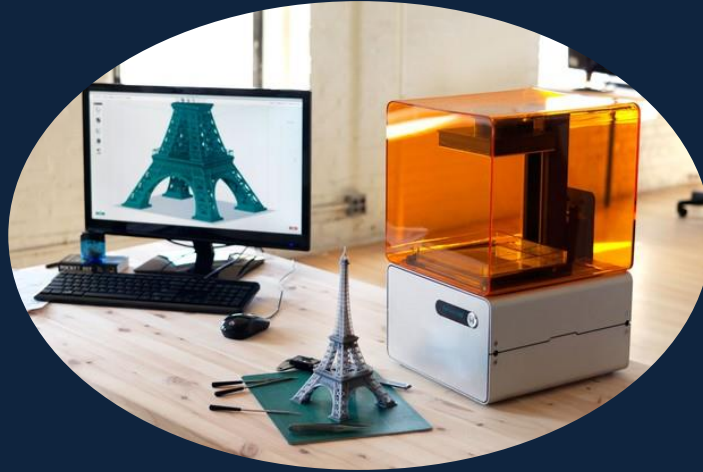
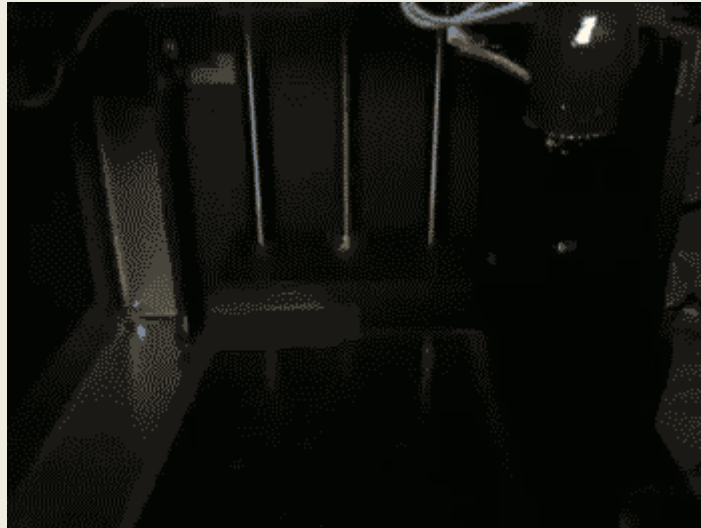


3D Printing



What is 3D Printing?

- Additive manufacturing process
- Produces three dimensional objects
 - Builds successive layers of material by computer control

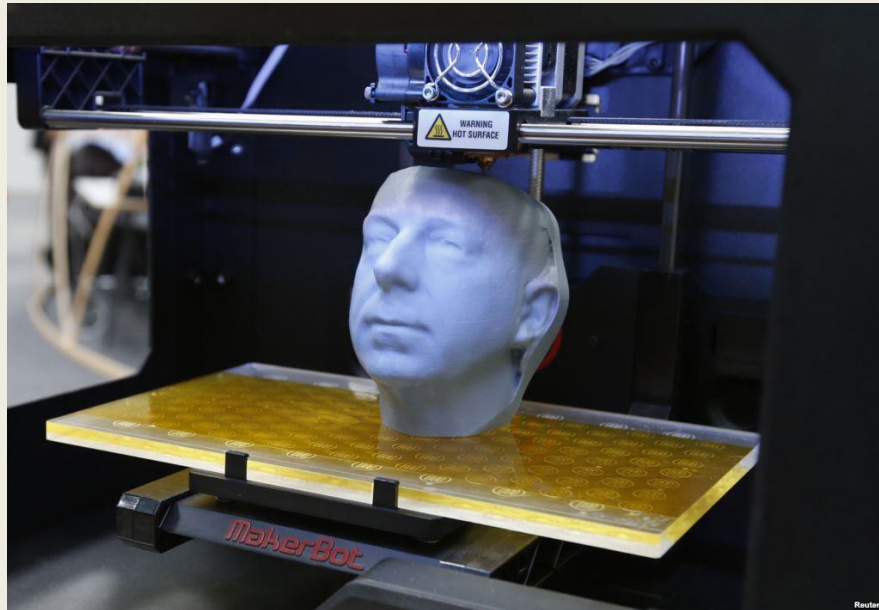


History

- Development started in the 1980s
- Additive manufacturing and 3D printing became synonymous only in the past few years
- Surge in consumer printing because patents are expiring
- Open-source design plays a big role in the advancement of consumer grade printers

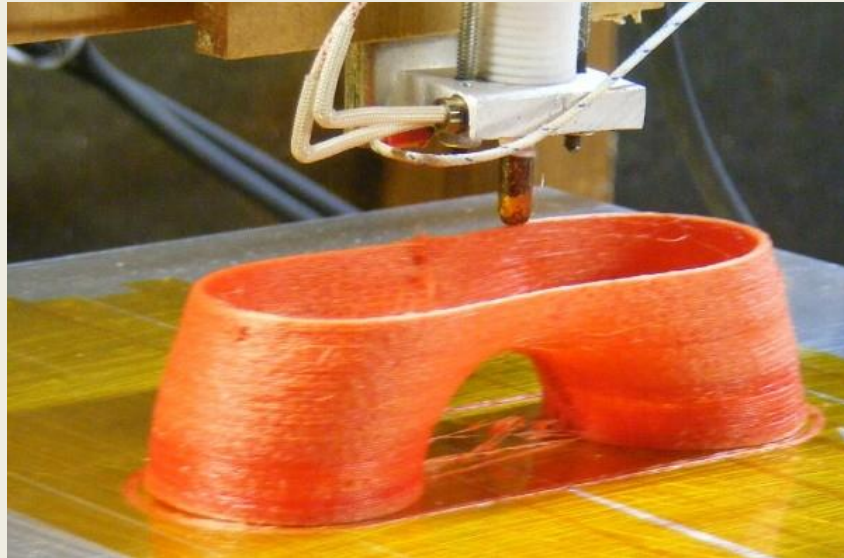
Types of printers

- Many methods of 3D printing but all share the same basic principal...
 - All of them build material layer by layer



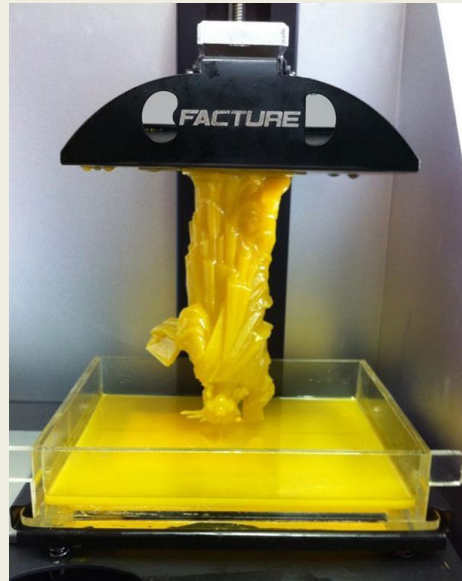
FDM

- Fused Deposition Modeling
 - Extrusion of a material that hardens to form each layer



SLA

- Stereolithography
 - A liquid polymer is exposed to a controlled light to harden each new layer



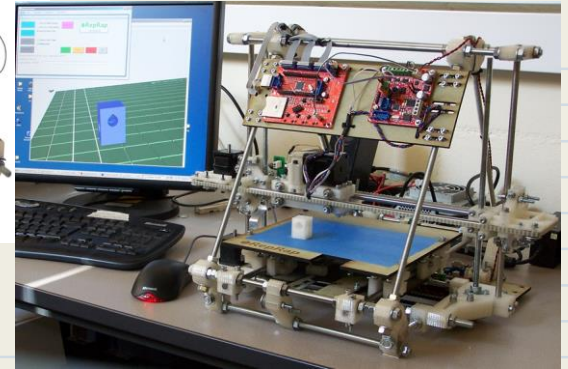
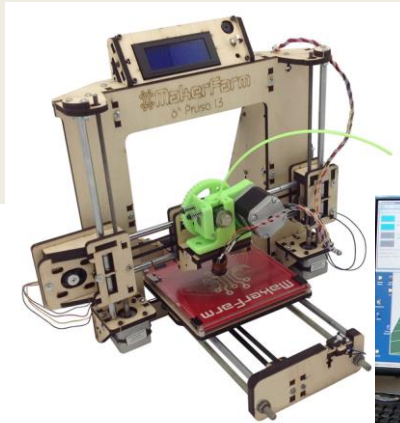
SLS

- Selective Laser Sintering
 - A laser sinters a powdered material binding each new layer together



Consumer Level

- \$300-\$3000
- Kits or Pre-assembled
- “Desktop” size



The Process

3D Innovations



CONCEPT



DESIGN/PROTOTYPE



MANUFACTURING



PRODUCT

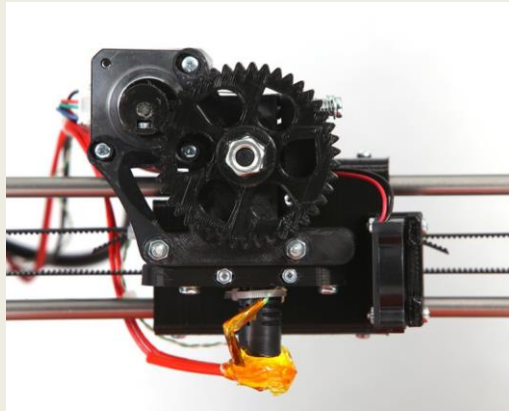
How do they work?

- We will be focussing on FDM printers since they are the most common
- Spool of thermoplastic filament is heated, extruded, and allowed to cool and solidify before another layer is added on top



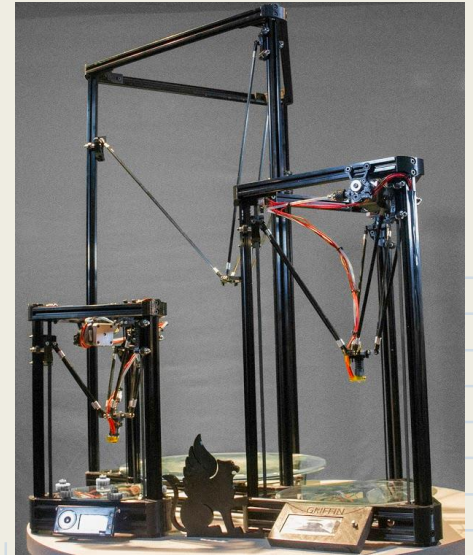
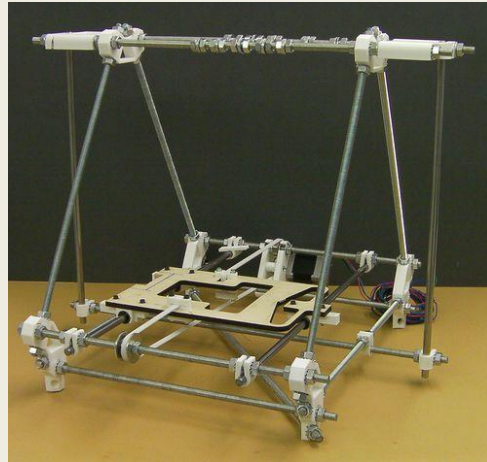
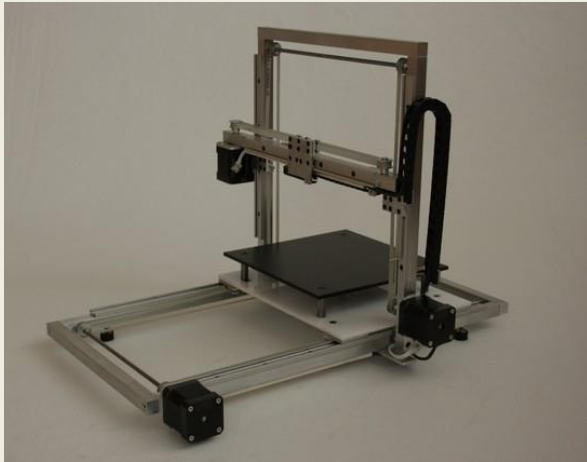
Hot End

- Filament is fed by a motor into the hotend
- A heating element heats the hotend to a set temperature so that the plastic melts in the nozzle



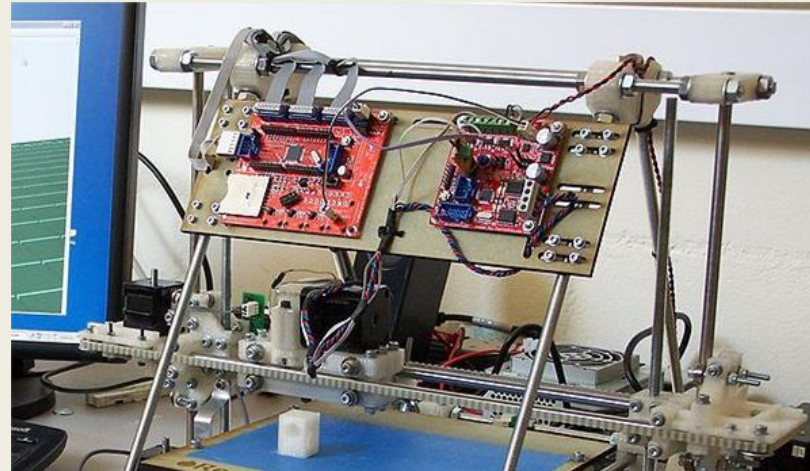
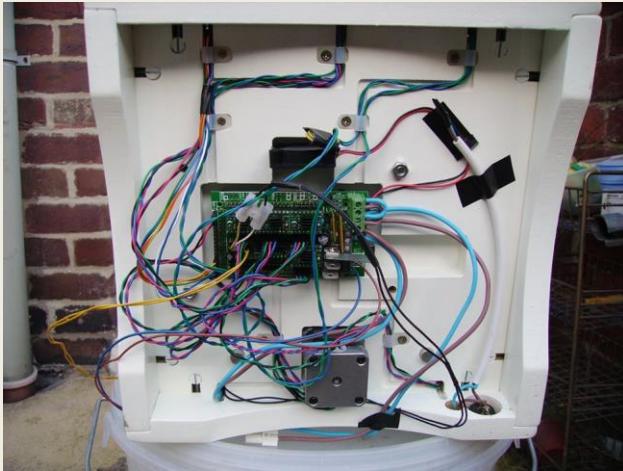
Gantry

- The hotend is moved in the X,Y, and Z directions as it extrudes to create a 3D object
- The structure that the extruder moves across is called the gantry



The Brains

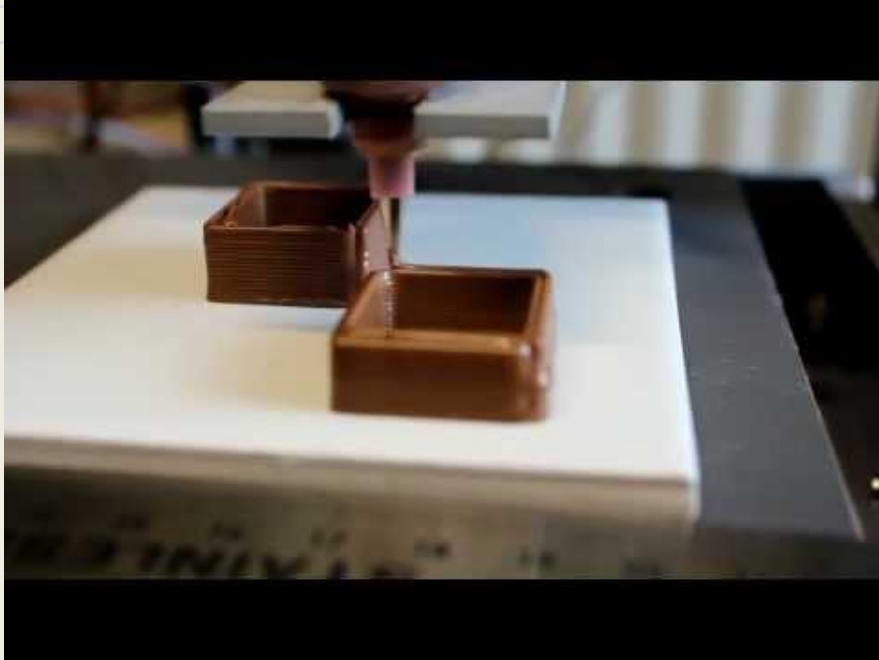
- The motors that move the extruder across the gantry are controlled by a controller separate from a computer
- Code generated on a computer is given to the controller
 - The printer doesn't know what it is making!
 - It is just told when and where to extrude plastic



Applications

- Art
- Tools
- Medical
- The “impossible”
- Self-repairs or replication
- Education

Edible Treats



Tech Limitations

- Speed
 - Tall items take longer than short ones
 - Faster print speeds can lower the quality
 - Higher print resolution increases print time
- Size
 - Large printers are much more expensive
 - Large parts to print take significantly longer
- Support Material
 - Each new layer needs a layer to build from
- Tolerances



FDM Materials

- Polylactic acid (PLA)
 - Plant sugar based
- Acrylonitrile butadiene styrene (ABS)
 - Petroleum based
- TPE
 - Flexible
- Special impregnated filaments
 - Wood fiber
 - Metal powders
 - Carbon fiber



CAD

- Computer Aided Design
- Different softwares for different jobs
 - Organic modeling
 - Programmatic
 - Direct Modeling
 - Parametric



Design Challenge

Derby Car Top Design

- Design the fastest and most creative derby car top that can carry a passenger without it falling out

Restrictions

- 60 x 30 x 20 mm maximum dimensions
- Must carry a passenger that is 19 x 10 x 7 mm
- Design must be able to print without support material

TinkerCAD Template

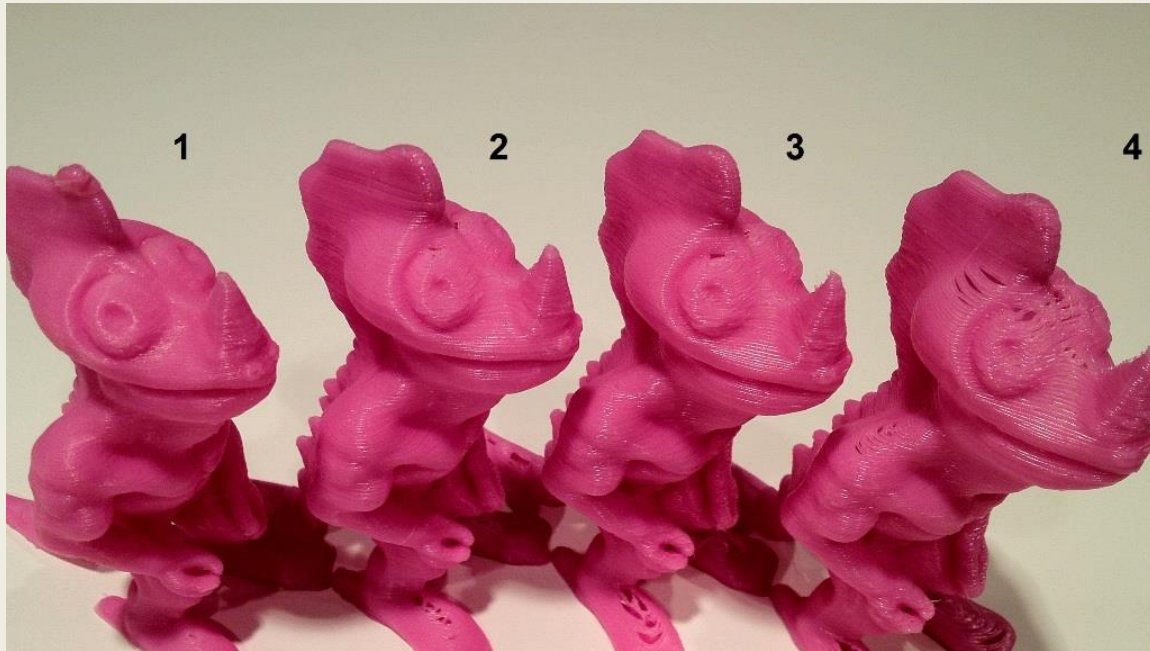
- Search “Makerspace Workshop Car Template”

Prepare for Printing

- Errors in the 3D file can hinder the 3D print job
 - Software can be used to check for any errors
- A printer doesn't know what to do with a 3D model file
- Slicing software turns a 3D model into layers for a printer
- G-code is what a printer reads to know when and where to move the extruder and to push out plastic

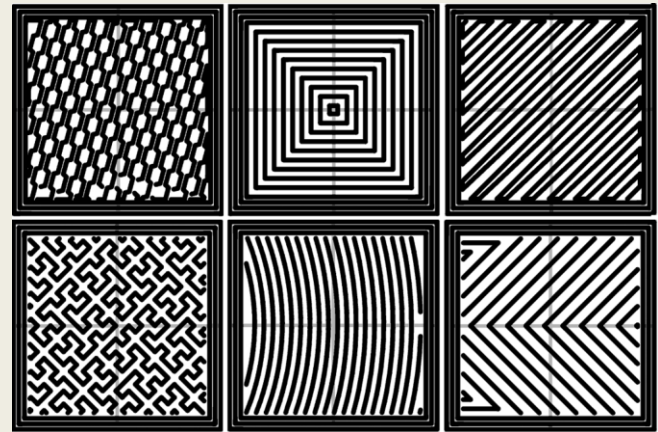
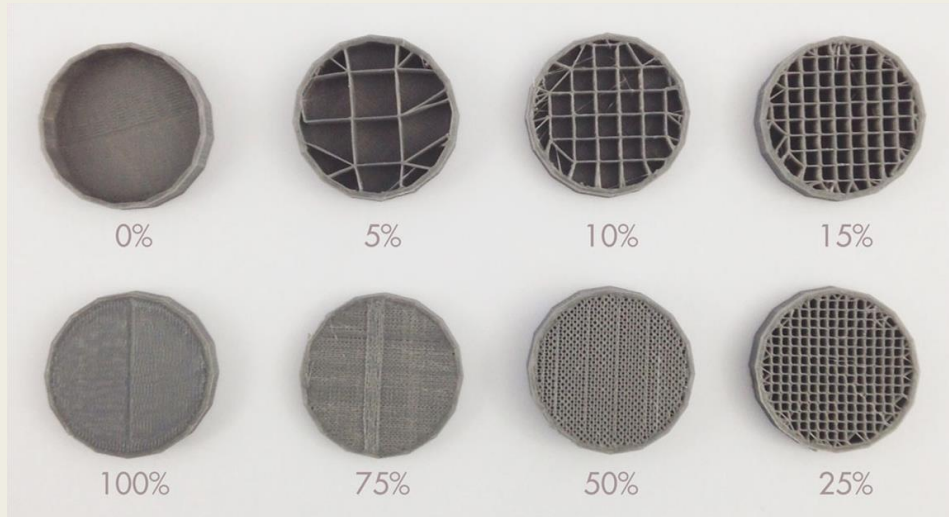
Print Settings

- Layer height
 - How tall each layer will be?



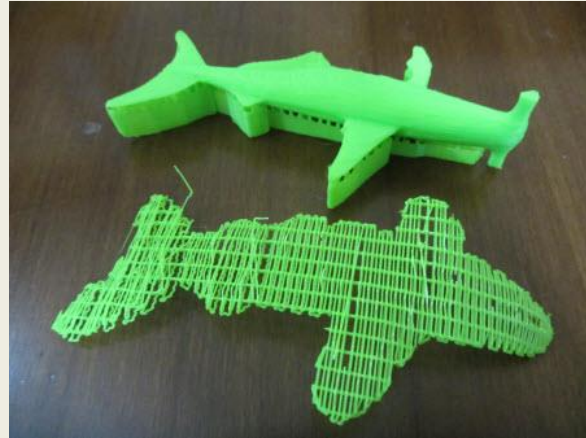
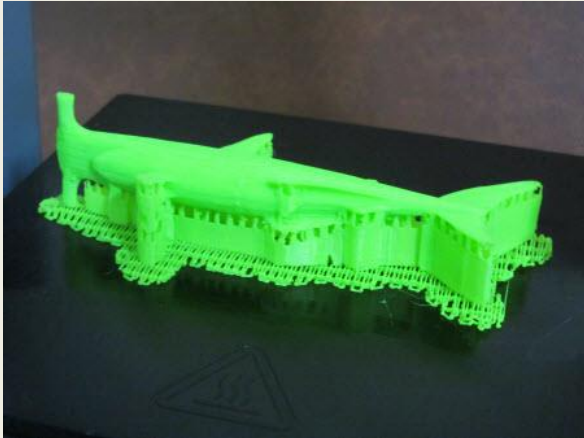
Print Settings

- Infill
 - How solid the piece will be?



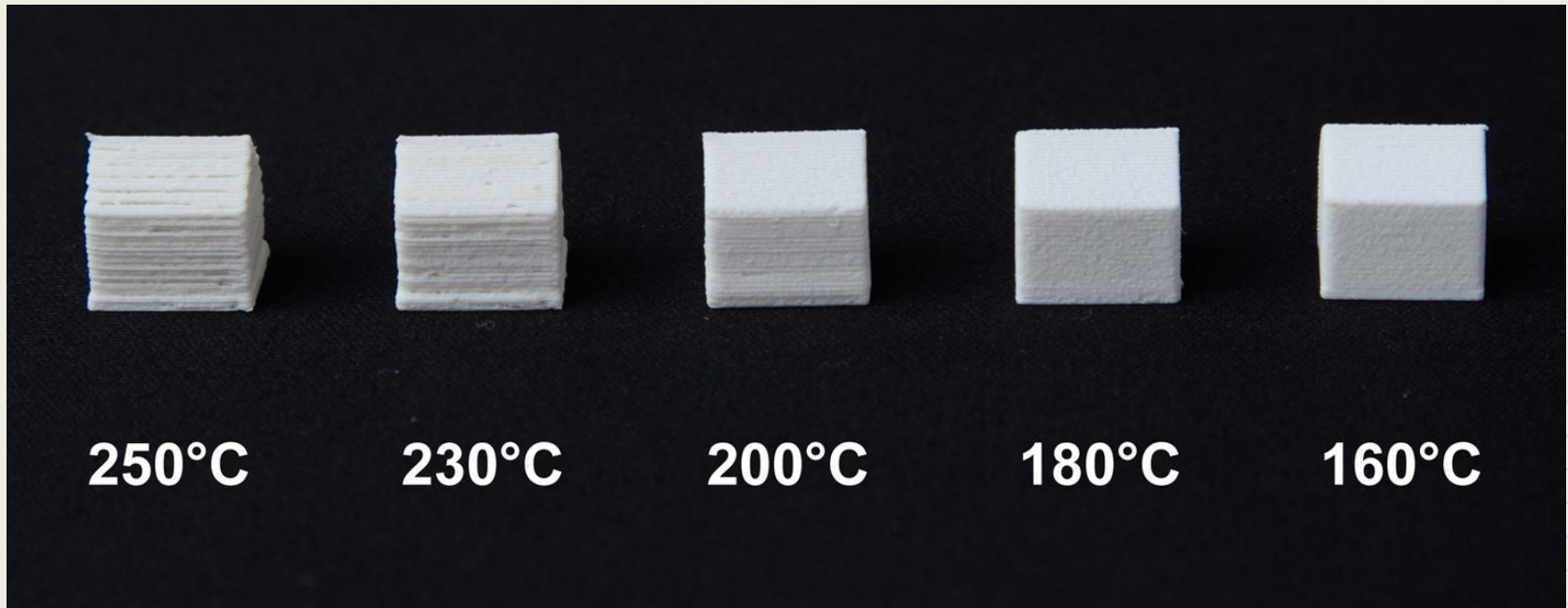
Print Settings

- Support Material
 - How will overhangs be supported?
- Rafts
 - Layers below the piece to help with bed adhesion



Print Settings

- Temperature



Running the Print

