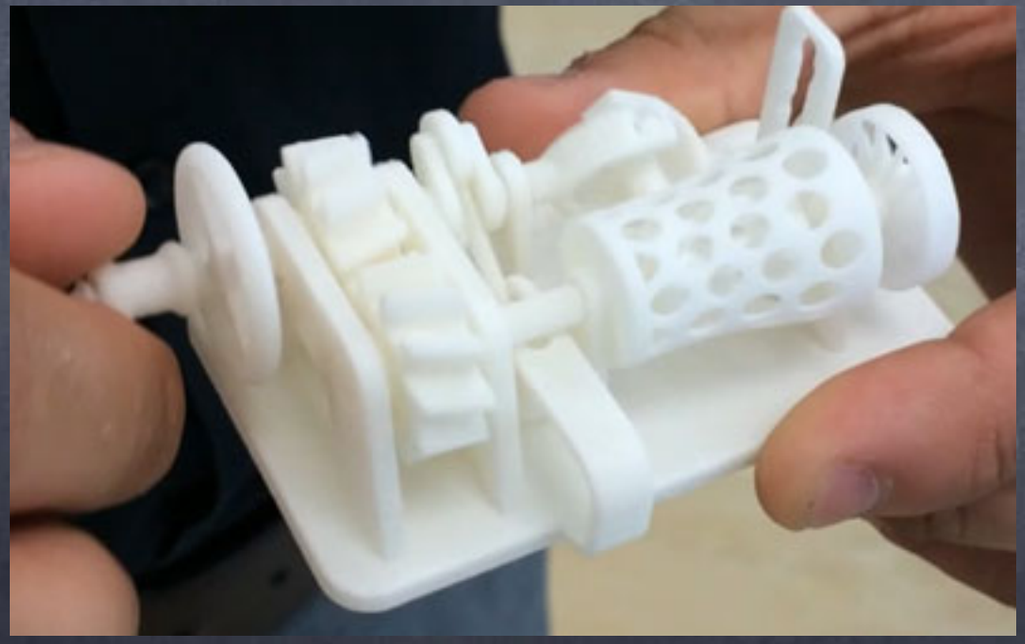
3D Printing (Organs??? Is a new future or Not???)

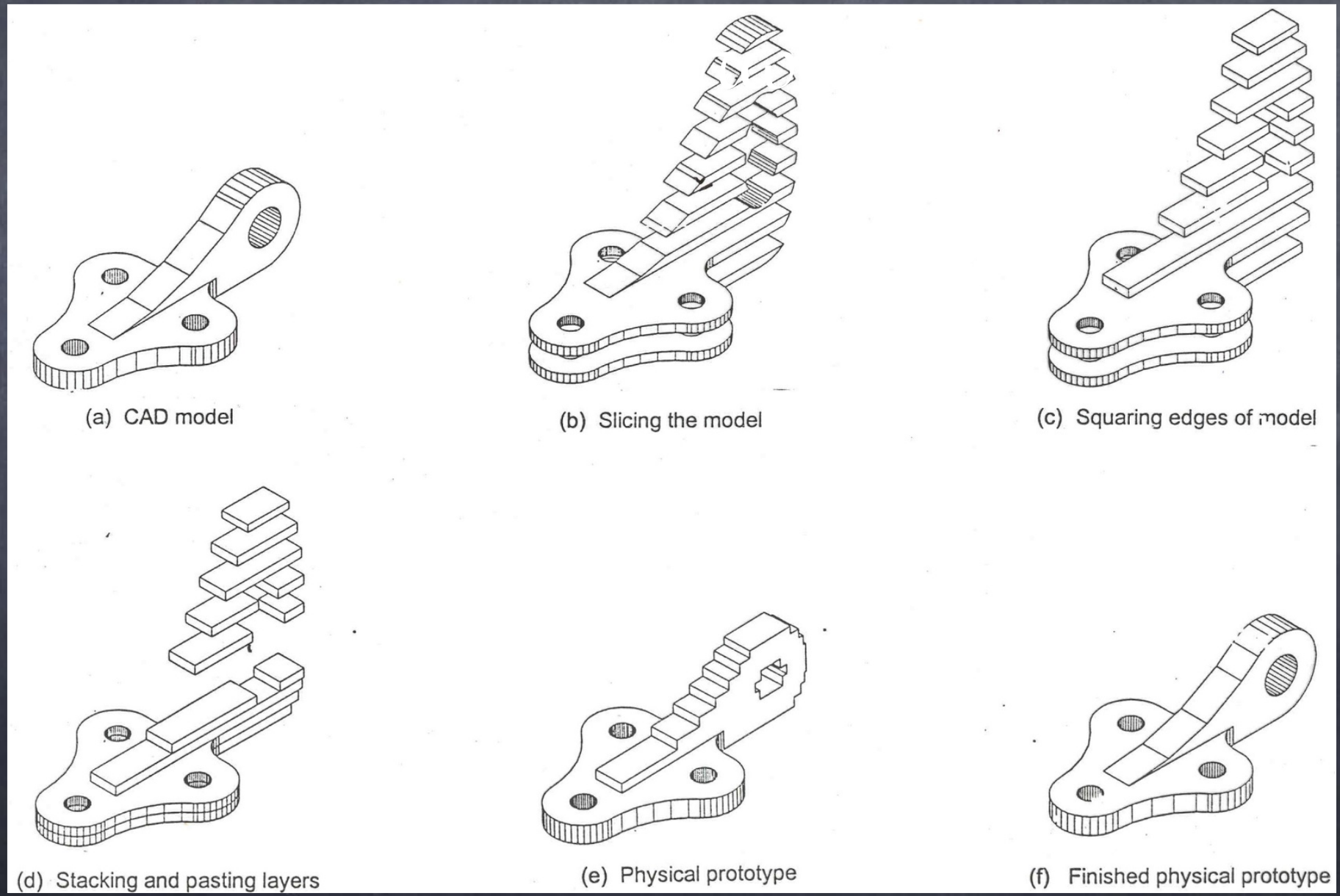
Dr. N. Vordos

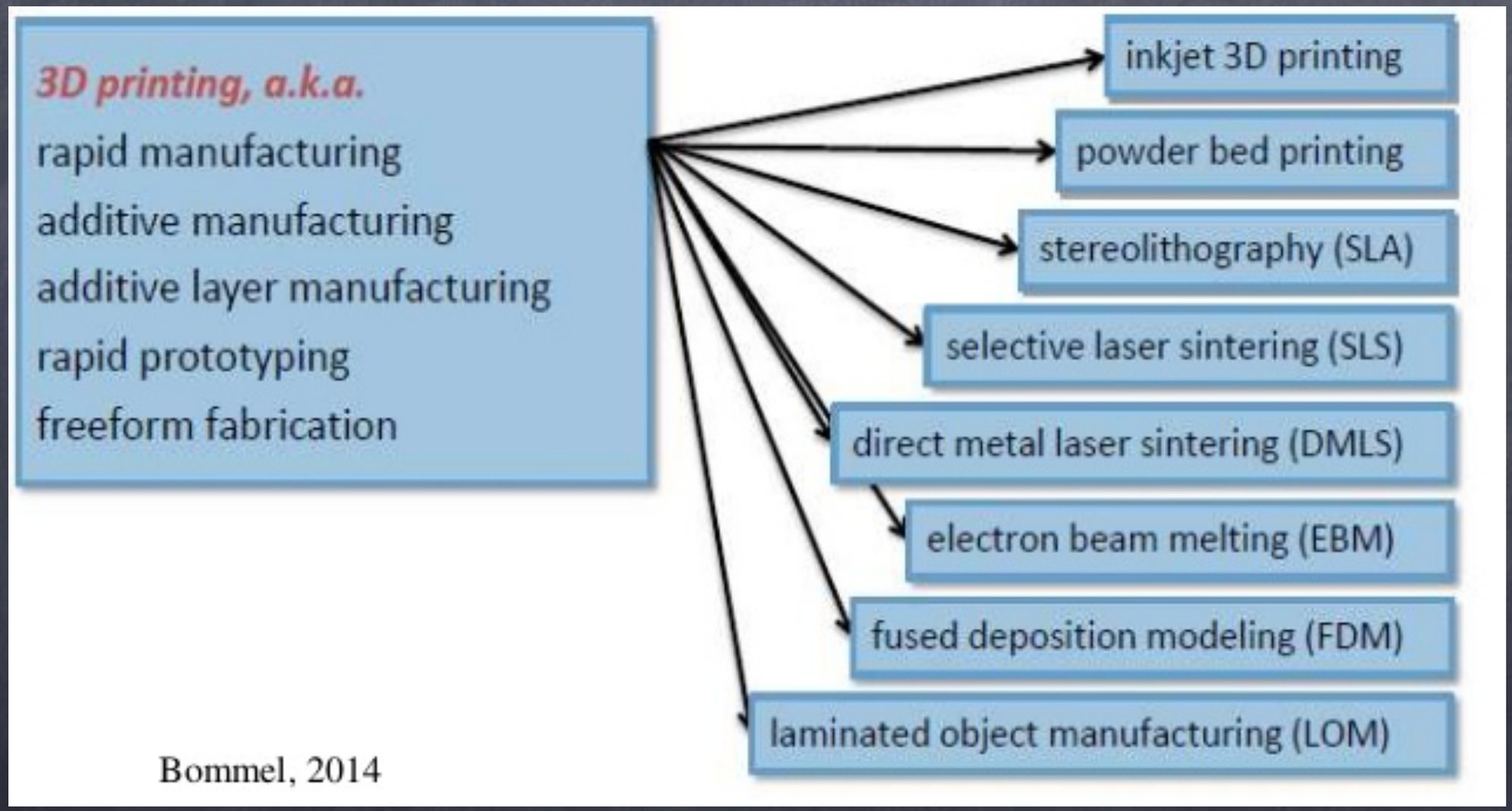
Από το σχέδιο (CAD)

στην εκτύπωση

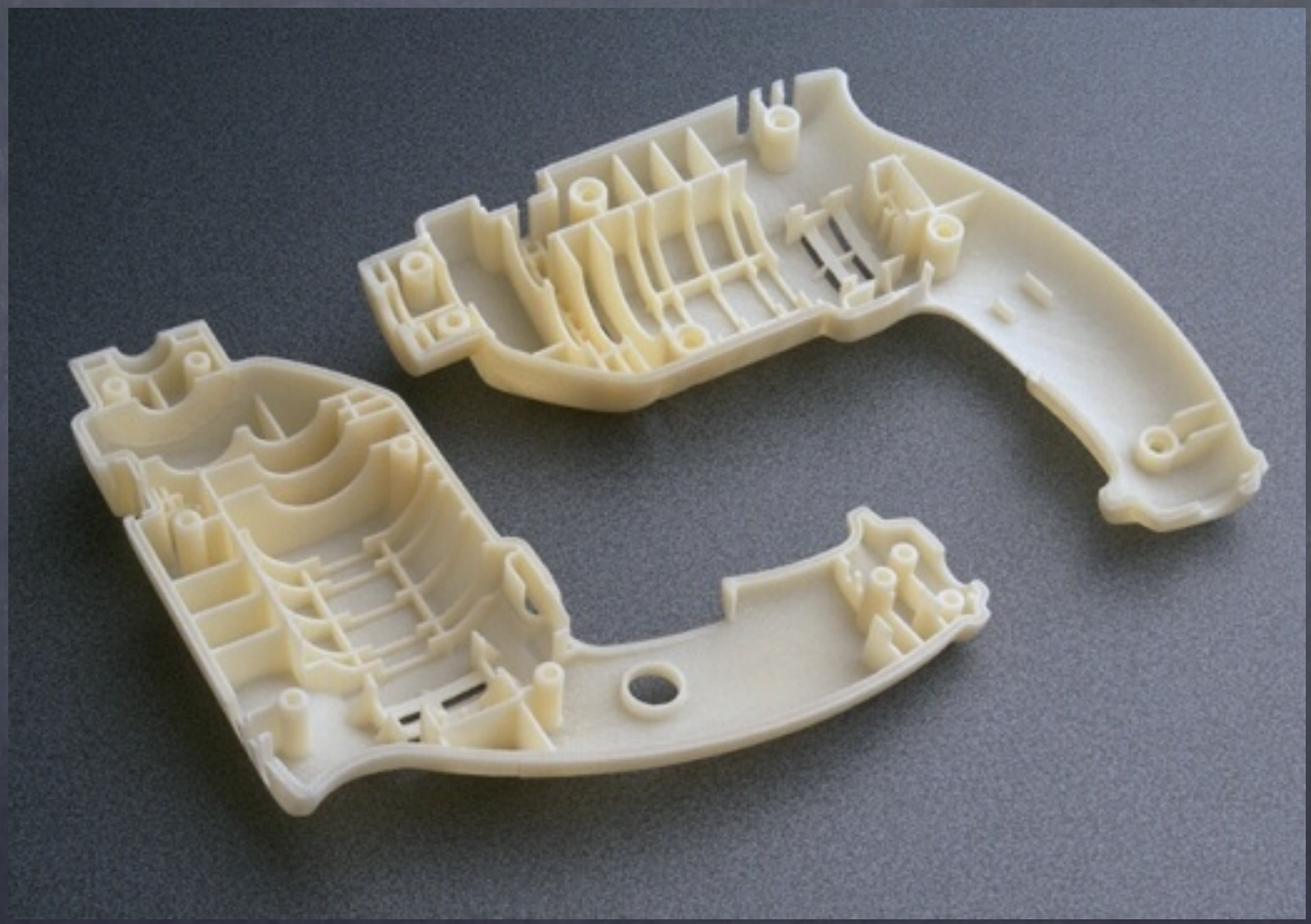


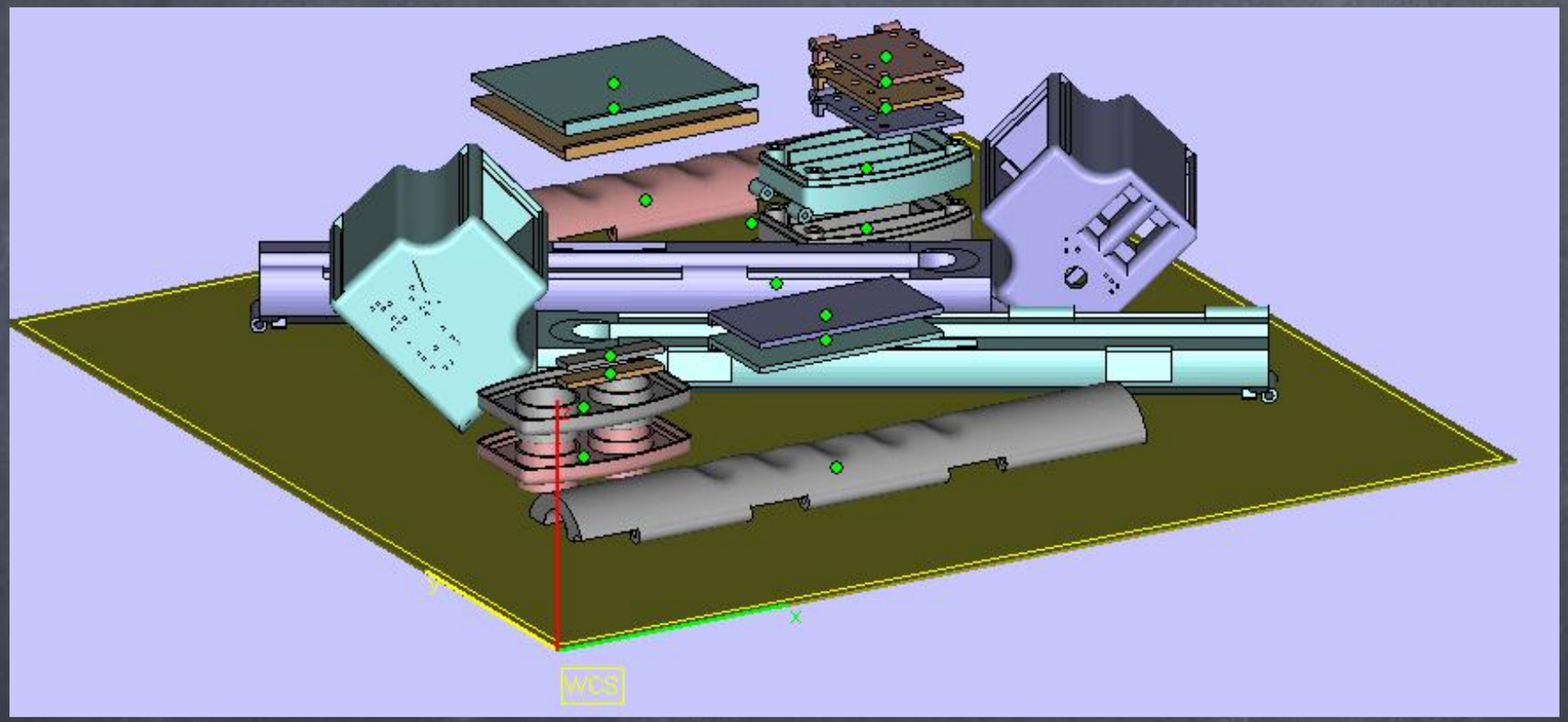
3D Διεργασία

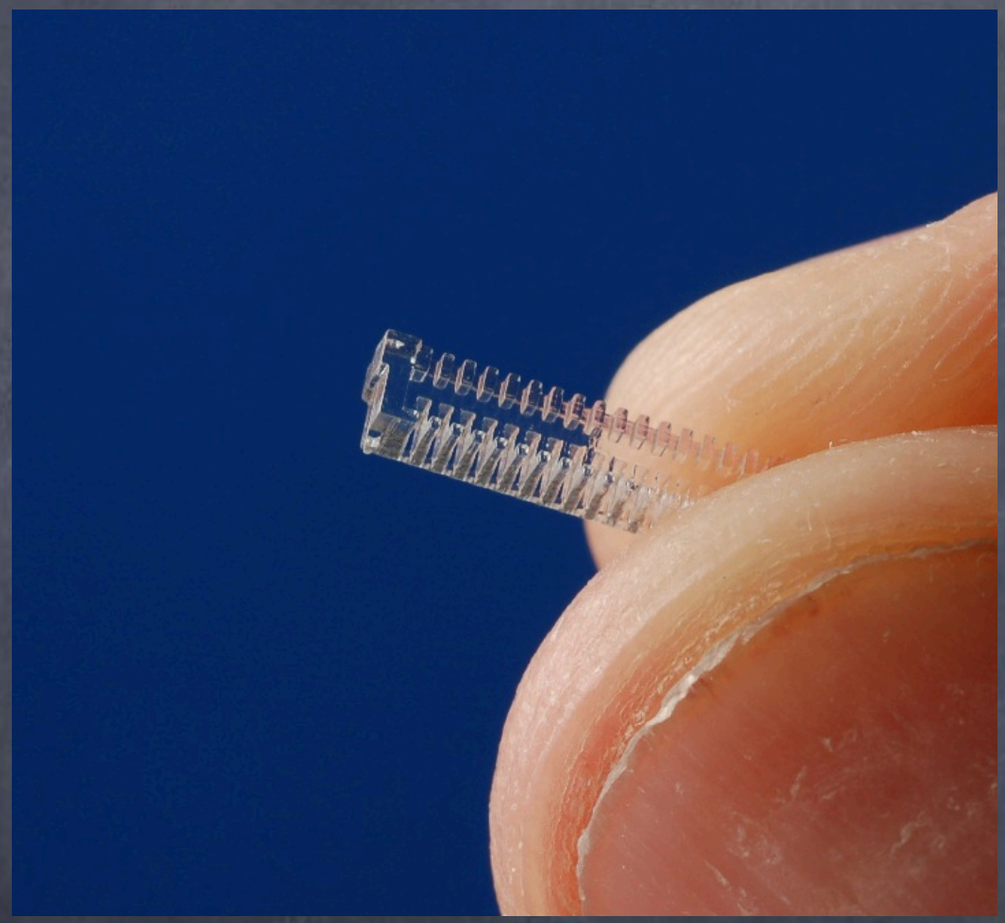


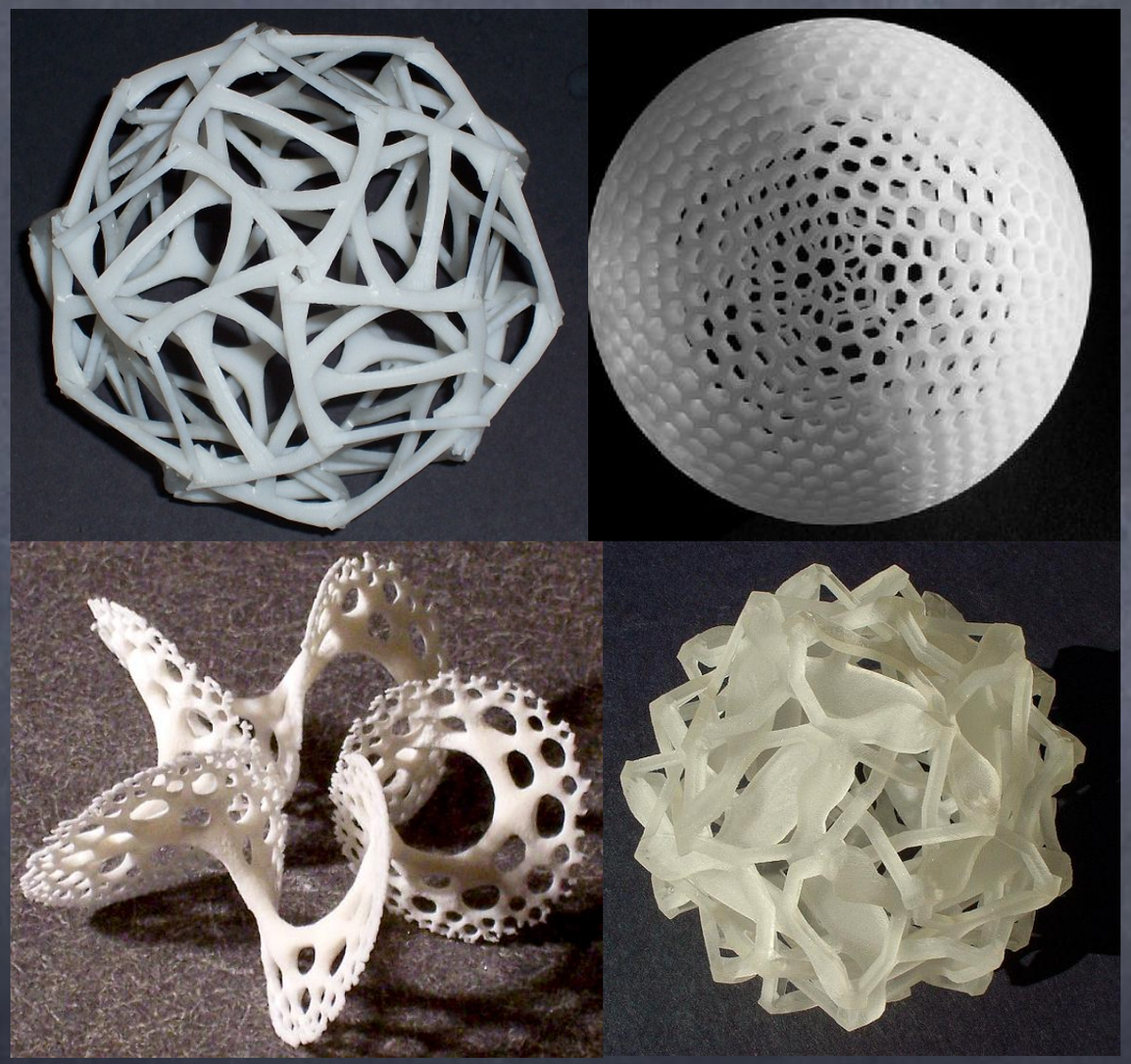

3D printing, a.k.a.
rapid manufacturing
additive manufacturing
additive layer manufacturing
rapid prototyping
freeform fabrication
inkjet 3D printing
powder bed printing
stereolithography (SLA)
selective laser sintering (SLS)
direct metal laser sintering (DMLS)
electron beam melting (EBM)
fused deposition modeling (FDM)
laminated object manufacturing (LOM)

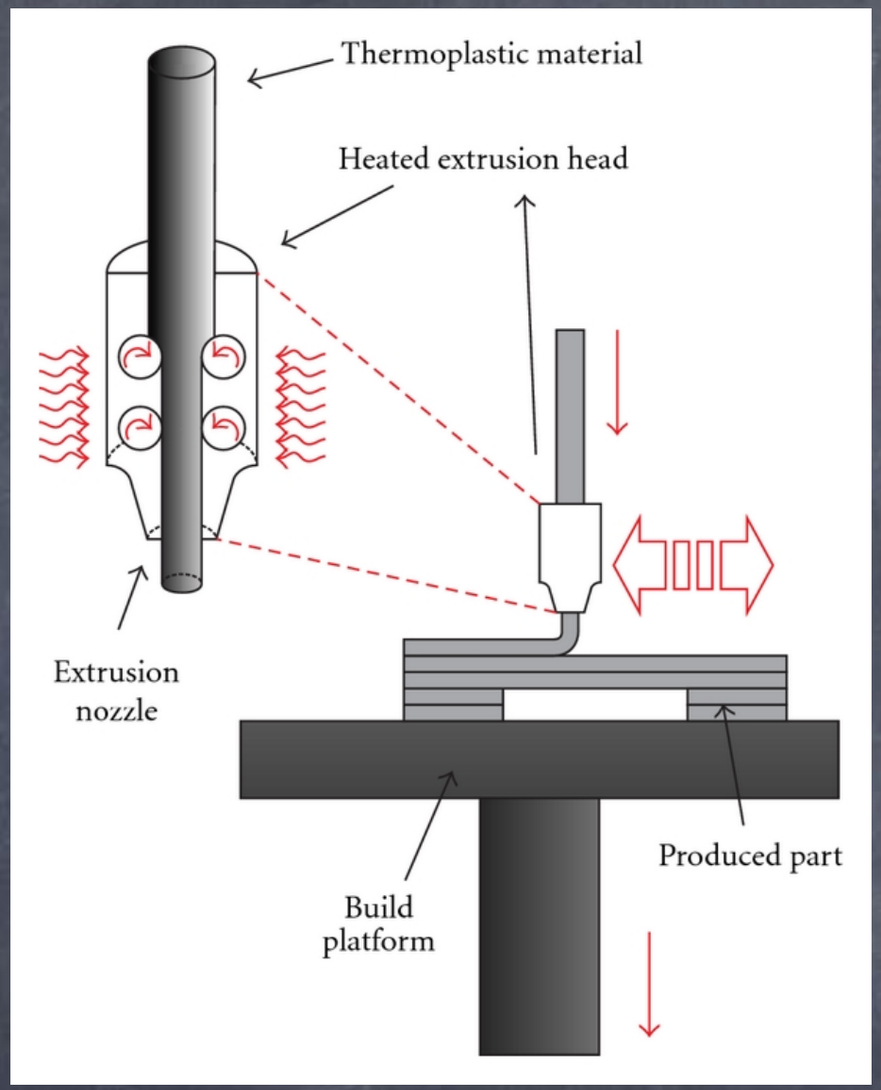
Bommel, 2014



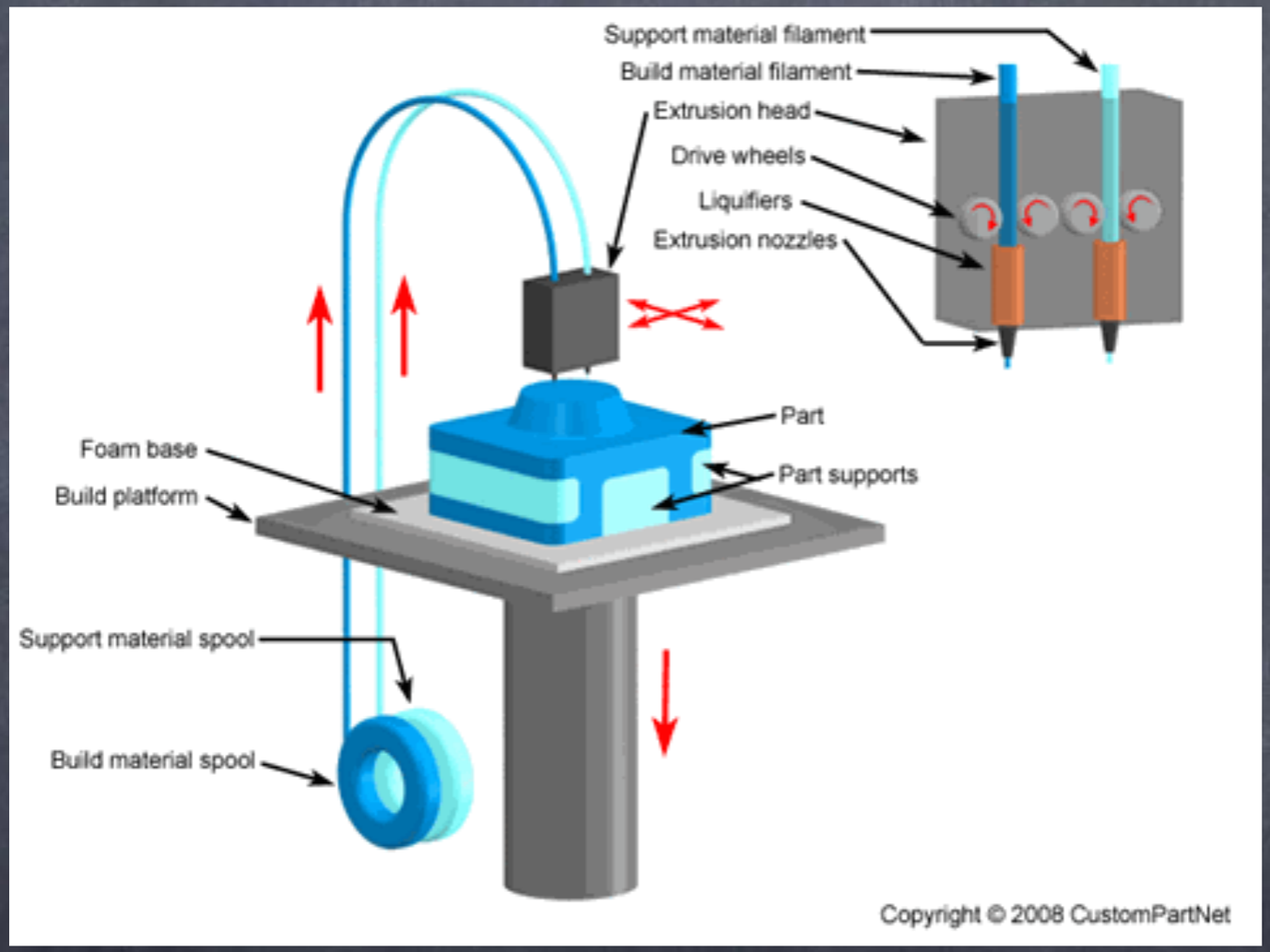

Y
X
WCS



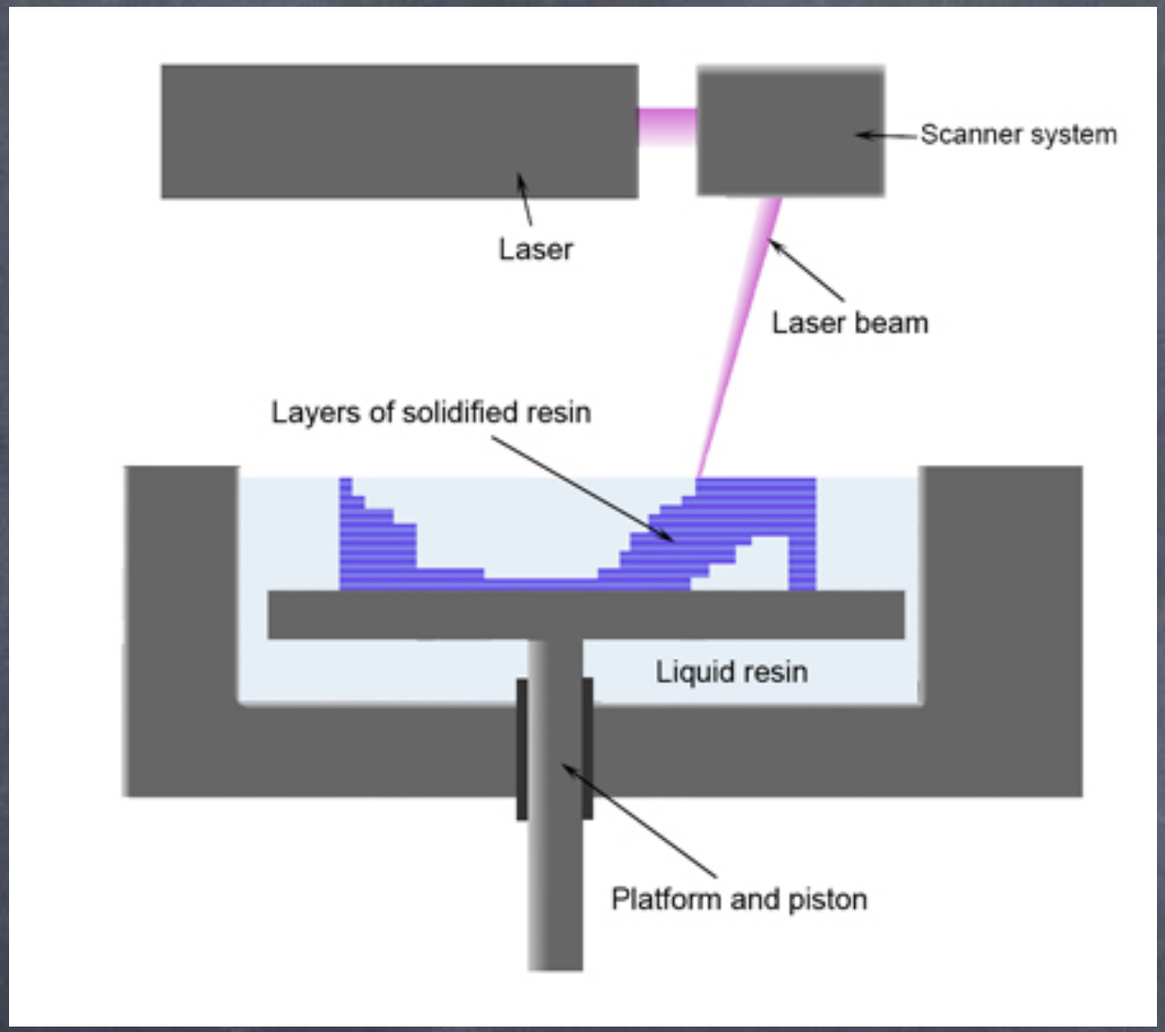




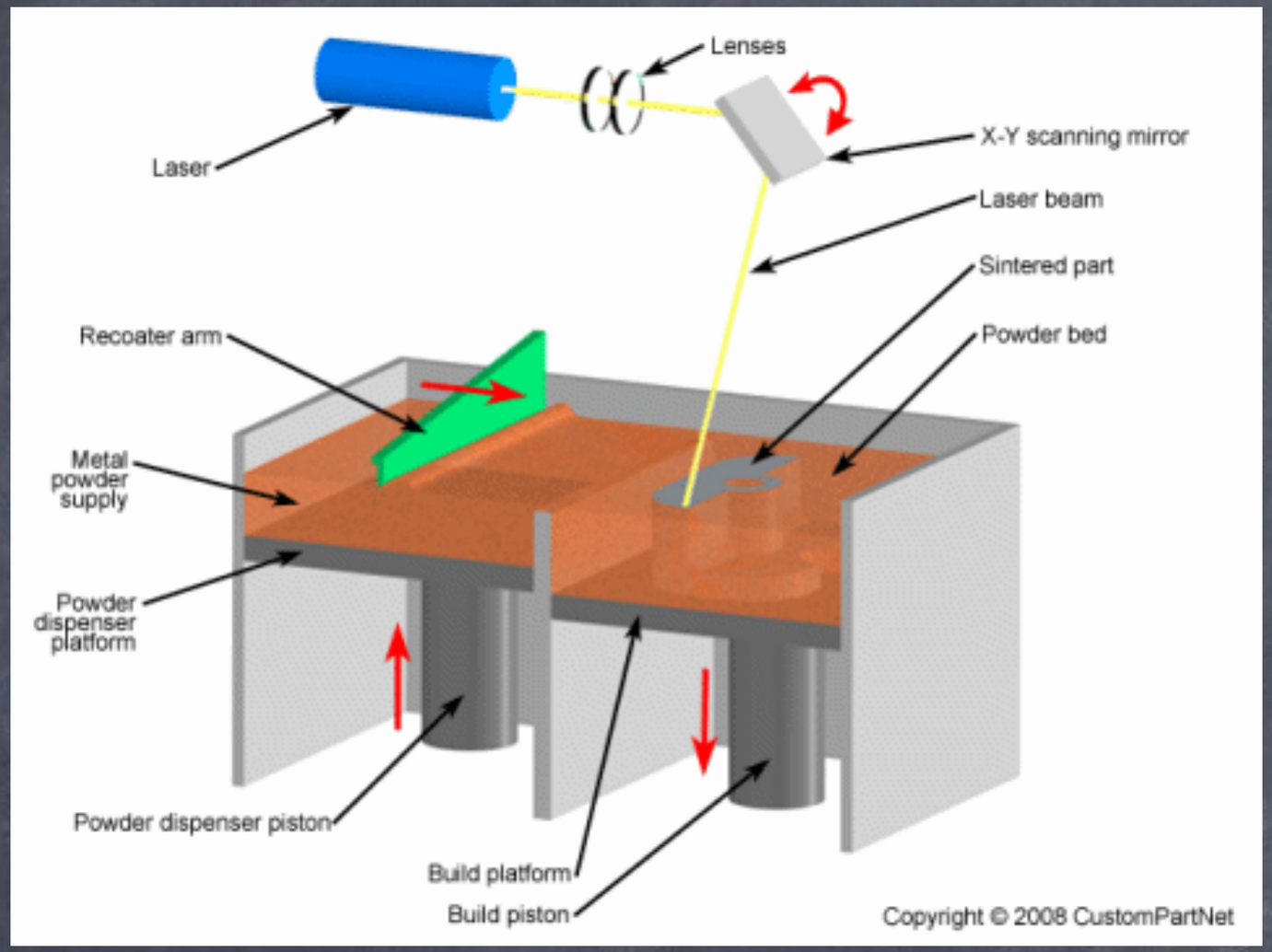
Fused Deposition Modeling (FDM)



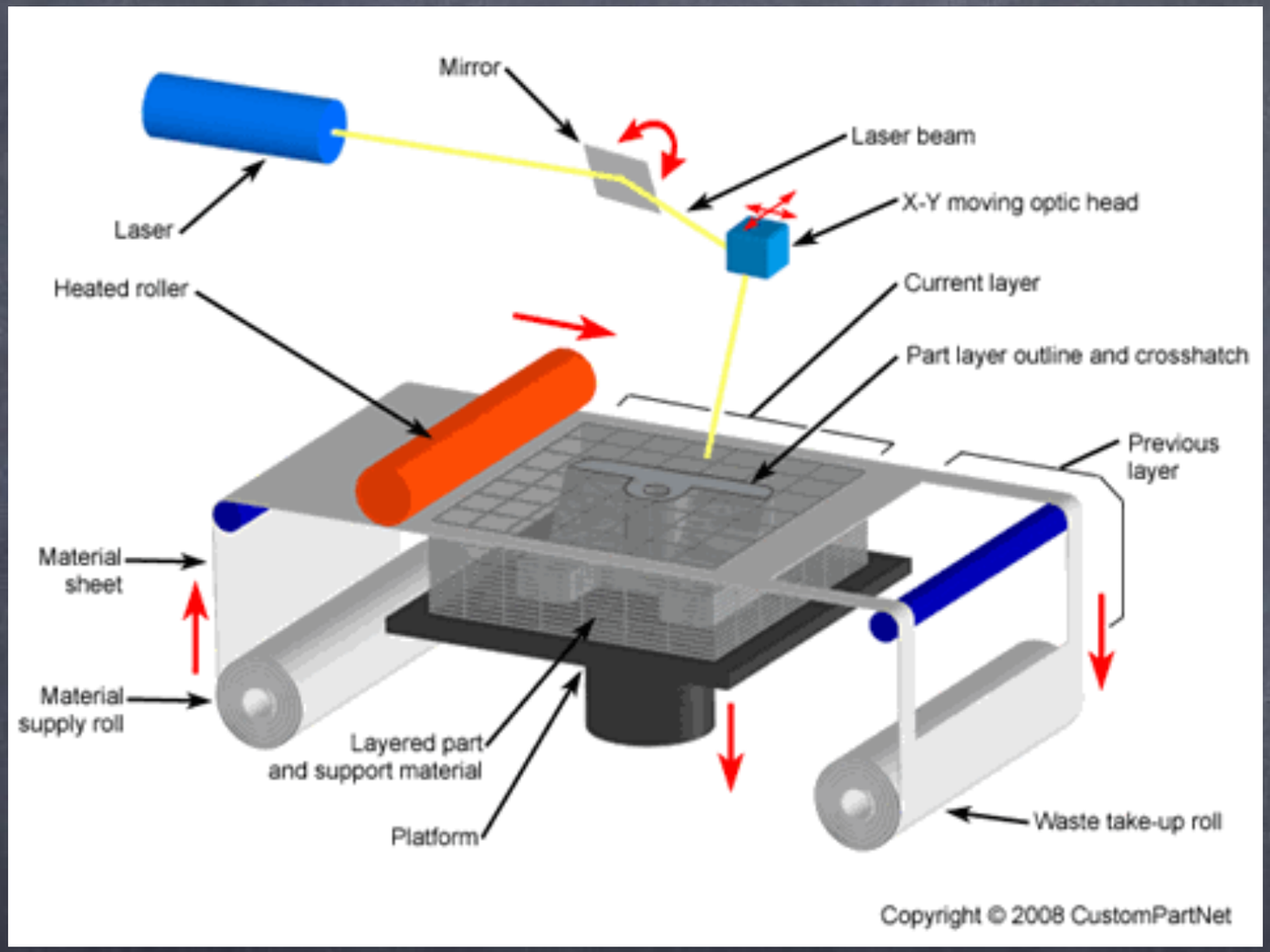
Fused Deposition Modeling (FDM)



Stereolithography (SLA)



Selective Laser Sintering (SLS)

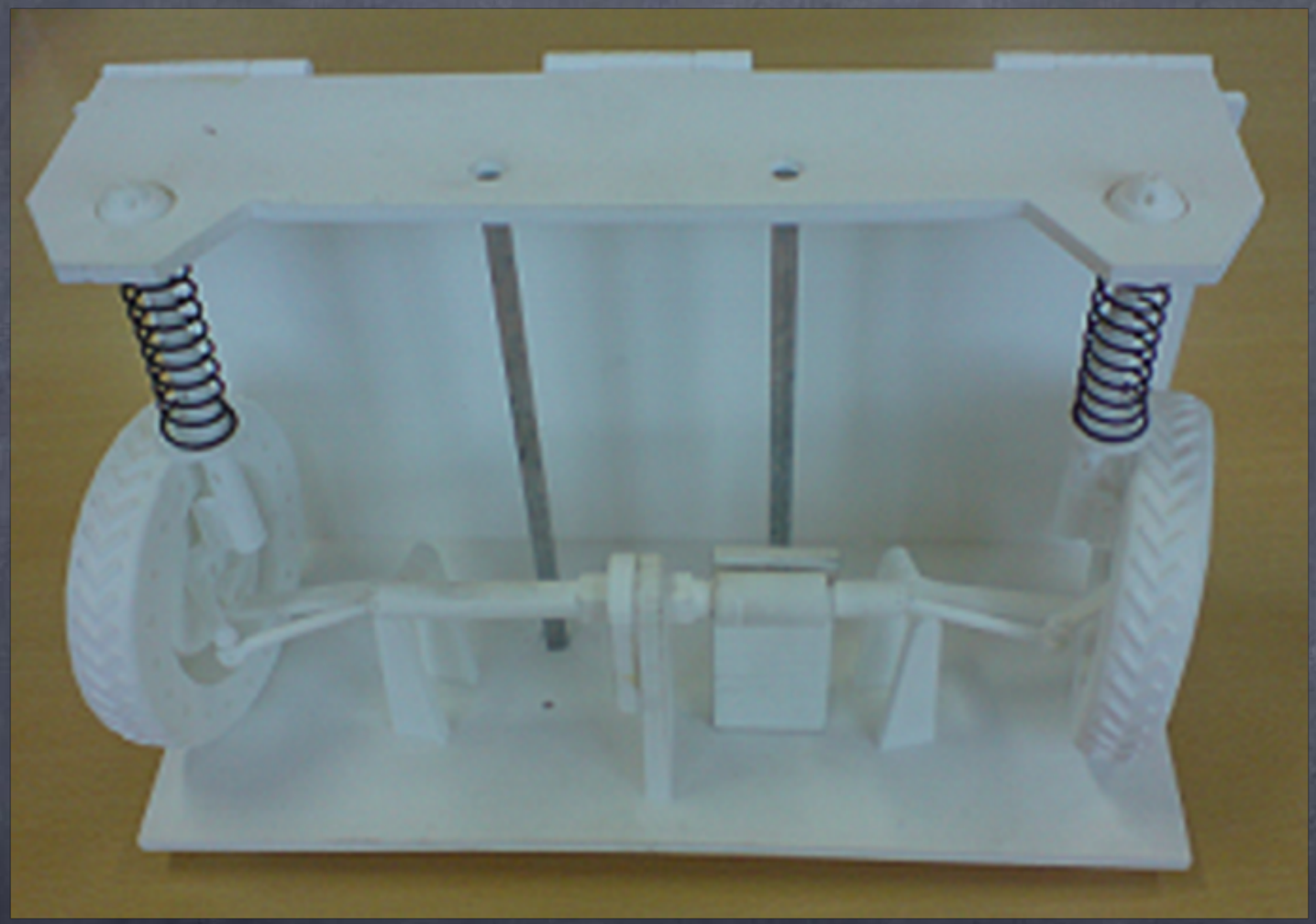


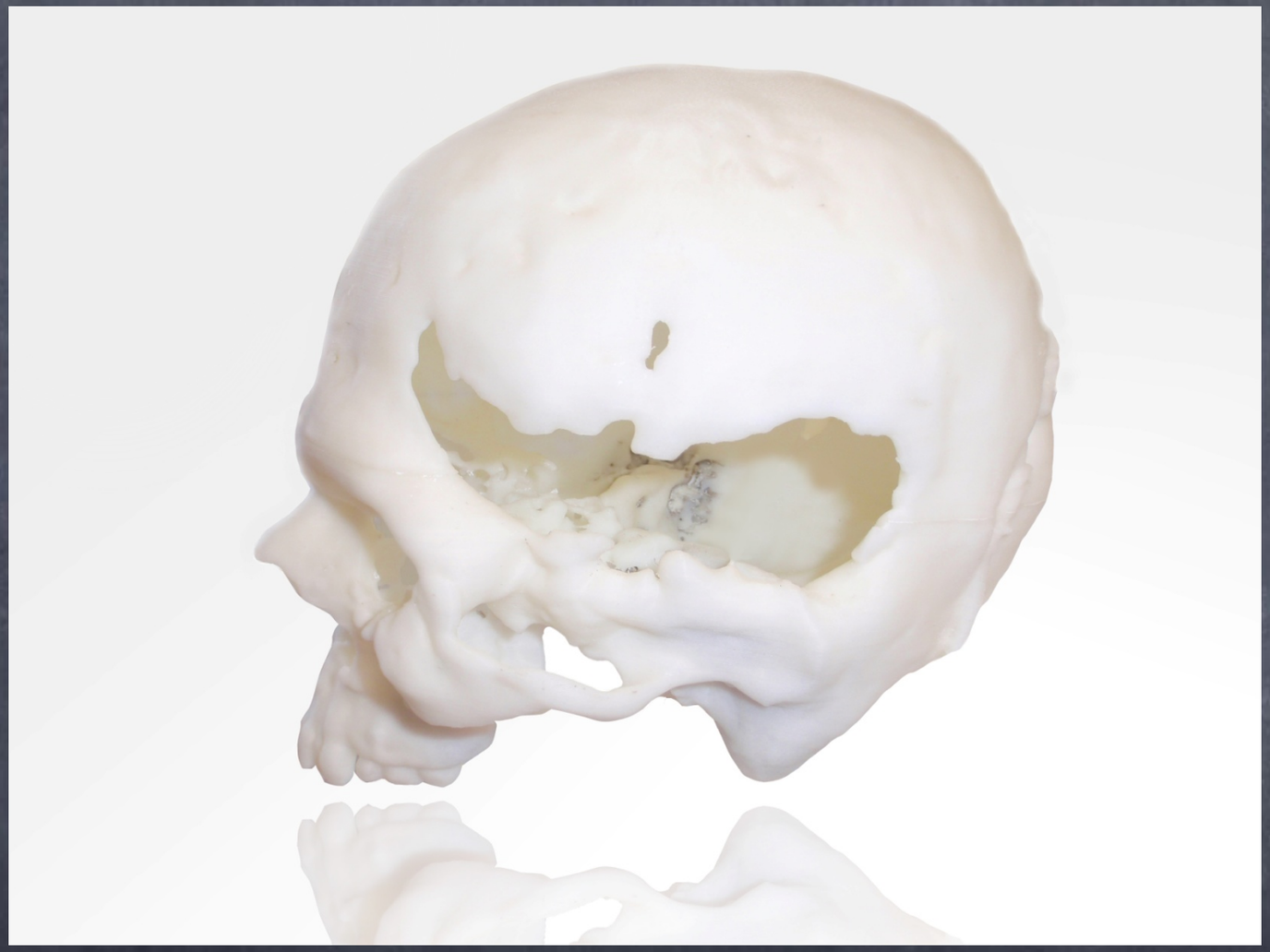
Laminated Object Manufacturing (LOM)


RadioShack
GIRO


RadioShack
GIRO

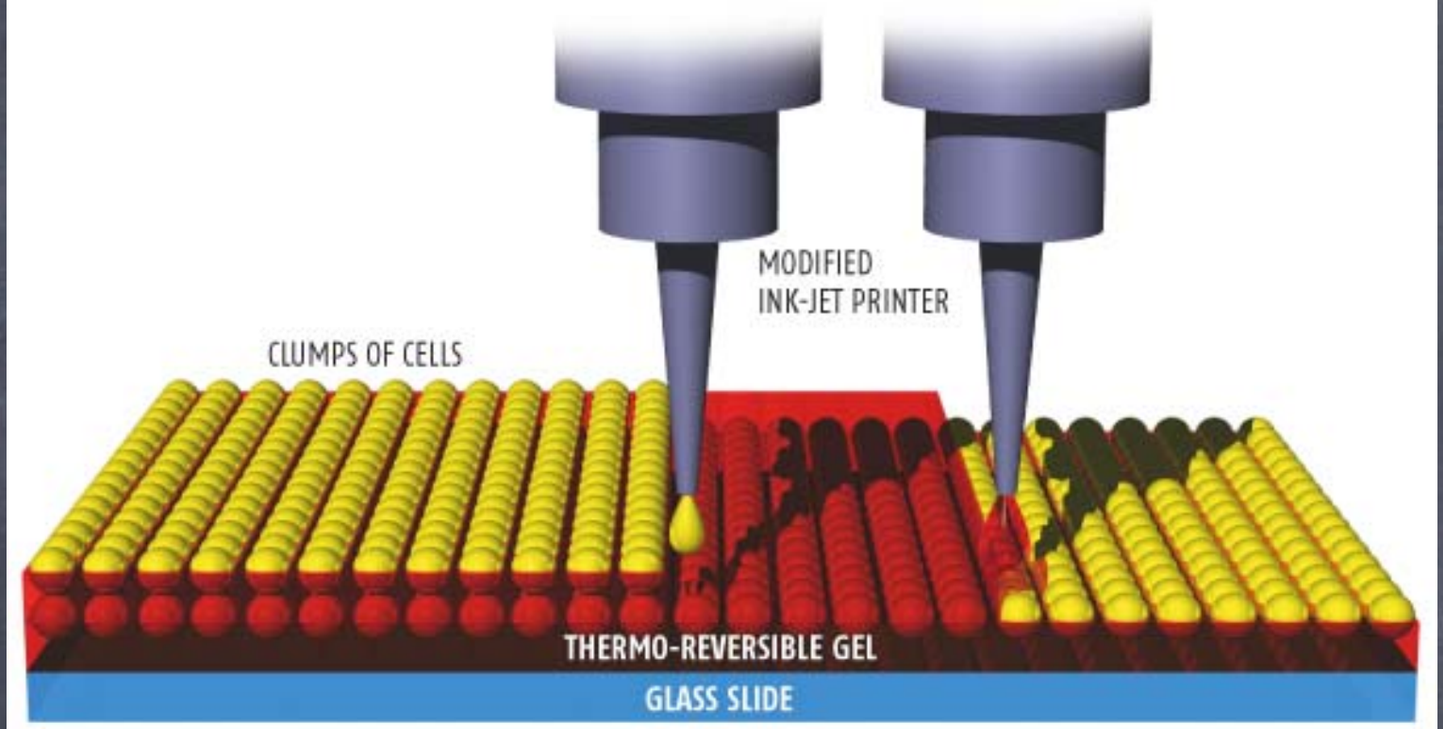

LA

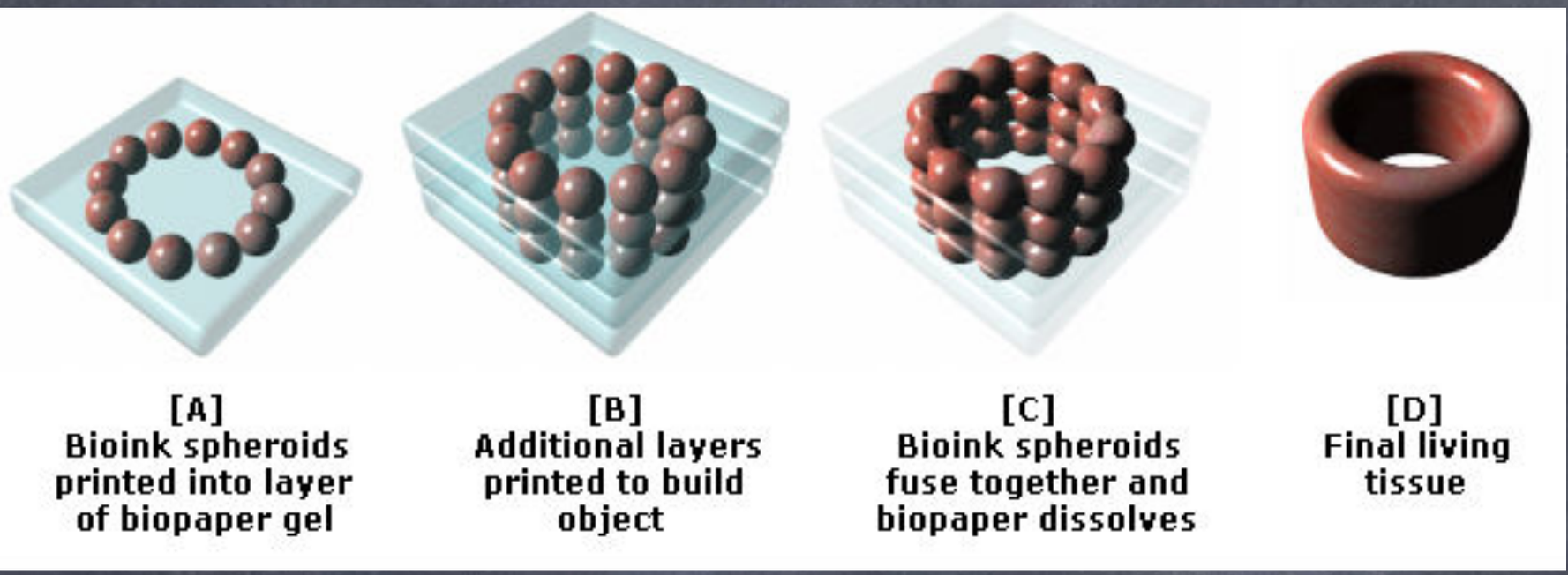




PRINTING ORGANS

Organs could be built up layer by layer by printing clumps of cells onto a gel that turns solid when warmed. Once the cells have fused the gel can be removed simply by cooling it



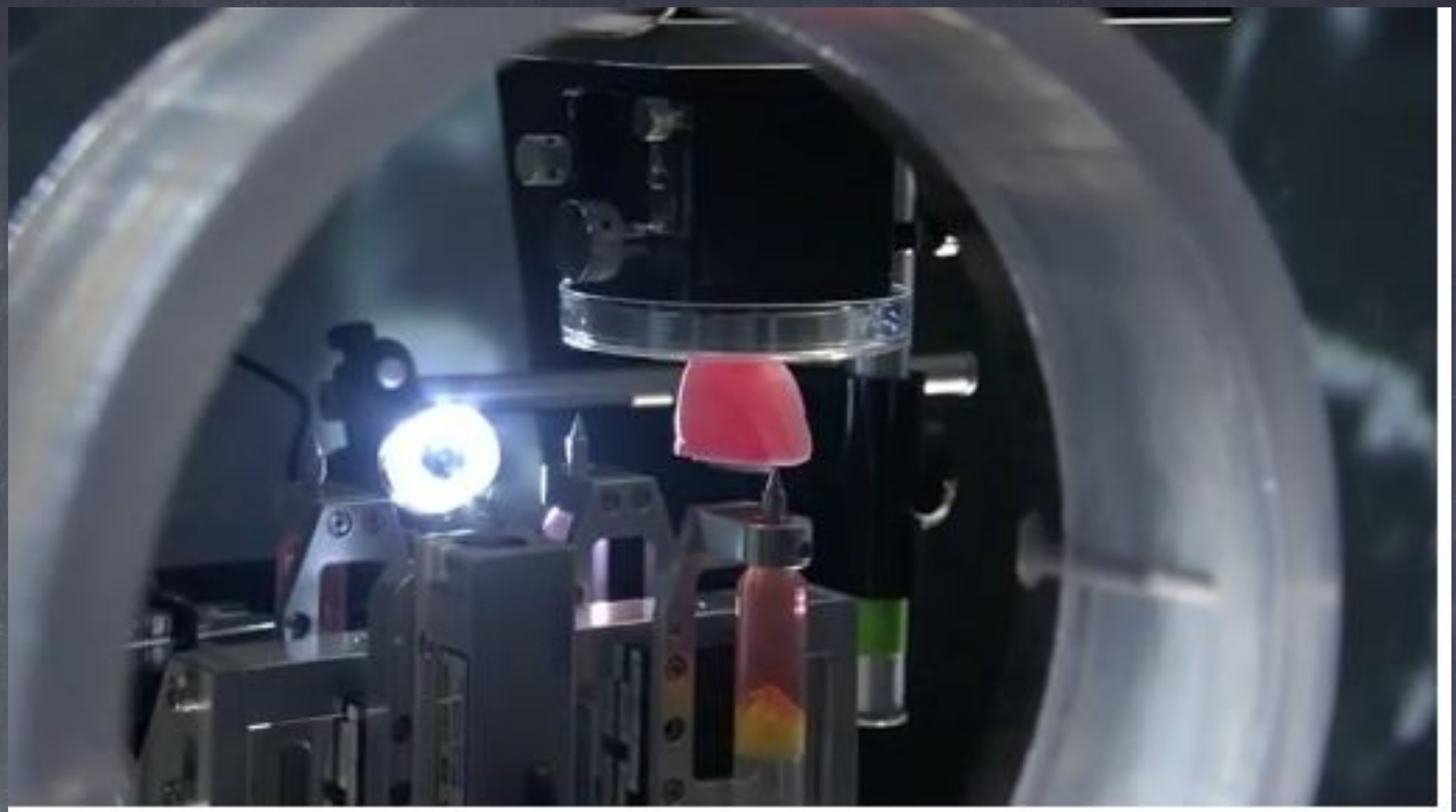


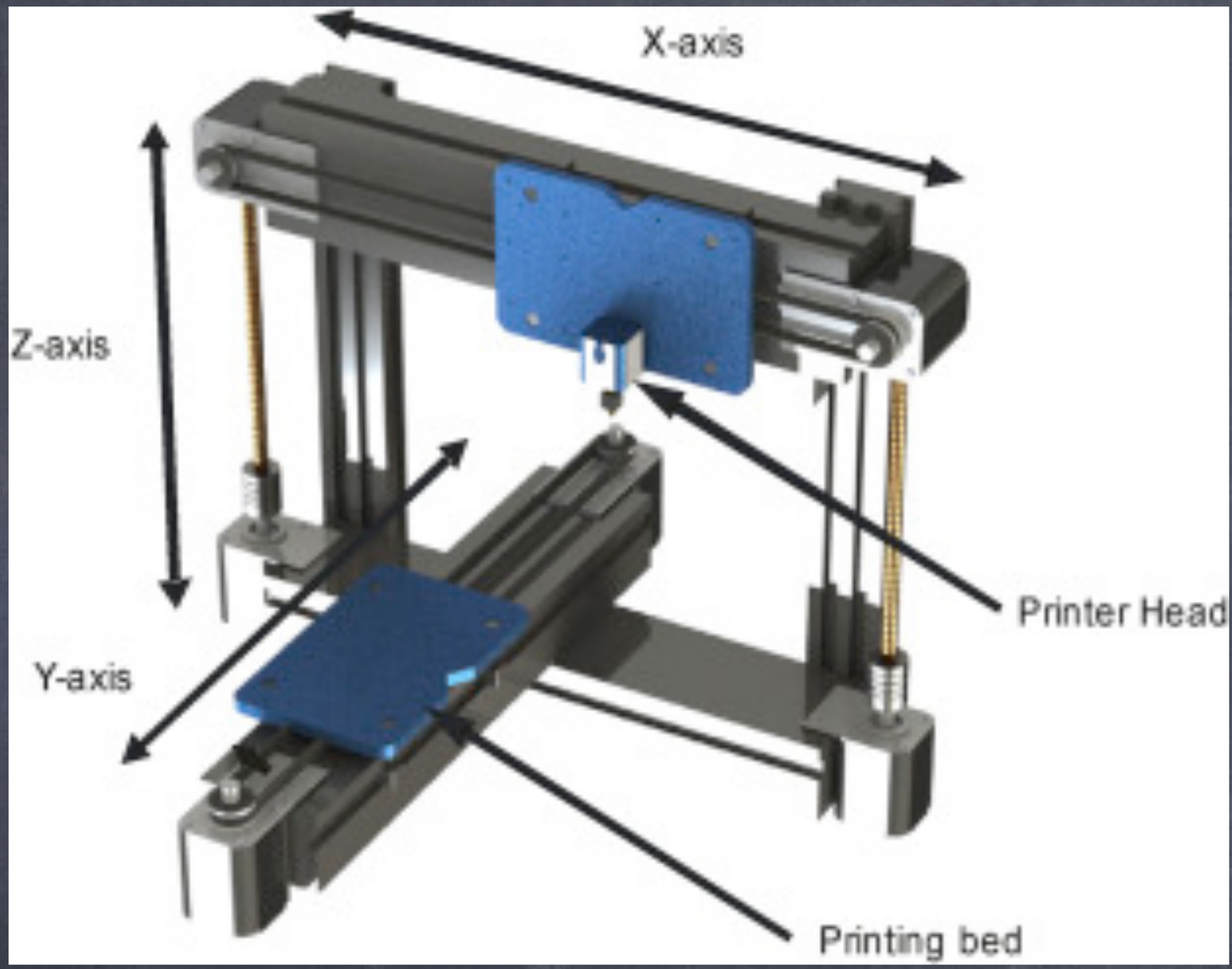
[A]
Bioink spheroids printed into layer of biopaper gel

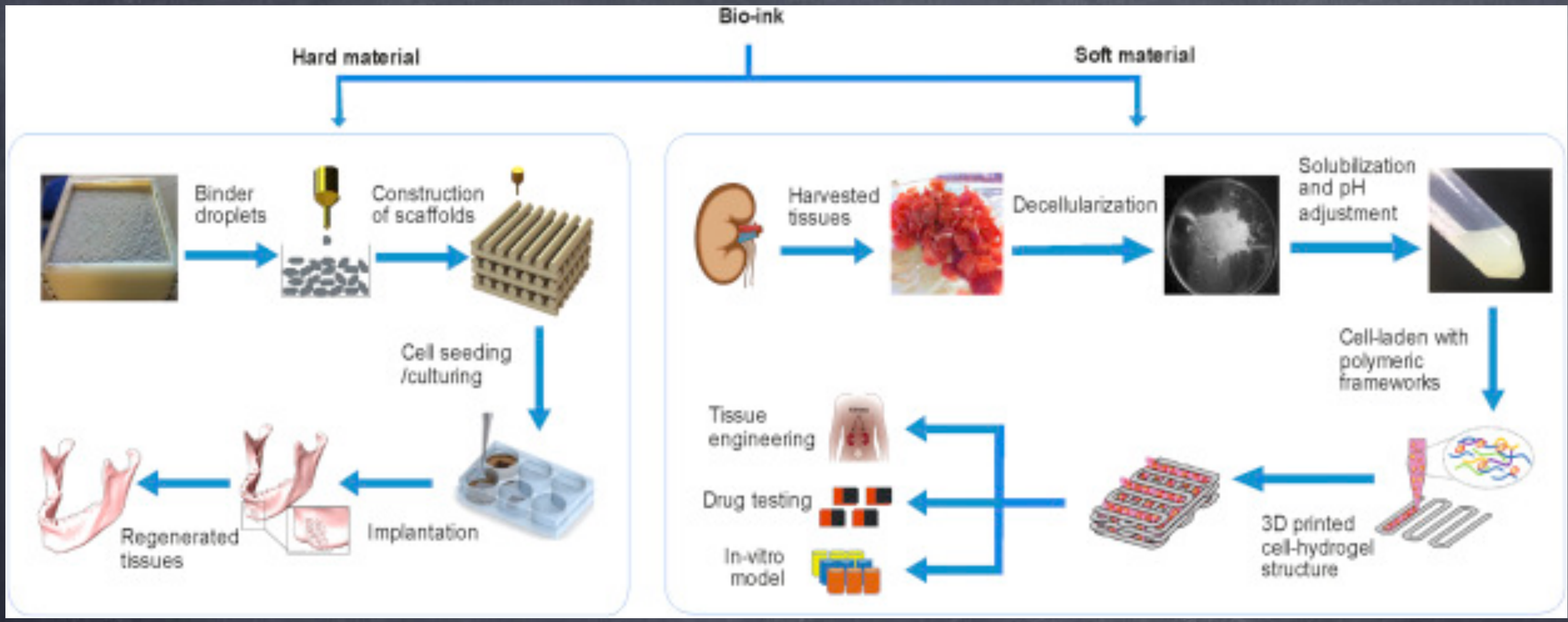
[B]
Additional layers printed to build object

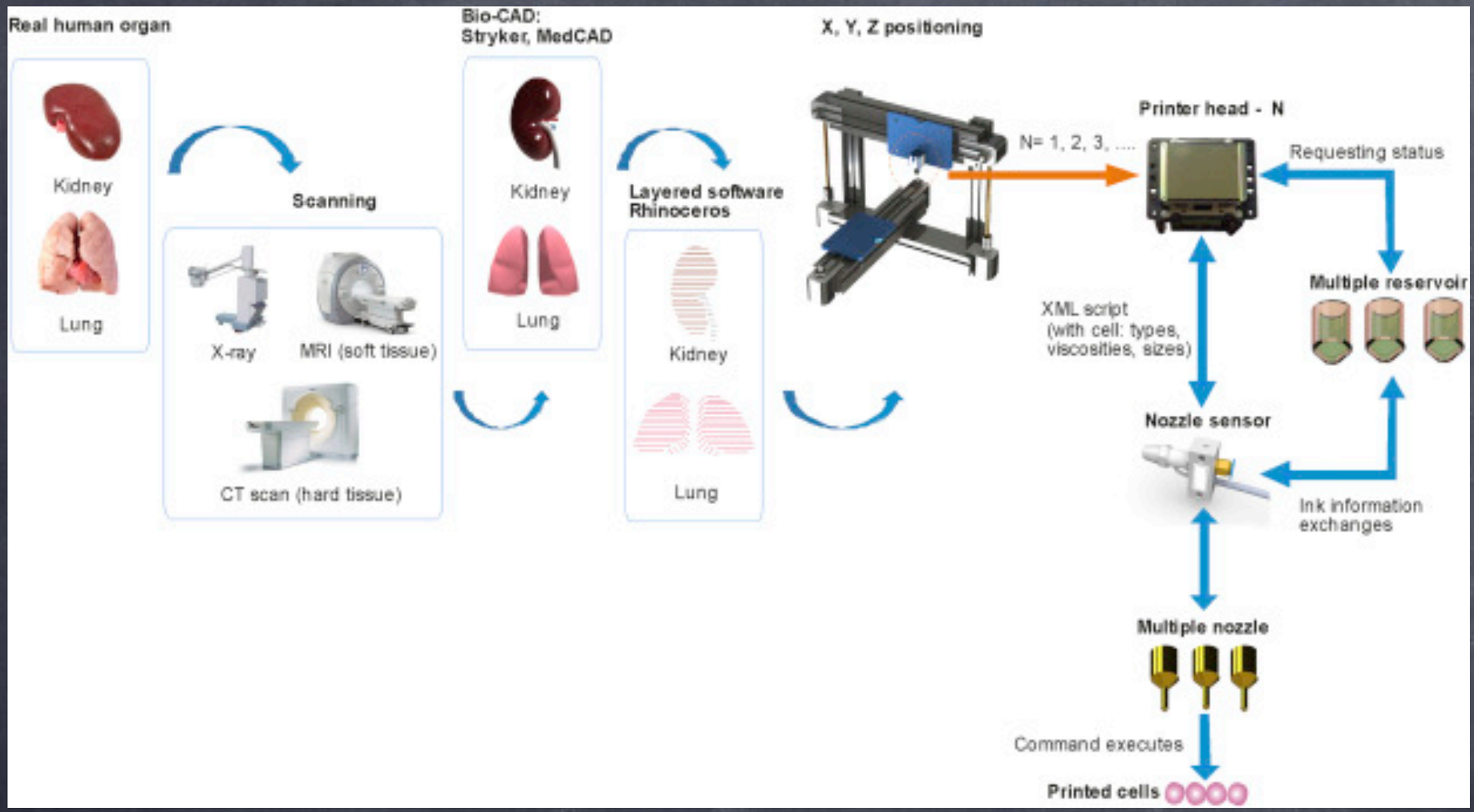
[C]
Bioink spheroids fuse together and biopaper dissolves

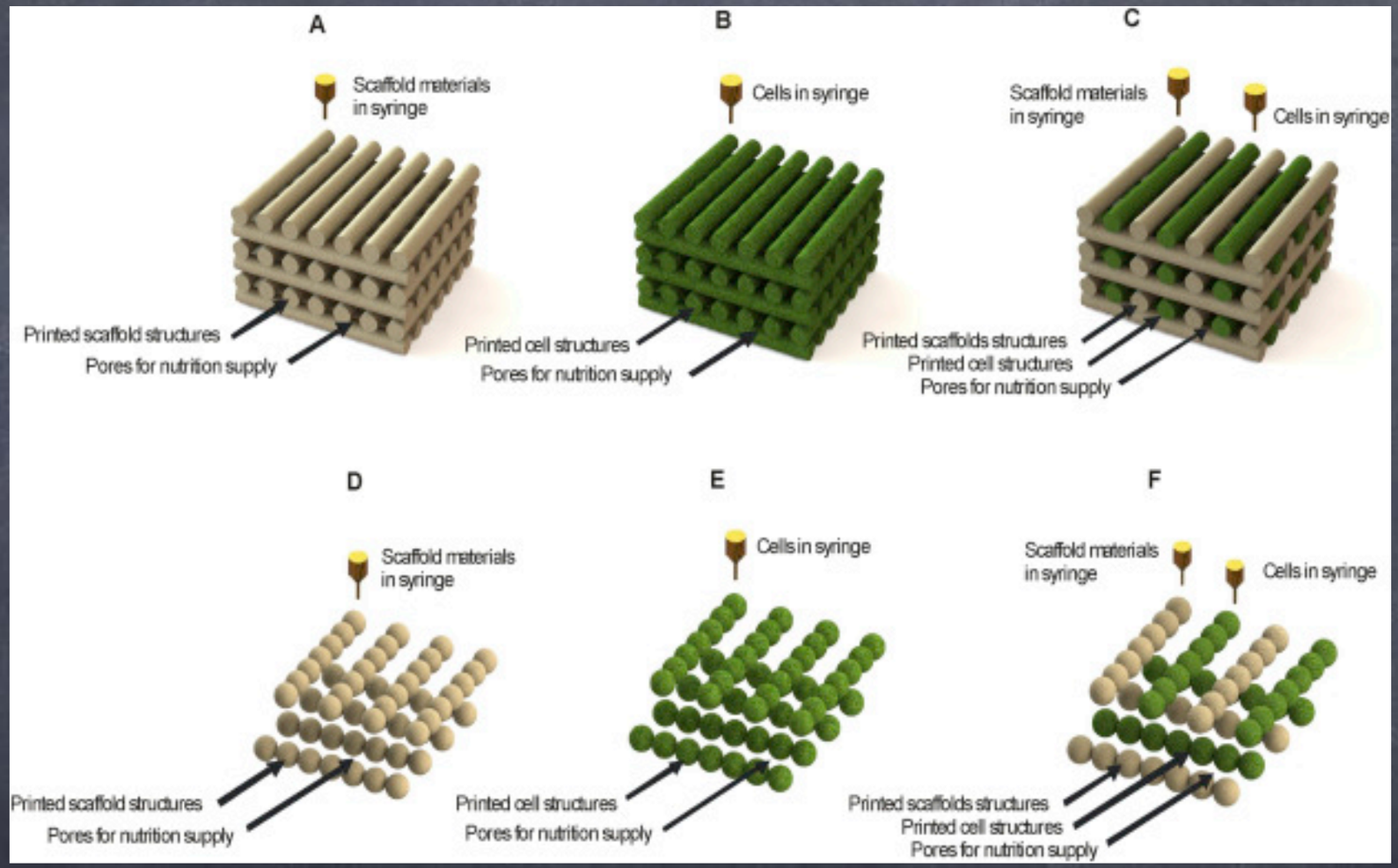
[D]
Final living tissue

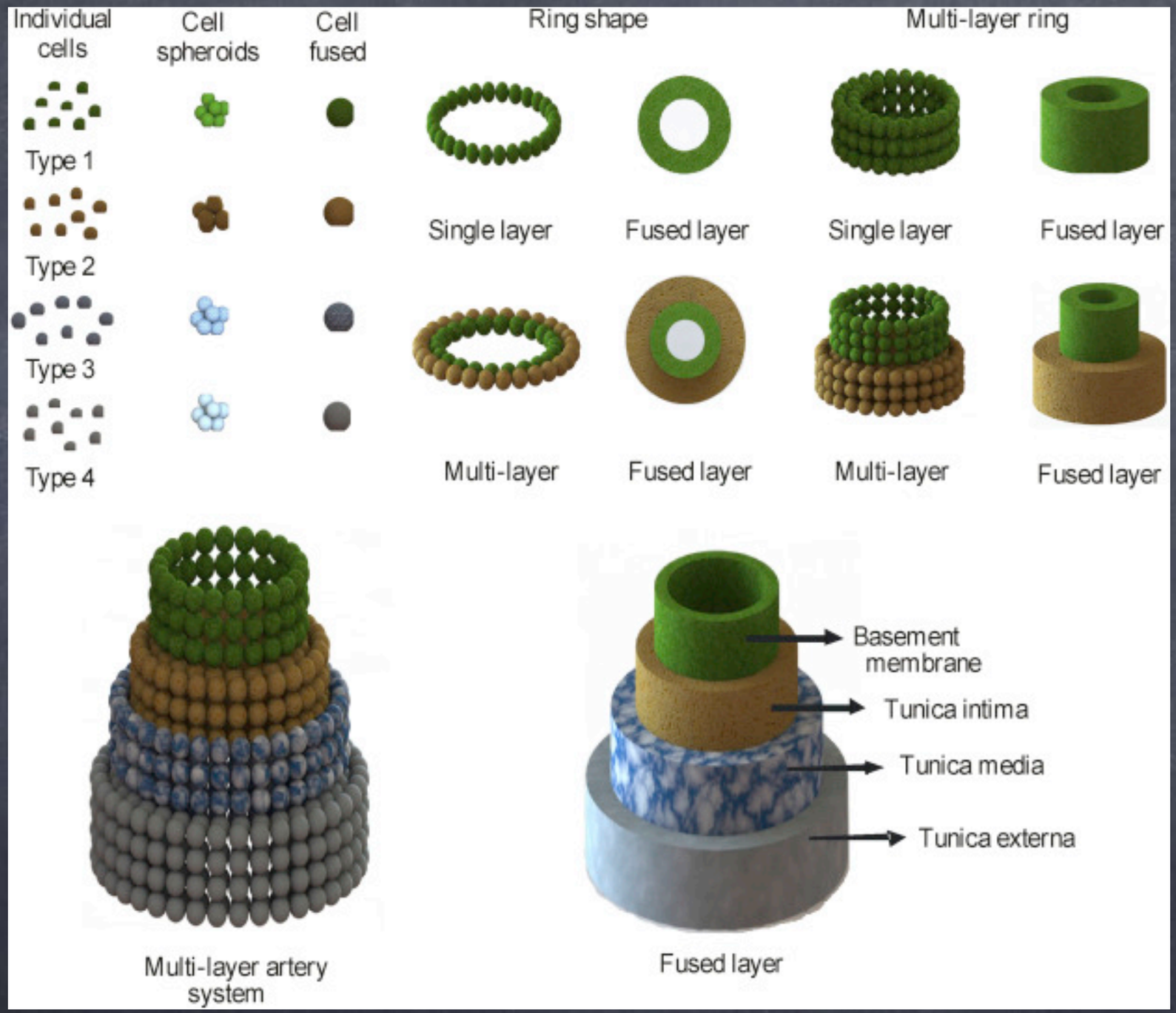



X-axis
Z-axis
Y-axis
Printer Head
Printing bed


Bio-ink
Hard material
Soft material
Binder droplets
Construction of scaffolds
Cell seeding /culturing
Implantation
Regenerated tissues
Harvested tissues
Decellularization
Solubilization and pH adjustment
Cell-laden with polymeric frameworks
3D printed cell-hydrogel structure
Tissue engineering
Drug testing
In-vitro model


Real human organ
Kidney
Lung
Scanning
X-ray
MRI (soft tissue)
CT scan (hard tissue)
Bio-CAD:
Stryker, MedCAD
Kidney
Lung
Layered software
Rhinoceros
Kidney
Lung
X, Y, Z positioning
N= 1, 2, 3, ...
Printer head - N
Requesting status
Multiple reservoir
XML script
(with cell: types,
viscosities, sizes)
Nozzle sensor
Ink information
exchanges
Multiple nozzle
Command executes
Printed cells


A
Scaffold materials in syringe
Printed scaffold structures
Pores for nutrition supply
B
Cells in syringe
Printed cell structures
Pores for nutrition supply
C
Scaffold materials in syringe
Cells in syringe
Printed scaffolds structures
Printed cell structures
Pores for nutrition supply
D
Scaffold materials in syringe
Printed scaffold structures
Pores for nutrition supply
E
Cells in syringe
Printed cell structures
Pores for nutrition supply
F
Scaffold materials in syringe
Cells in syringe
Printed scaffolds structures
Printed cell structures
Pores for nutrition supply


Individual cells
Cell spheroids
Cell fused
Ring shape
Multi-layer ring
Type 1
Type 2
Type 3
Type 4
Single layer
Fused layer
Single layer
Fused layer
Multi-layer
Fused layer
Multi-layer
Fused layer
Multi-layer artery system
Basement membrane
Tunica intima
Tunica media
Tunica externa
Fused layer

TEDX

https://www.ted.com/talks/anthony_atala_printing_a_human_kidney