3D Printing

Filaments and Catapult

Student Sheet

- *Materials Needed:*
    - These materials were only available for students who registered for and attended the session on 11/5/20 – Overview experiment videos are available for the following:
        - 3D printing filament samples - PLA & TPU, Catapult base and interchangeable arms (A,B,C) overview, how to change arms, projectile testing.

3D Printer Filament & Fused Deposition Modeling (FDM) Printing

- Each filament is 1.75mm in diameter.
- Both filaments are common in FDM printing.
- FDM is AKA Fused Filament Fabrication (FFF) printing.
- The 3D printer is fed the filament through a long tube, and it gets melted at the "hot end" and comes out the nozzle at a diameter of around .4mm. Each layer is extruded onto the bed in a specific pattern at a specific layer height and then fuses with the layer above to create a 3D object.
- Polylactic Acid – **PLA** – is the **black filament**. It is more brittle and used for printing hard objects. It is usually made from corn starch, tapioca roots or sugar cane. [1]
- Thermoplastic Polyeurethane – **TPU** – is the **orange filament**. Has elastic properties and is used for flexible or rubbery prints. [2]
- Stereolithography Apparatus or SLA printing is another type of 3D printing. Instead of a filament, SLA Printing uses a pool of light sensitive polymer to cure or harden prints layer by layer. [3]

3D (Printing) Design, Slicing, G-Code

- AutoDesk makes the three common 3D design programs: Fusion 360, Meshmixer and also TinkerCAD. If you've never designed in a 3D space before, you can get a FREE TinkerCAD account to start creating today! If you have an education account, you can probably get Fusion 360 for free as well!
- The catapult that we're using today was designed by Thingiverse user, 3E8. Saul then modified the 3 arms, and they were laid out for printing in TinkerCAD with 10-arms per print bed. These files were all exported as .STL or stereolithography files.
- Once an STL file is created, it needs to be "sliced" into individual 2D layers by a slicing program in order to be printed. Then, it's saved as G-Code file, which tells the 3d printer where to deposit filament, how much filament to deposit, and other details too. [3]

- Here's an example of some G-Code for Catapult Arm – A:
  - ;TYPE:WALL-OUTER
  - G1 F1200 X121.425 Y187.413 E73.03969
  - G1 X122.122 Y187.567 E73.06343
  - G1 X122.236 Y187.594 E73.06733
  - G1 X123.067 Y187.683 E73.09512
  - G1 X123.9 Y187.683 E73.12283
  - G1 X124.729 Y187.594 E73.15056
  - G1 X125.543 Y187.413 E73.17829
  - G1 X126.333 Y187.148 E73.20601
  - G1 X127.09 Y186.797 E73.23376
- G1 – Move command, X – X-axis coordinates, Y – Y-axis coordinates, E – How much to extrude.
- Infill is also determined in this step as well.

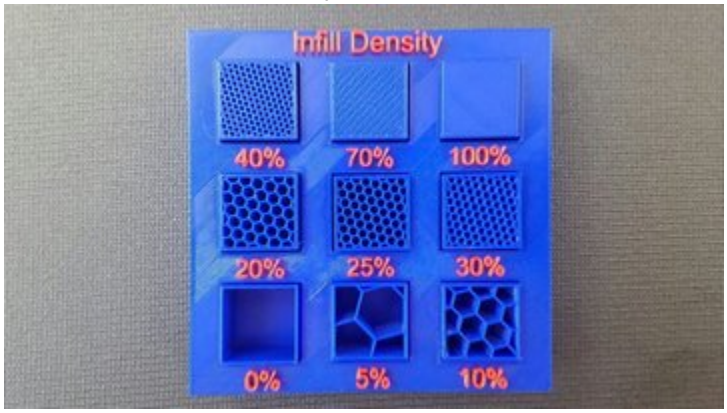

Image Source: https://all3dp.com/2/infill-3d-printing-what-it-means-and-how-to-use-it/

Sources

1. https://all3dp.com/1/pla-plastic-material-polylactic-acid/
2. https://all3dp.com/2/tpu-filament-explained-and-compared/
3. https://all3dp.com/fdm-vs-sla/