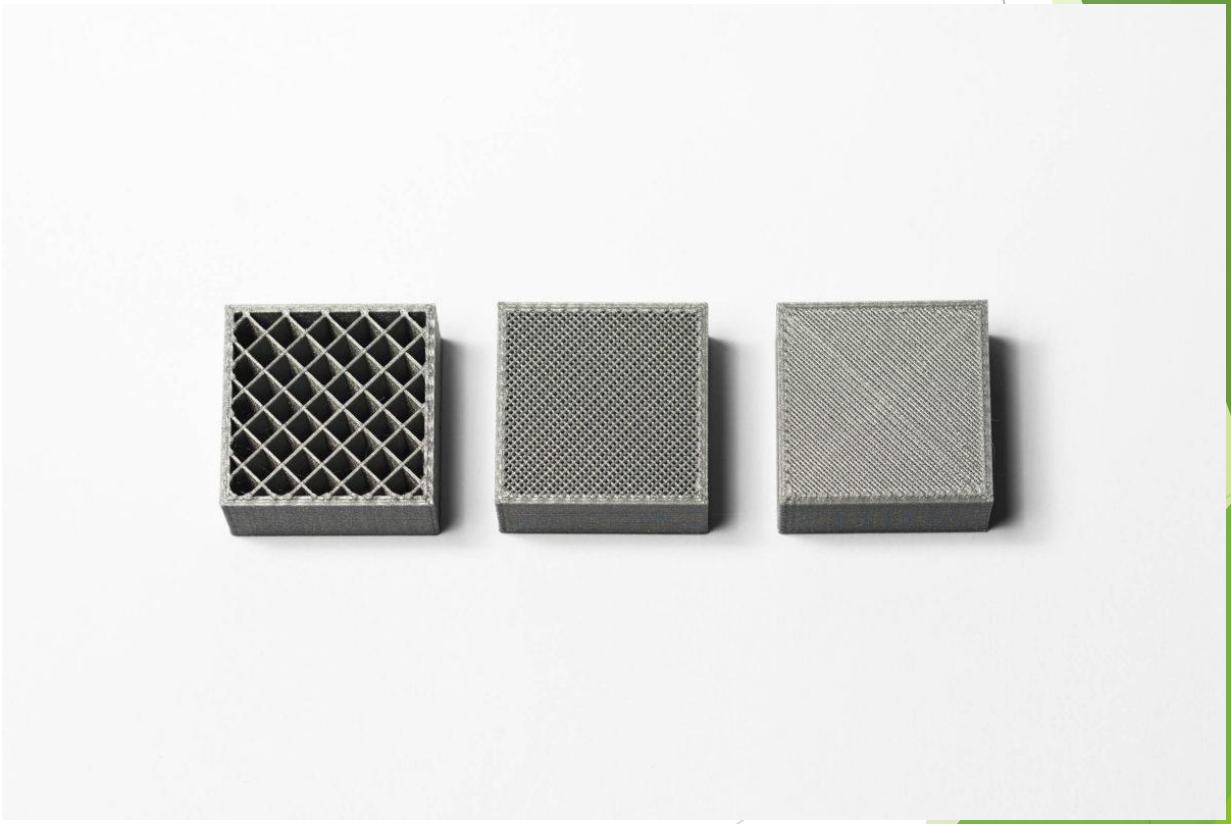


8. Infill settings

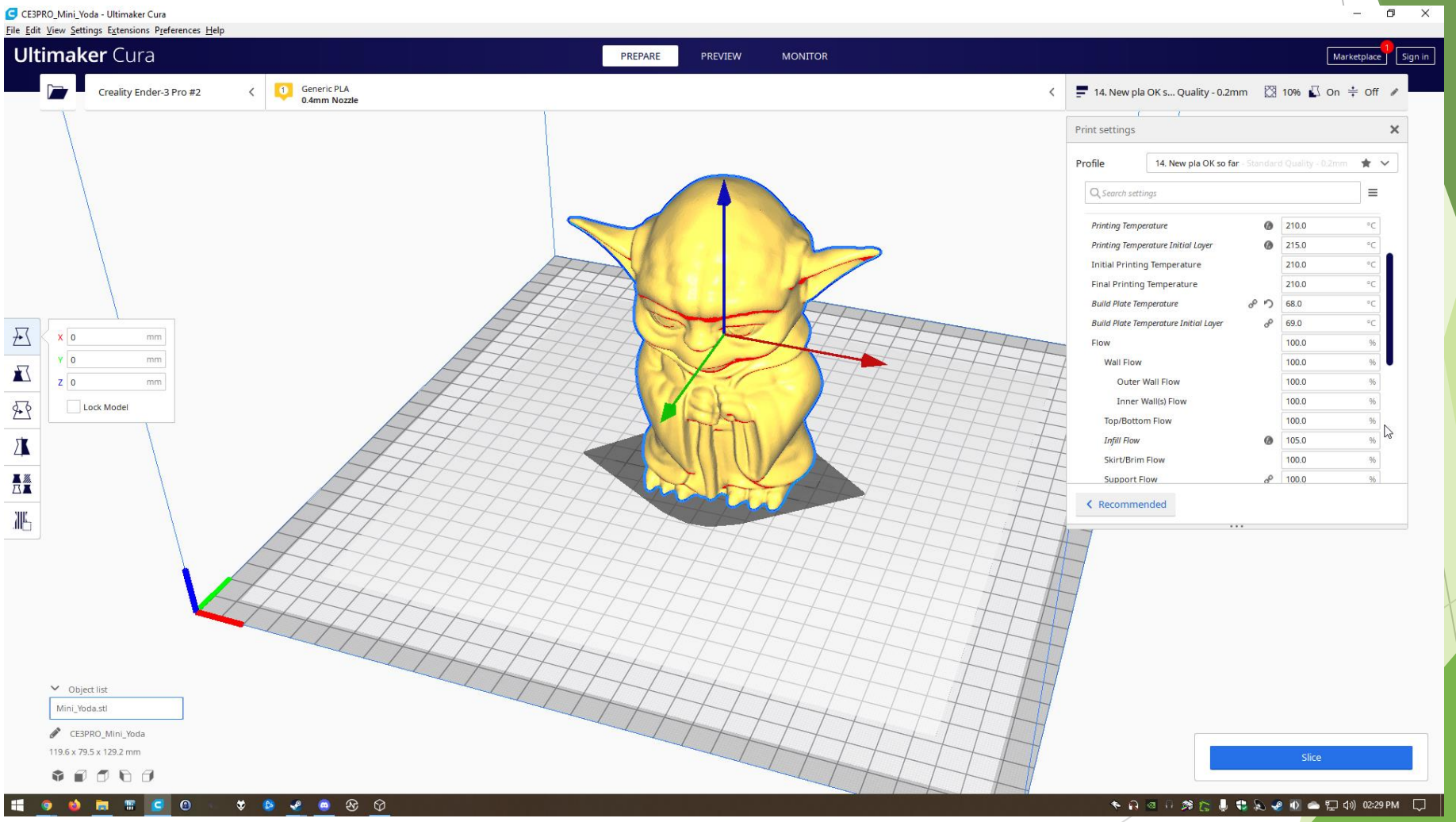


The internal geometry of FDM prints

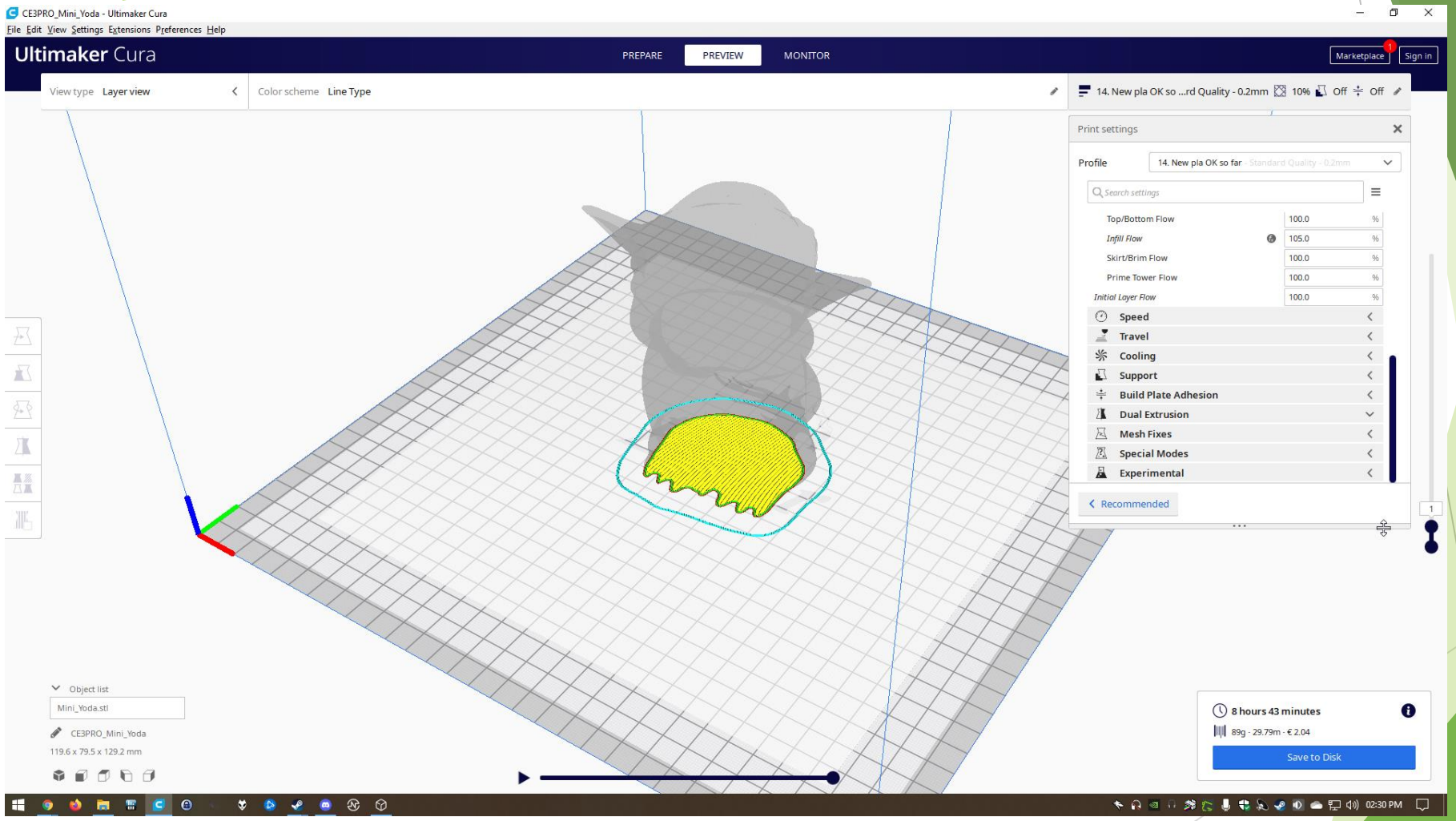
To reduce print time and save on material, FDM parts are usually not printed solid. Instead, the outer perimeter—called the shell—is traced using several passes, and the interior—called the infill—is filled with an internal low-density structure.



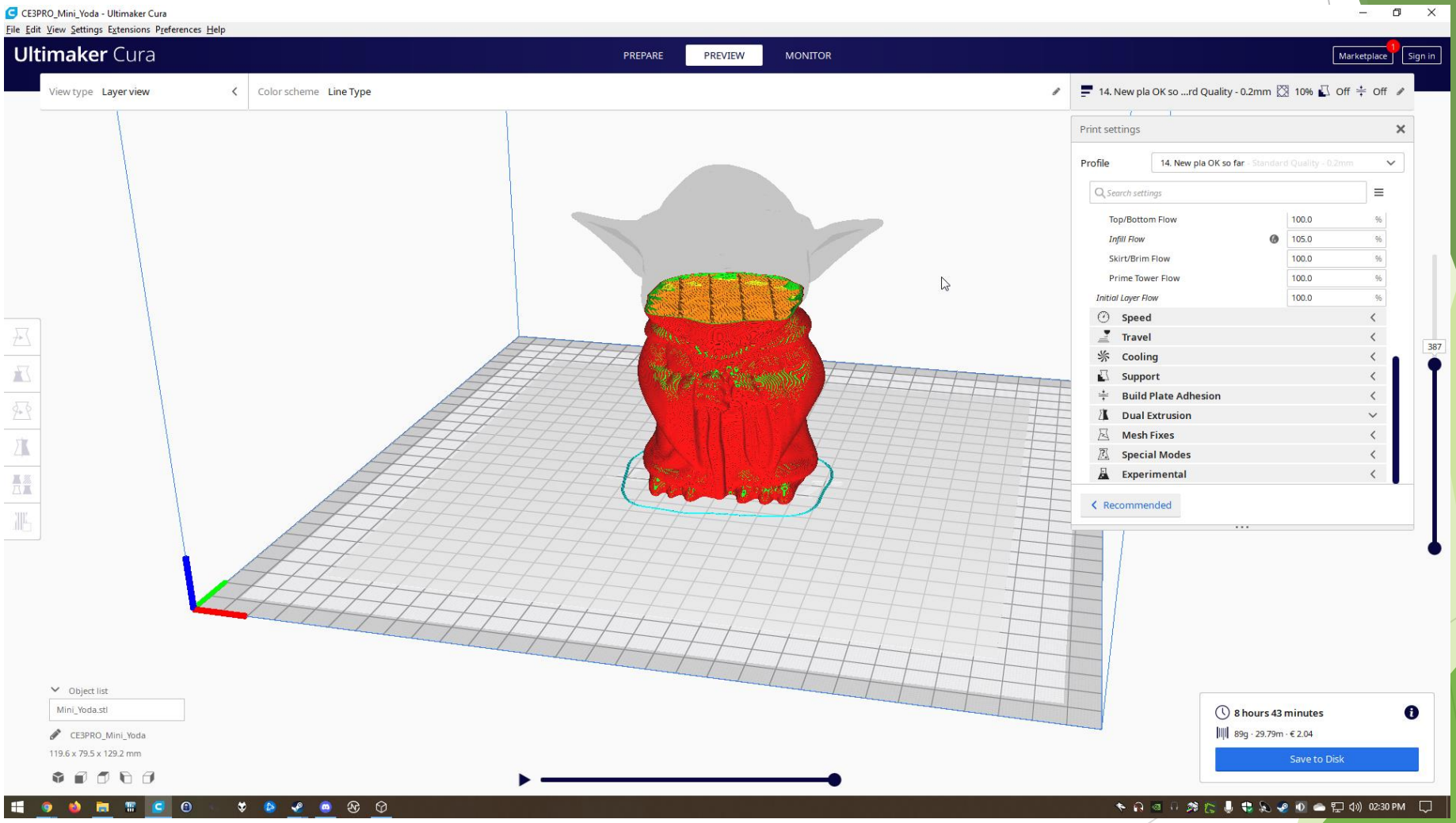
9. Material settings



First layer

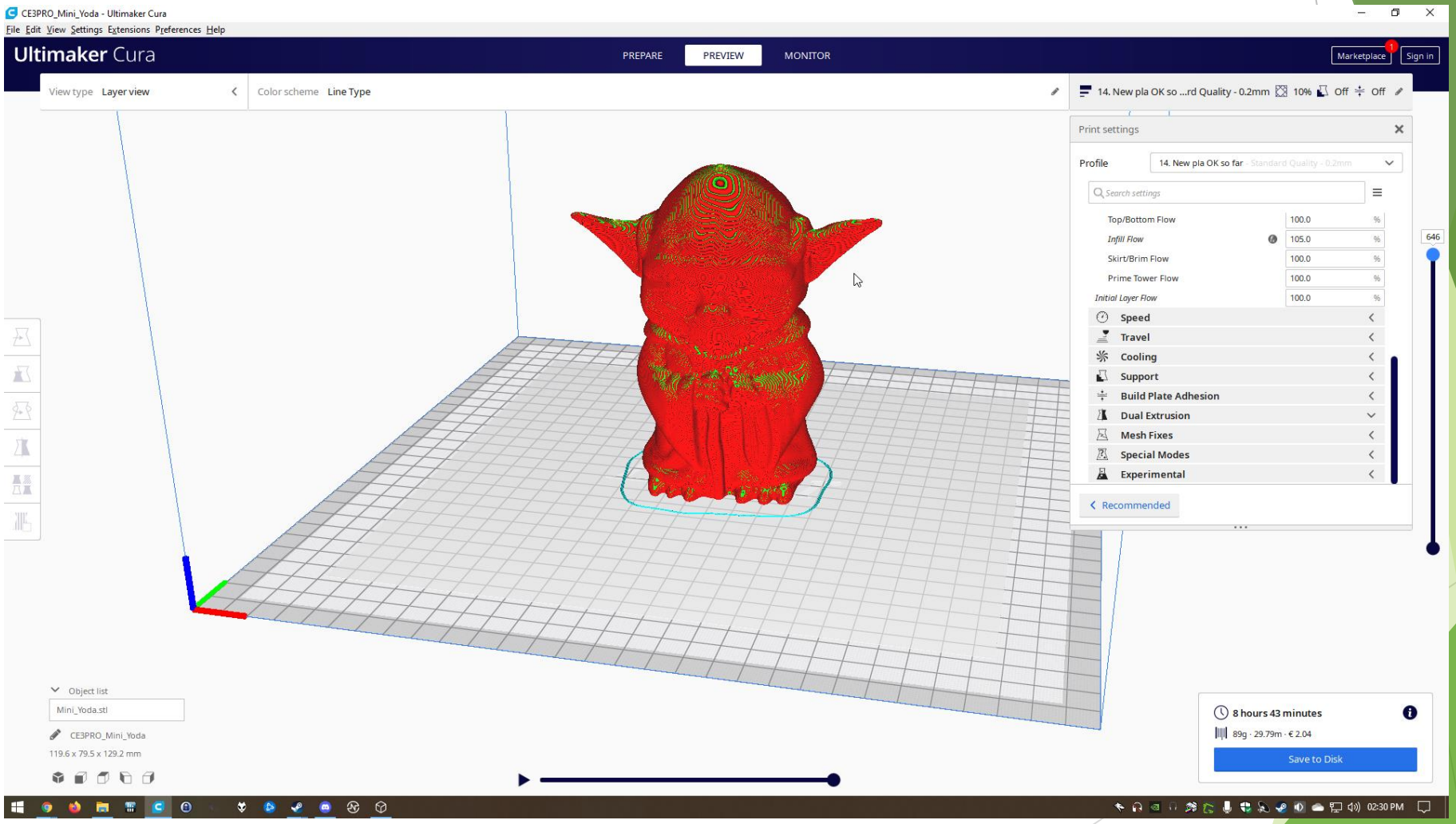

CE3PRO_Mini_Yoda - Ultimaker Cura
File Edit View Settings Extensions Preferences Help
Ultimaker Cura
PREPARE
PREVIEW
MONITOR
Marketplace
Sign in
View type Layer view
Color scheme Line Type
14. New pla OK so ...rd Quality - 0.2mm 10% Off Off
Print settings
Profile
14. New pla OK so far
Search settings
Top/Bottom Flow 100.0 %
Infill Flow 105.0 %
Skirt/Brim Flow 100.0 %
Prime Tower Flow 100.0 %
Initial Layer Flow 100.0 %
Speed
Travel
Cooling
Support
Build Plate Adhesion
Dual Extrusion
Mesh Fixes
Special Modes
Experimental
Recommended
Object list
Mini_Yoda.stl
CE3PRO_Mini_Yoda
119.6 x 79.5 x 129.2 mm
8 hours 43 minutes
89g · 29.79m · € 2.04
Save to Disk
02:30 PM

Layer 387


CE3PRO_Mini_Yoda - Ultimaker Cura
File Edit View Settings Extensions Preferences Help
Ultimaker Cura
PREPARE
PREVIEW
MONITOR
Marketplace
Sign in
View type Layer view
Color scheme Line Type
14. New pla OK so ...rd Quality - 0.2mm 10% Off Off
Print settings
Profile
14. New pla OK so far - Standard Quality - 0.2mm
Search settings
Top/Bottom Flow 100.0 %
Infill Flow 105.0 %
Skirt/Brim Flow 100.0 %
Prime Tower Flow 100.0 %
Initial Layer Flow 100.0 %
Speed
Travel
Cooling
Support
Build Plate Adhesion
Dual Extrusion
Mesh Fixes
Special Modes
Experimental
Recommended
387
Object list
Mini_Yoda.stl
CE3PRO_Mini_Yoda
119.6 x 79.5 x 129.2 mm
8 hours 43 minutes
89g · 29.79m · € 2.04
Save to Disk
02:30 PM

Work in progress

Finished product



What are the advantages of FDM 3D printing?

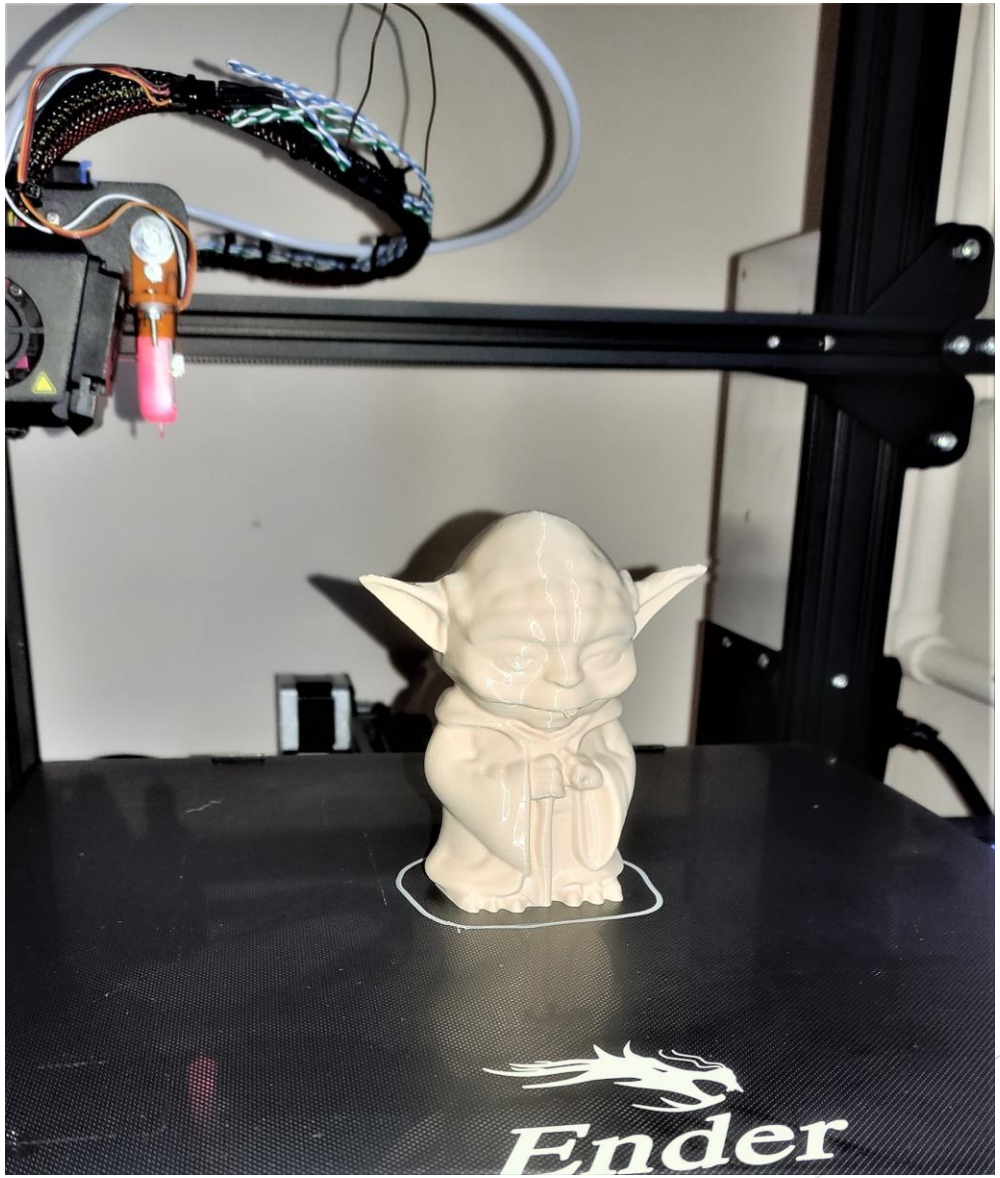
- FDM is the most cost-effective way to produce custom thermoplastic parts and prototypes.
- Lead times are short (typically a few days) due to the ubiquity of the technology.
- A wide range of materials is available, suitable for both prototyping and some functional applications.

What are the disadvantages of FDM 3D printing?

- FDM has the lowest resolution compared to other 3D printing technologies, so it is not suitable for parts with very small details.

- Parts are likely to have visible layer lines, so post-processing is required for a smooth finish.

May the Force be with you!



Ref.no. 2019-1-UK01-KA229-061773

DISCLAIMER

“The European Commission support for the production of this publication does not constitute an endorsement of the contents which reflects the views only of the authors, and the National Agency and Commission cannot be held responsible for any use which may be made of the information contained therein”.

Co-funded by the
Erasmus+ Programme
of the European Union