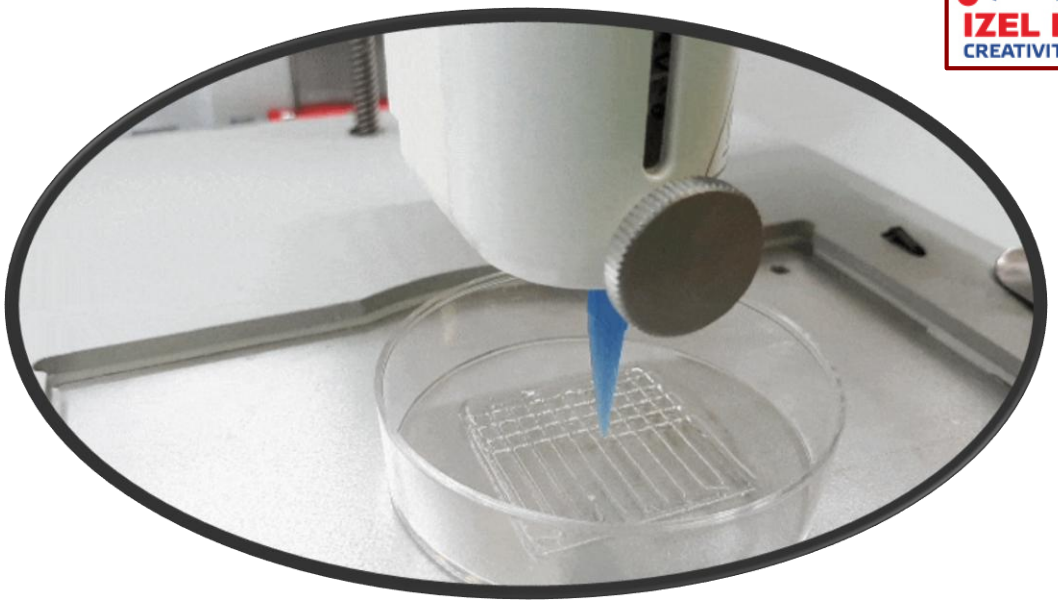
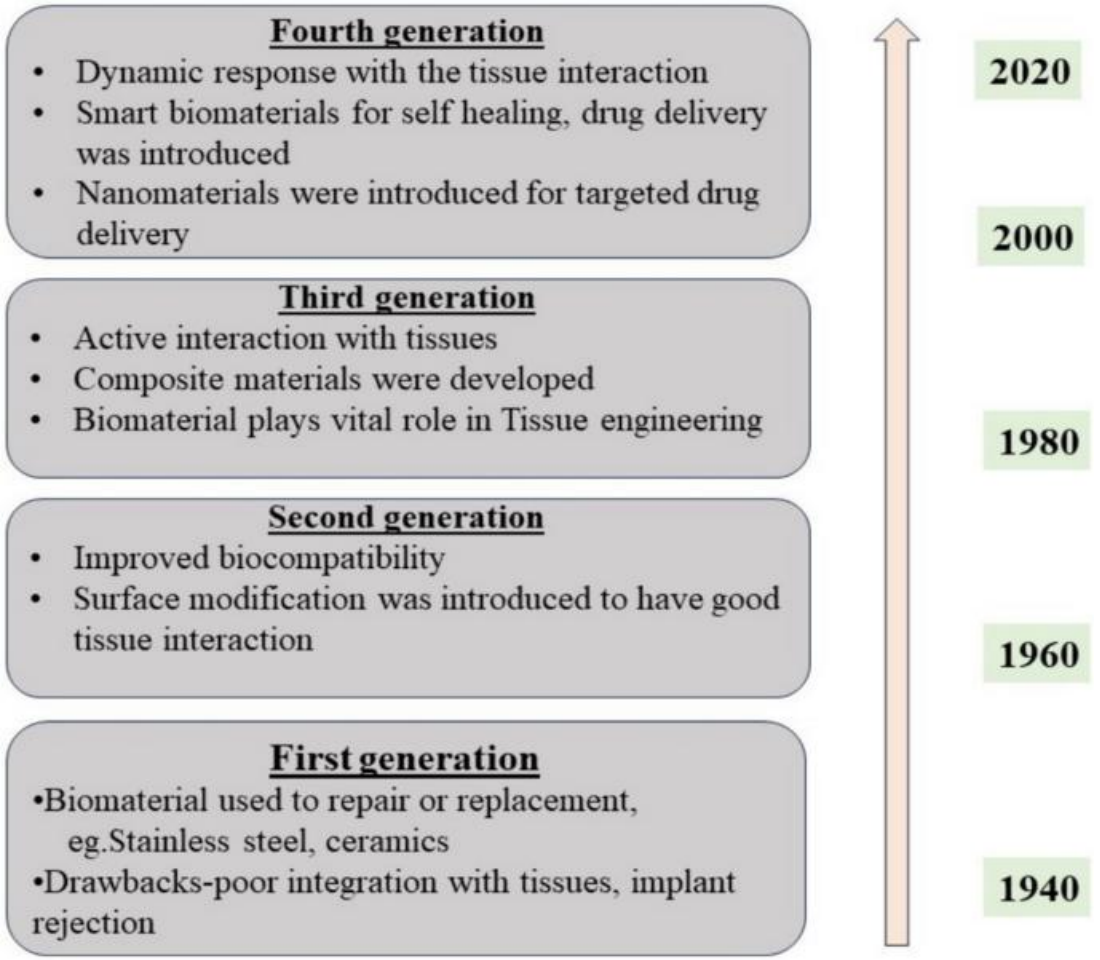
Biomaterials



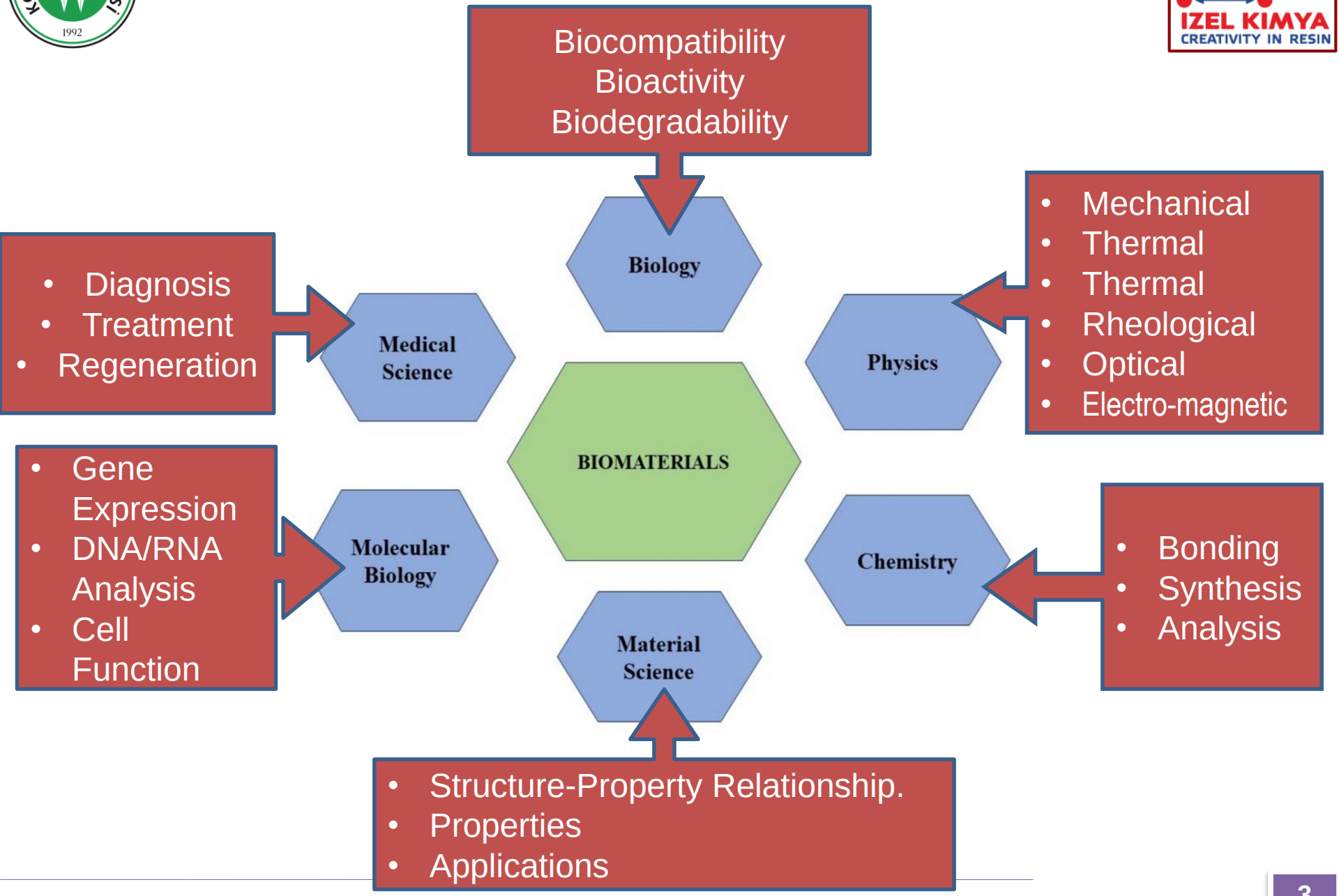
Turdimuhammad Abdullah

Definition of biomaterials

- Implanted within or used in conjunction **with the body**
- Designed to have properties closely **matching that of the biological system**
- Have properties stable enough for the aimed use
- Have appropriate levels of bioactivity and
- partially or completely **fulfill** the functions of the **diseased, damaged or malfunctioning tissues and organs**.



Multidisciplinary



Materials selection

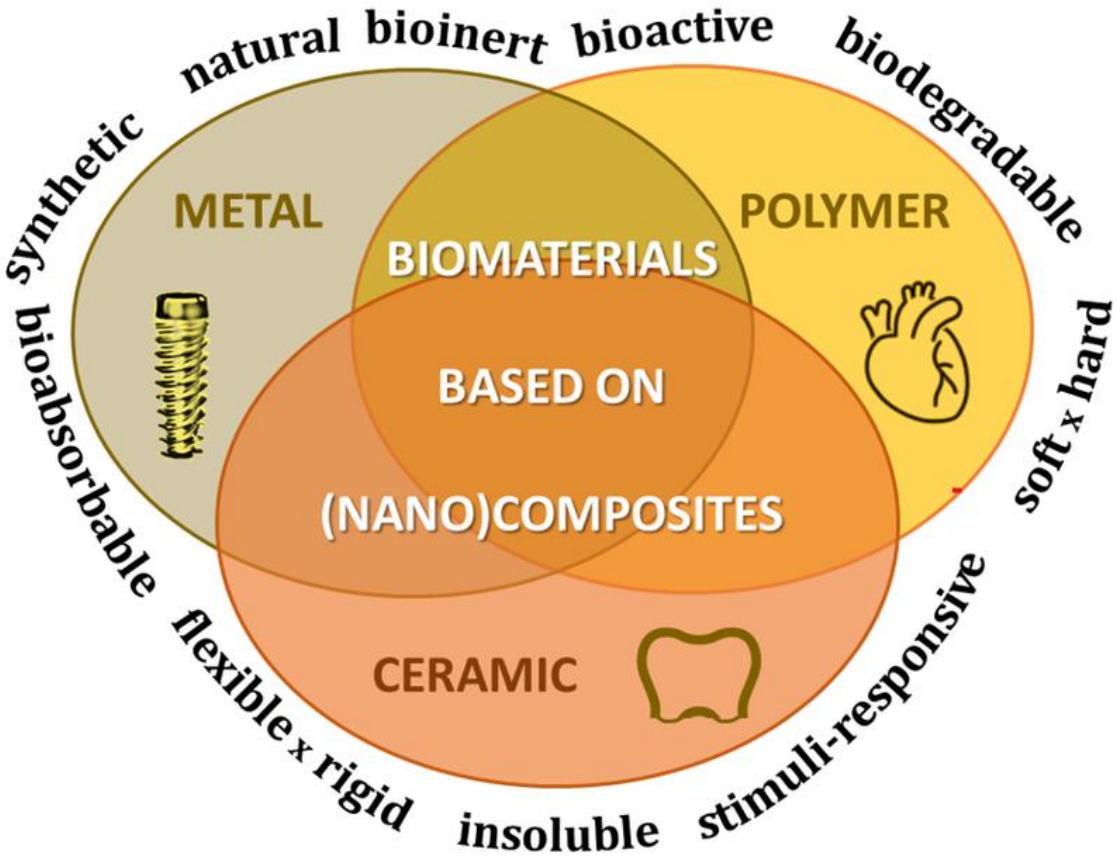
Where to use?

How to use?

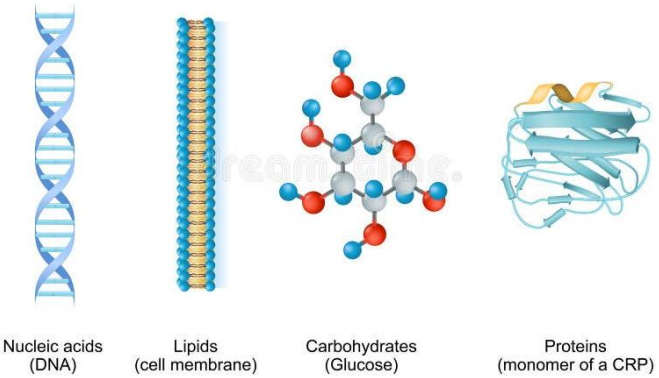
When to use?

What to use?

Why to use?



Polymers



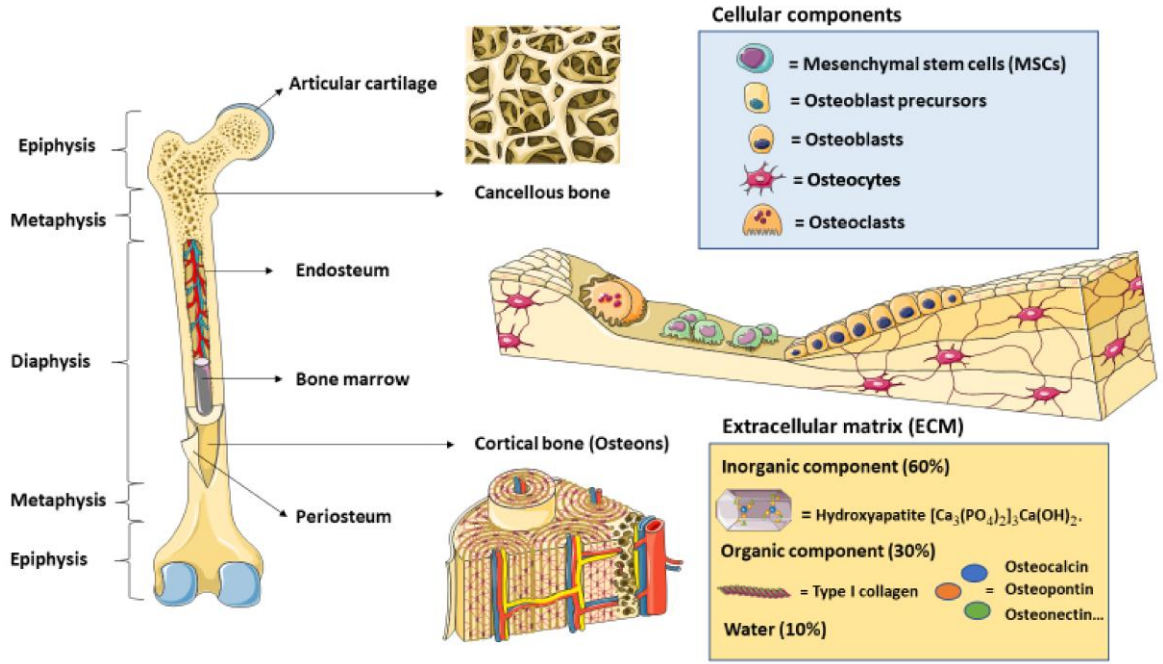
We are made of polymers

We eat polymers

We wear polymers

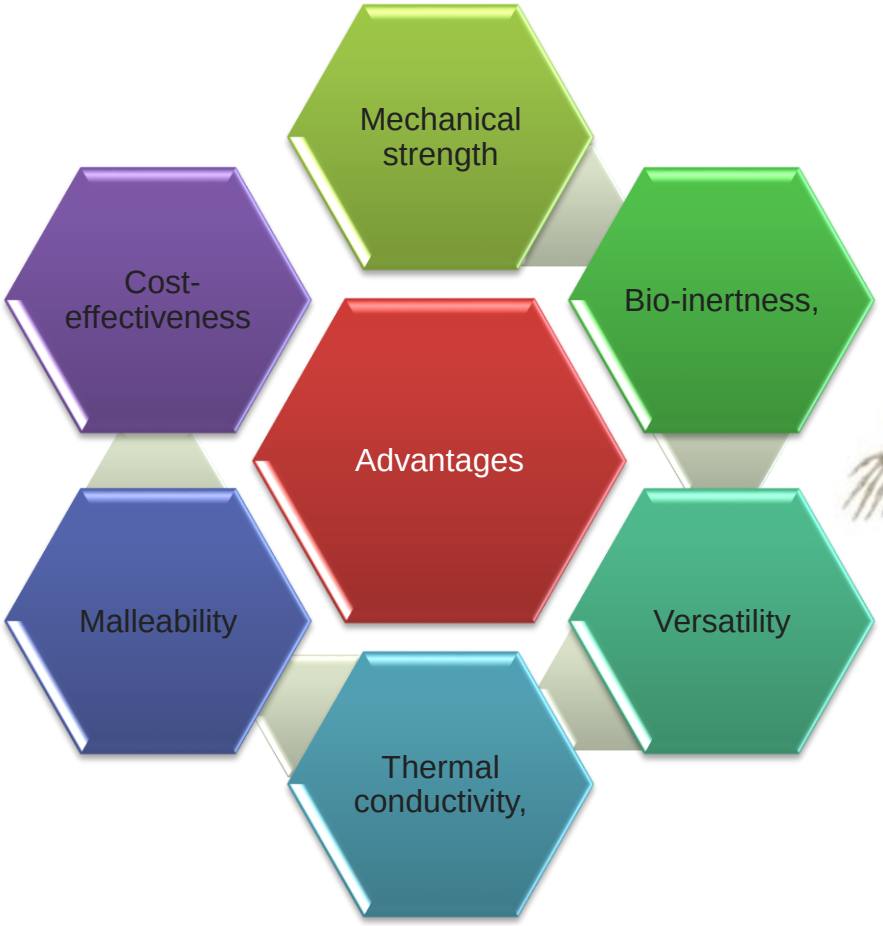
We live with polymers

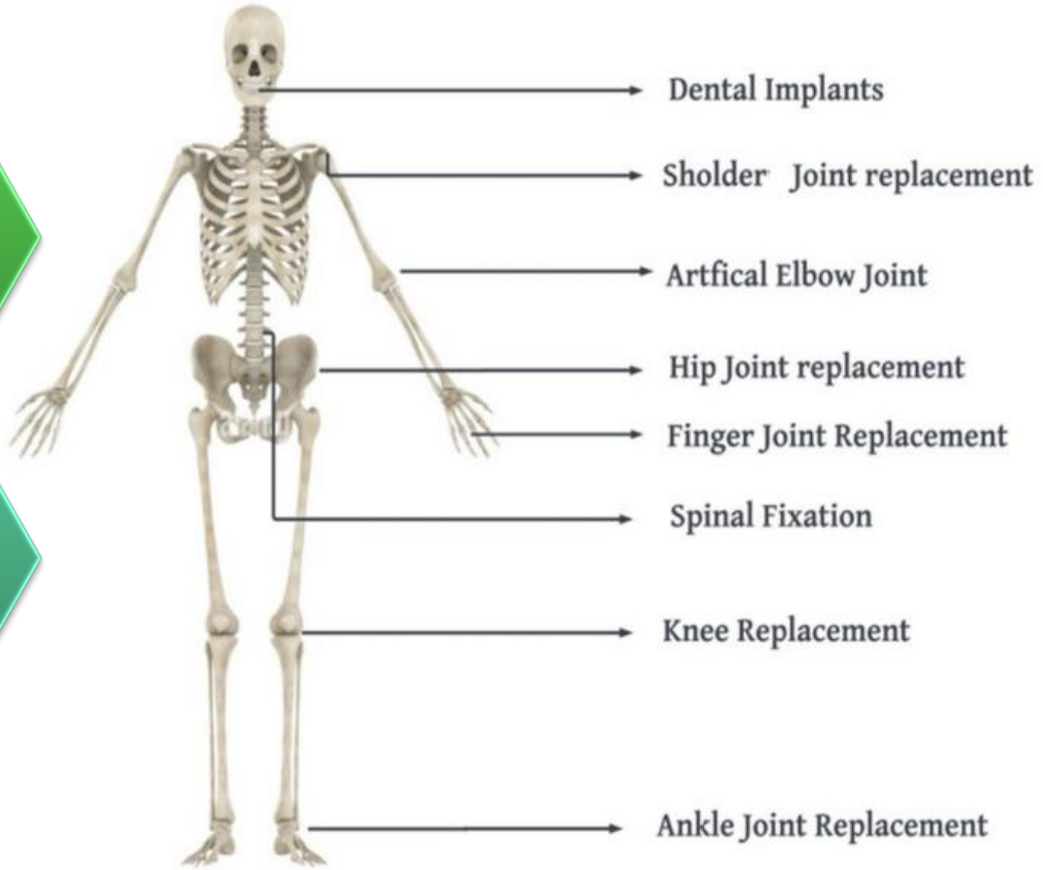
Ceramics



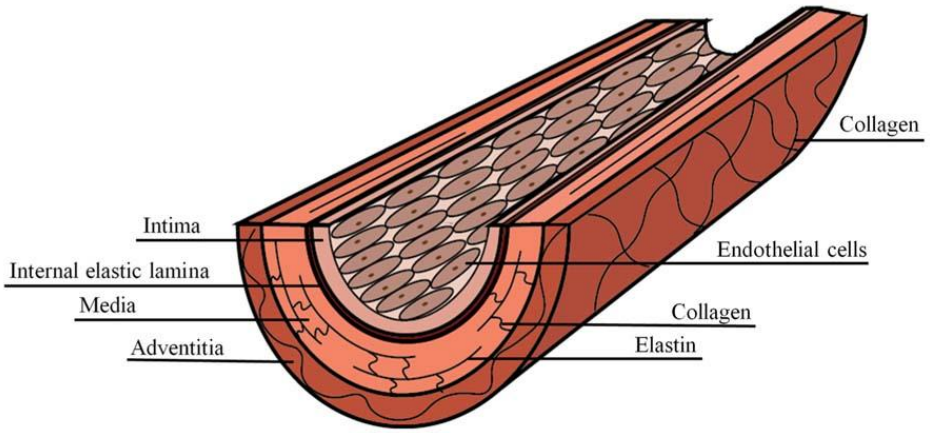
Composition of Bone		Bone Contains
Calcium	39%	99% of the body's calcium
Potassium	0.2%	4% of the body's potassium
Sodium	0.7%	35% of the body's sodium
Magnesium	0.4%	50% of the body's magnesium
Carbonate	9.7%	80% of the body's carbonate
Phosphate	17%	99% of the body's phosphate
Total inorganic components	67%	
Organic compounds (mostly collagen)	33%	

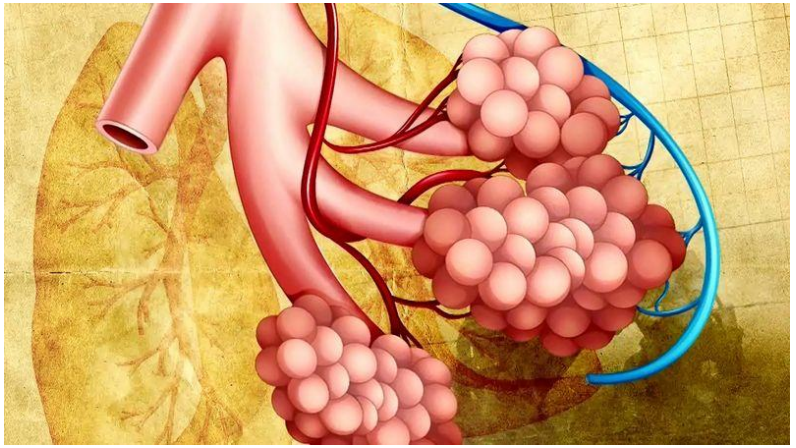
Metals

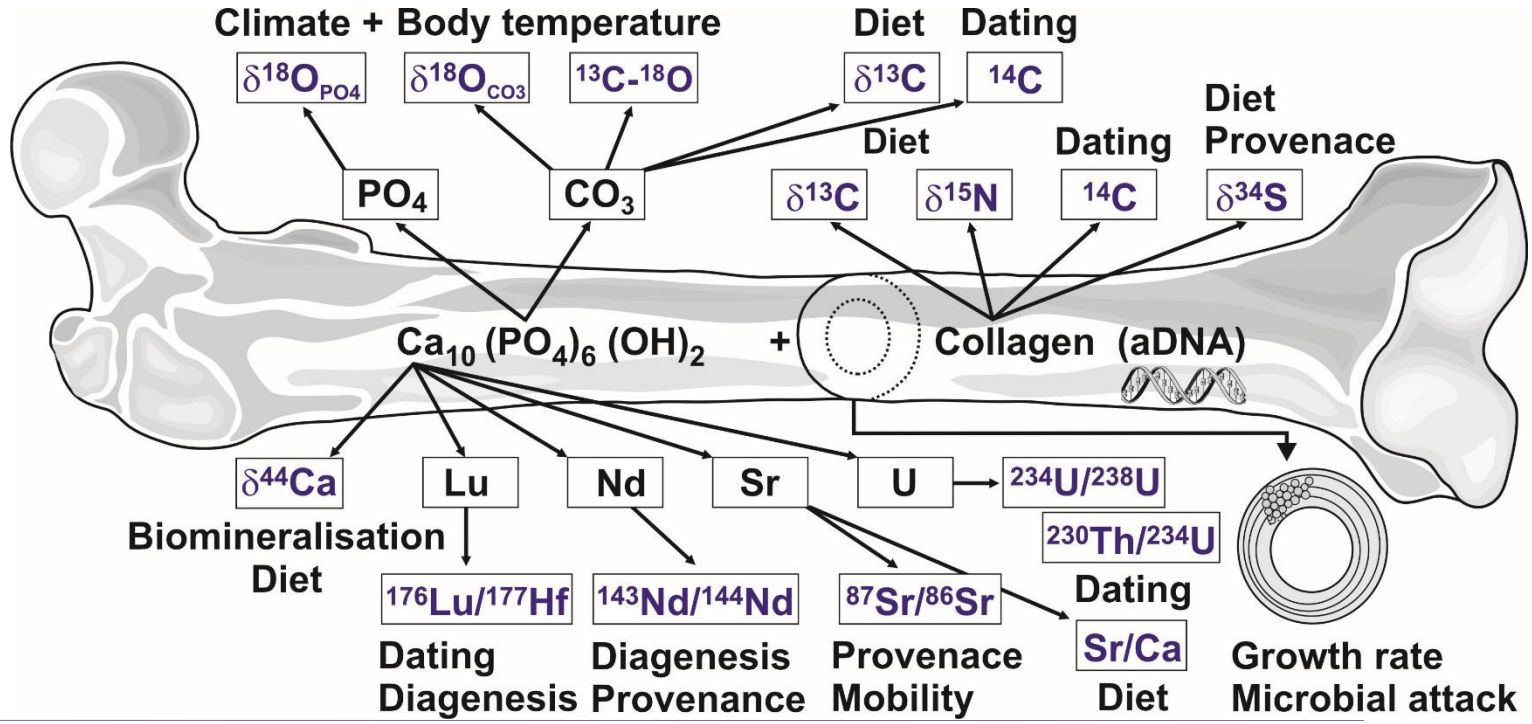

Mechanical strength
Cost-effectiveness
Bio-inertness,
Advantages
Malleability
Versatility
Thermal conductivity,


Dental Implants
Sholder Joint replacement
Artfical Elbow Joint
Hip Joint replacement
Finger Joint Replacement
Spinal Fixation
Knee Replacement
Ankle Joint Replacement

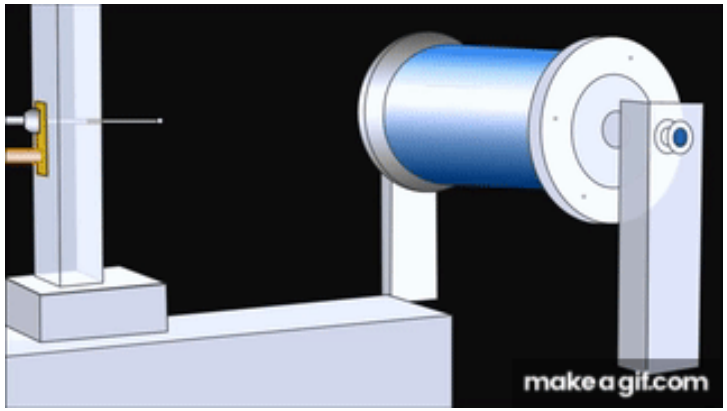
Composites

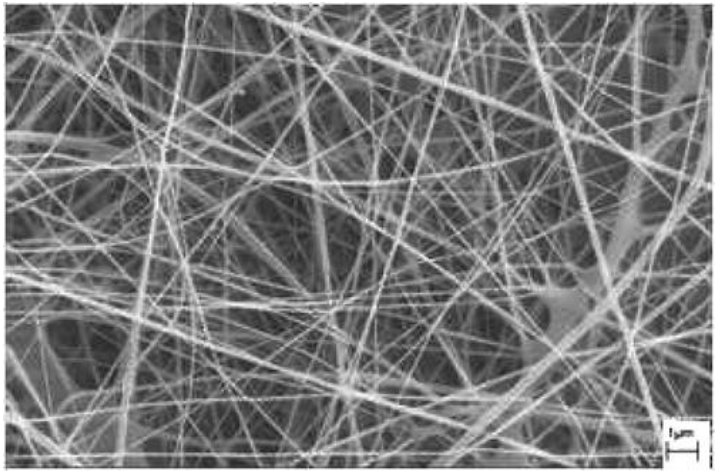

Collagen
Intima
Endothelial cells
Internal elastic lamina
Media
Collagen
Adventitia
Elastin



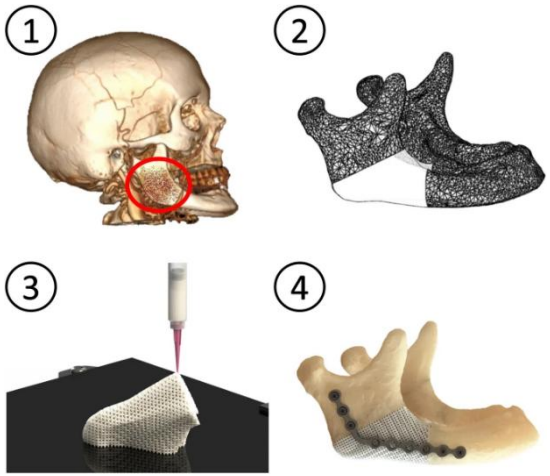

Climate + Body temperature
Diet
Dating
δ18OPO4
δ18OCO3
13C-18O
δ13C
14C
Diet
Dating
Diet Provenace
PO4
CO3
δ13C
δ15N
14C
δ34S
Ca10 (PO4)6 (OH)2
+
Collagen (aDNA)
δ44Ca
Lu
Nd
Sr
U
234U/238U
230Th/234U
Biomineralisation
Diet
176Lu/177Hf
143Nd/144Nd
87Sr/86Sr
Dating
Sr/Ca
Dating
Diagenesis
Diagenesis
Provenance
Provenace
Mobility
Diet
Growth rate
Microbial attack

Electrospinning

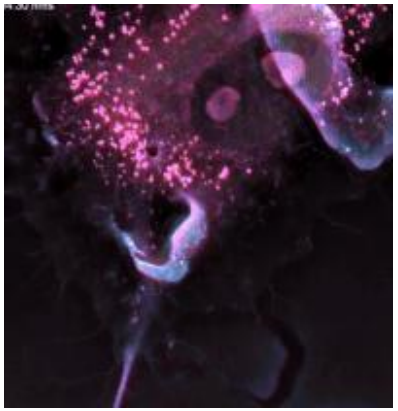


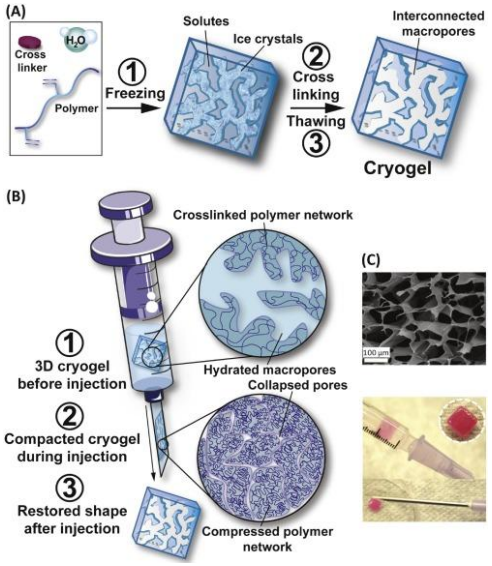


3D printing

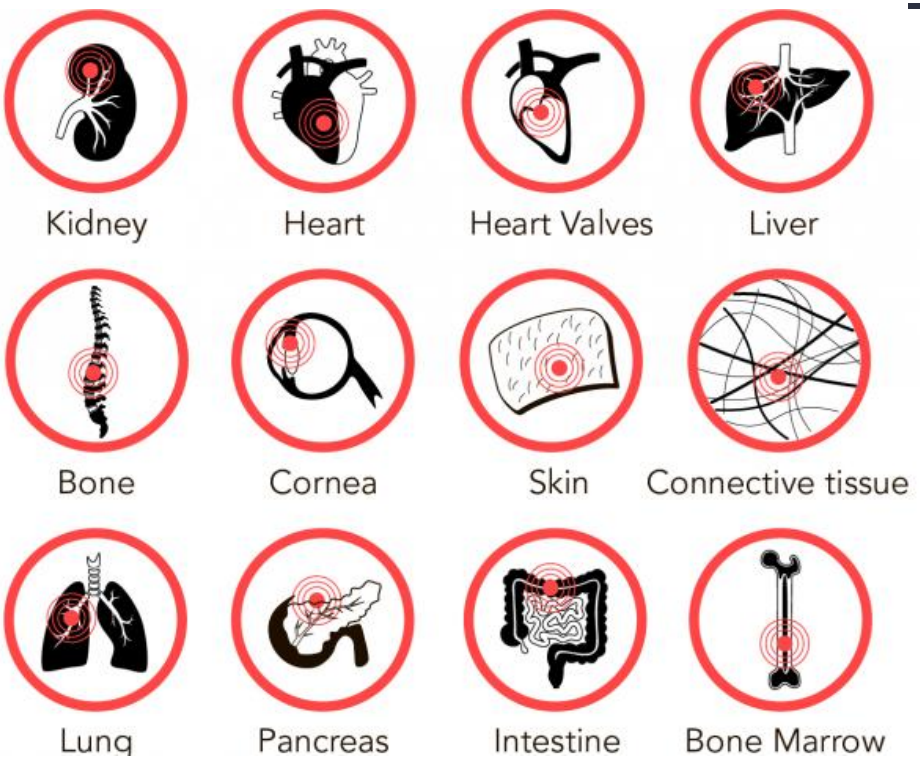


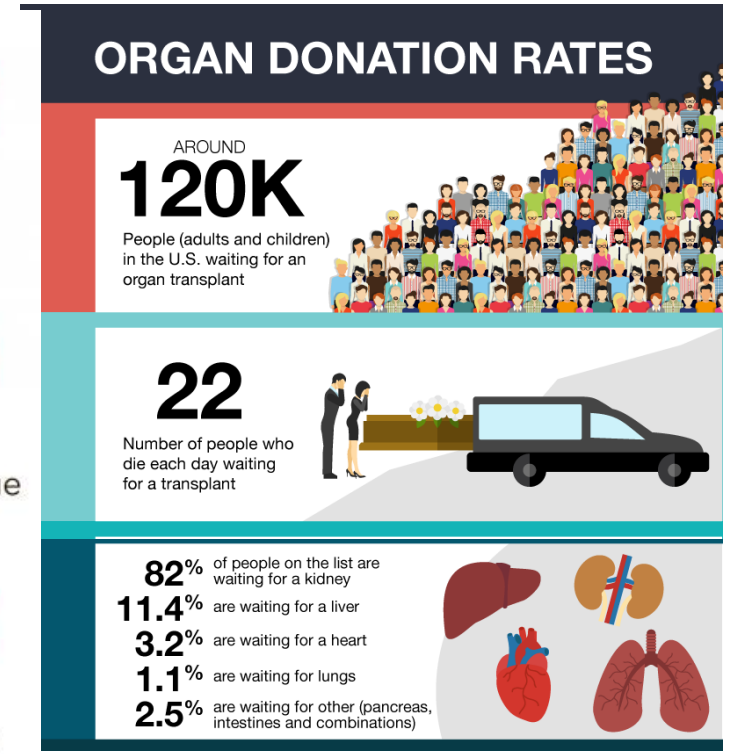
Hydrogels

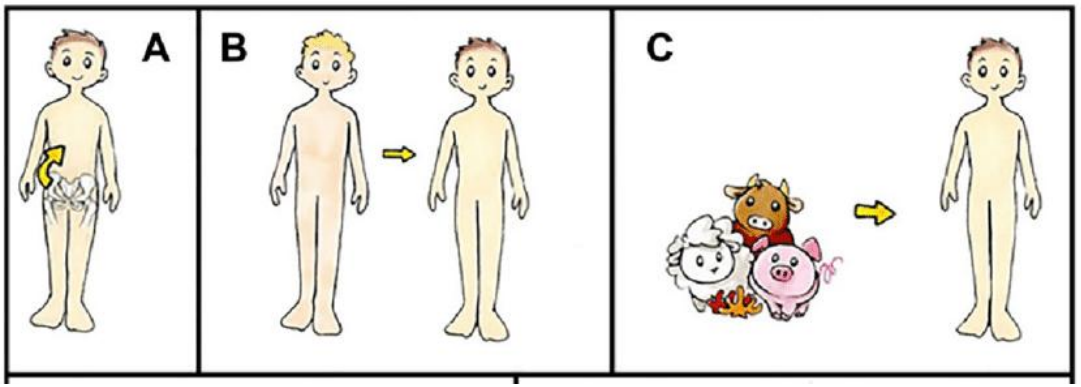


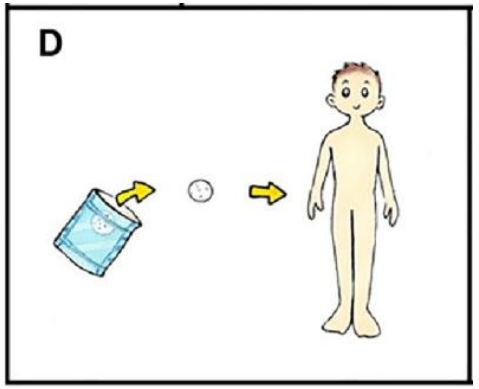


Biomaterials and implants

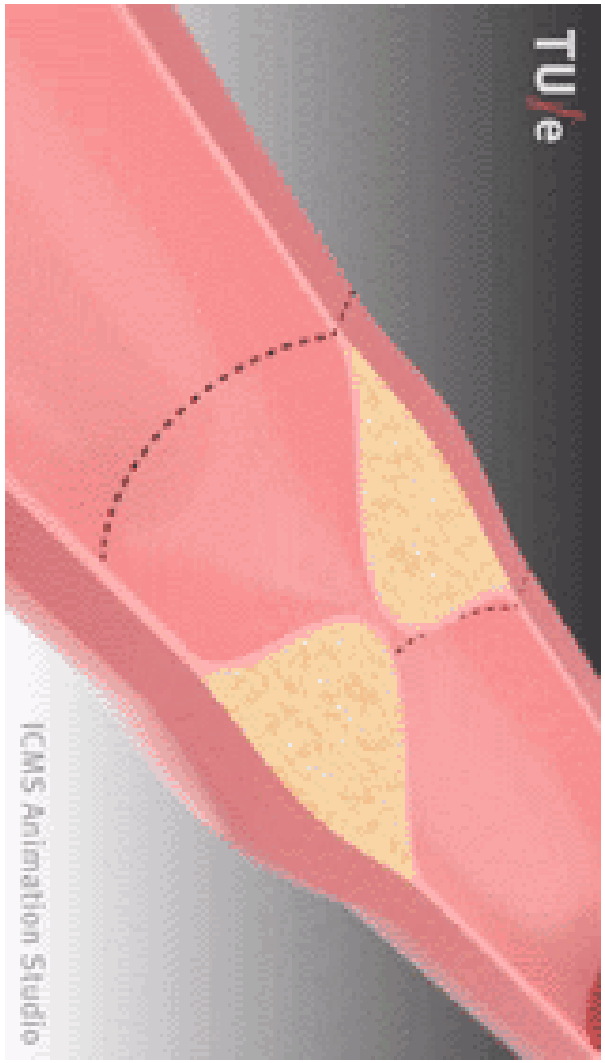


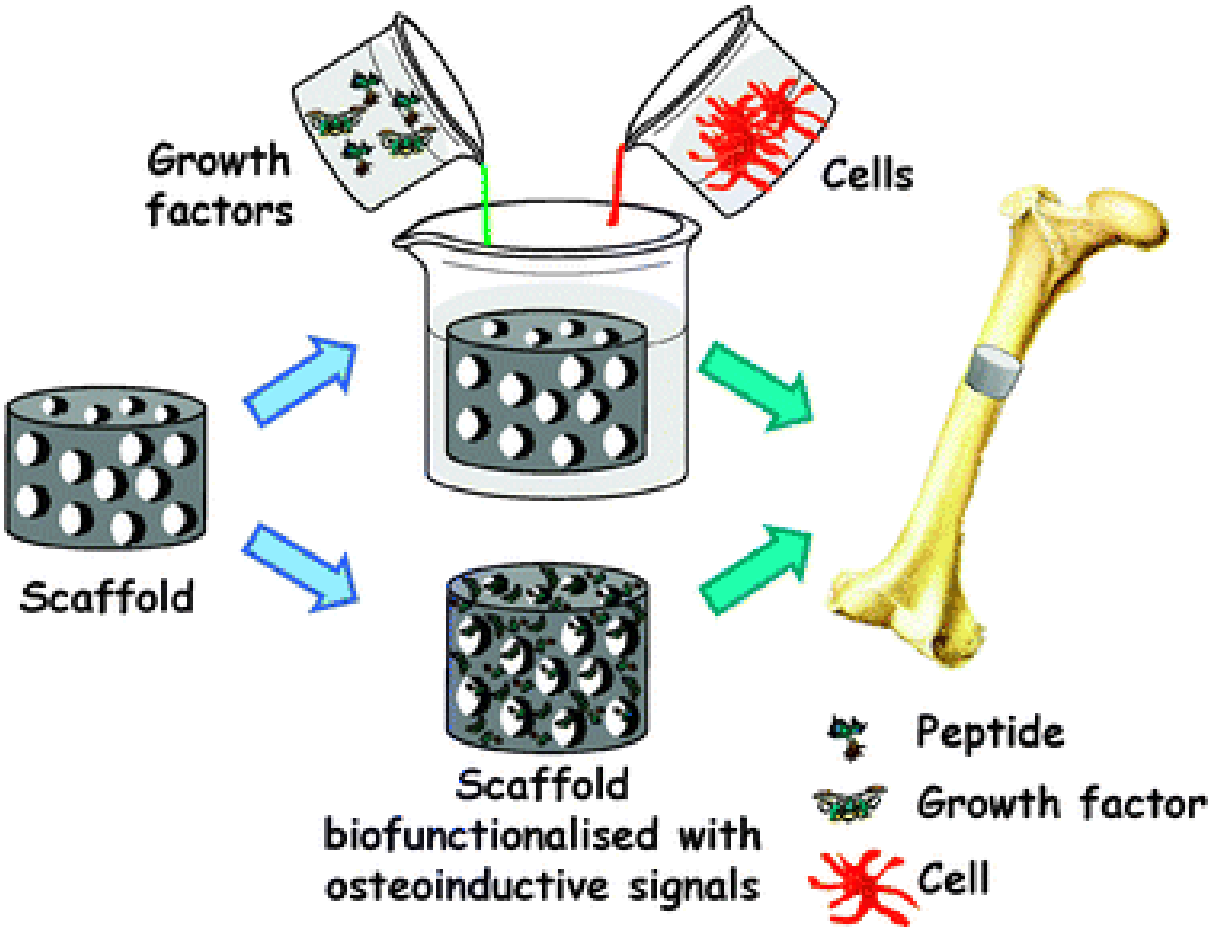






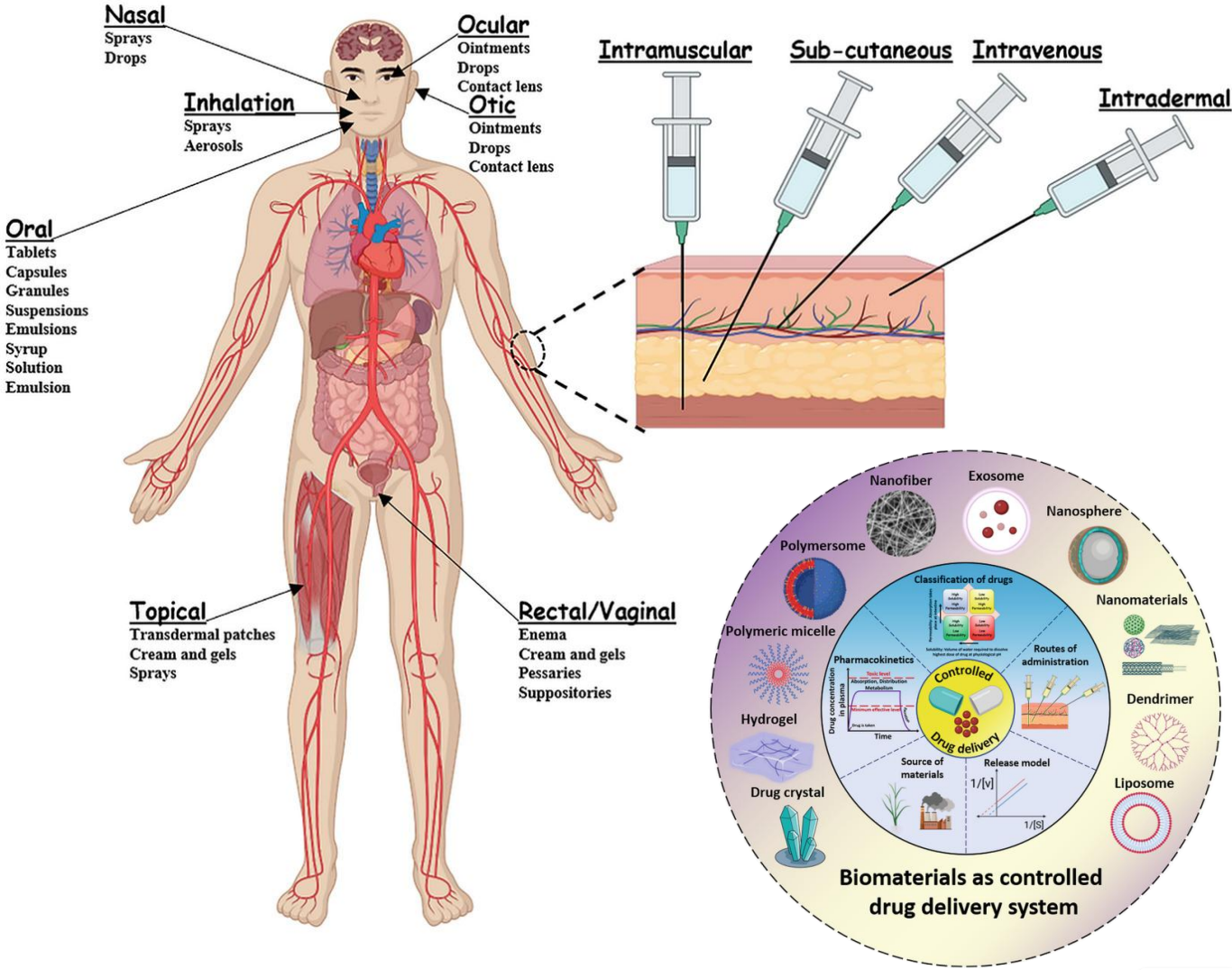
Biomaterials and tissue engineering





Biomaterials and drug delivery

- Controlled Release.
- Targeted Delivery.
- Biodegrada-bility
- Enhanced Solubility
- Protection of Drugs
- Drug-Eluting Implants

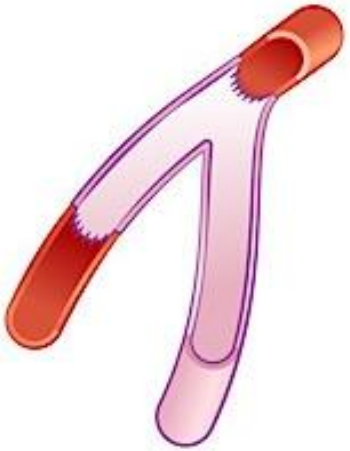


Biomaterials and medical device

Joint Replacements

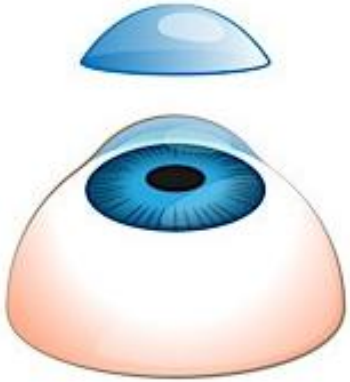
Hip Replacements

Heart Valves

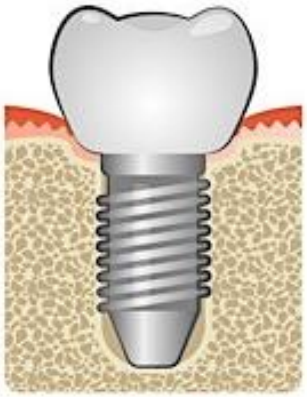


Blood Vessel Prosthesis

Cochlear Replacements



Contact Lenses

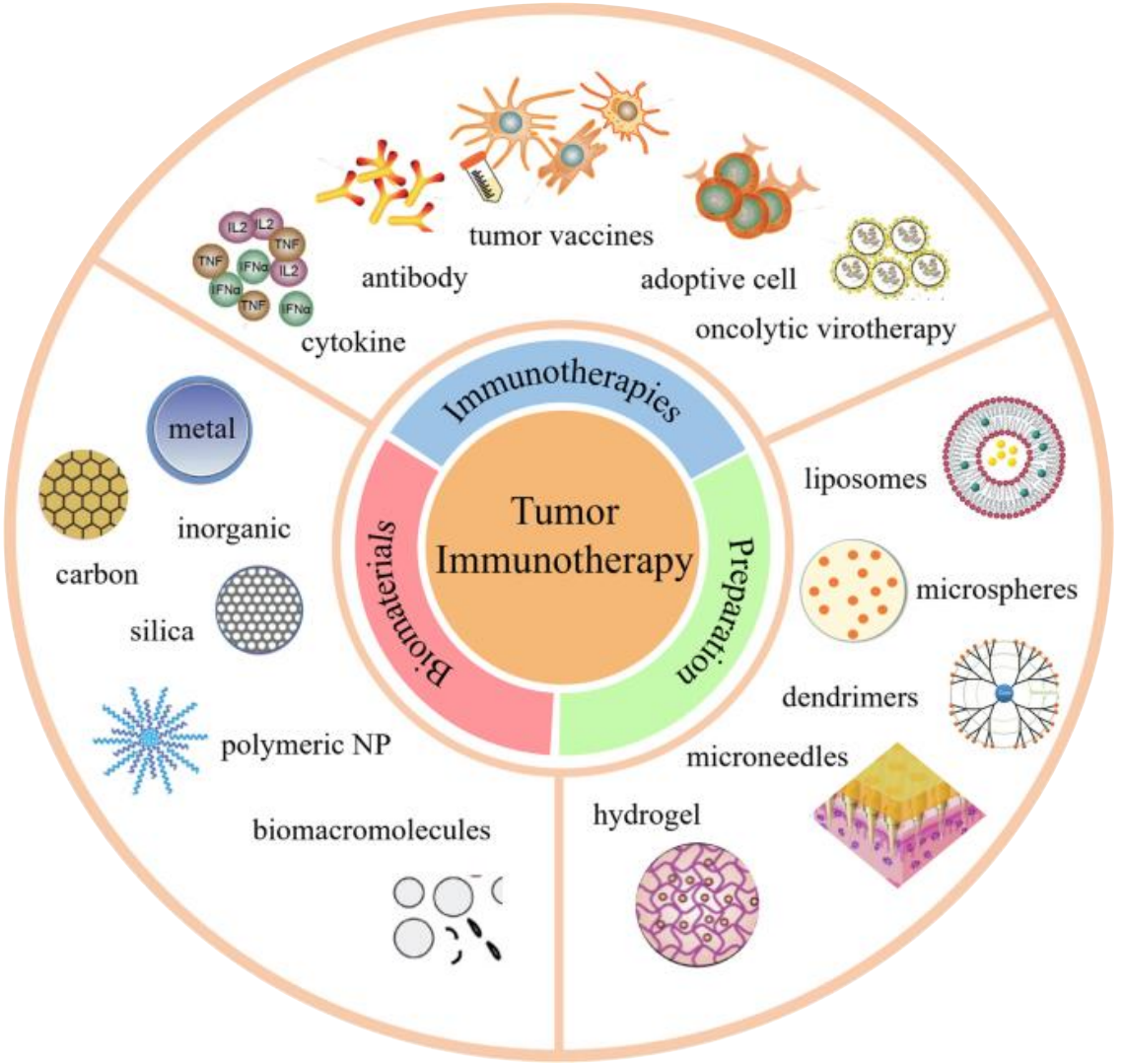


Dental Implants

Skin Repair Devices

Biomaterials and Immune therapy

- **Biomaterials can be engineered to enhance or suppress immune responses.**
- **They can be designed to deliver immunotherapies.**
- **They can provide scaffolding for immune cells to grow, differentiate, and function**



Biomaterials and Biosensors

Biocompatible Substrates

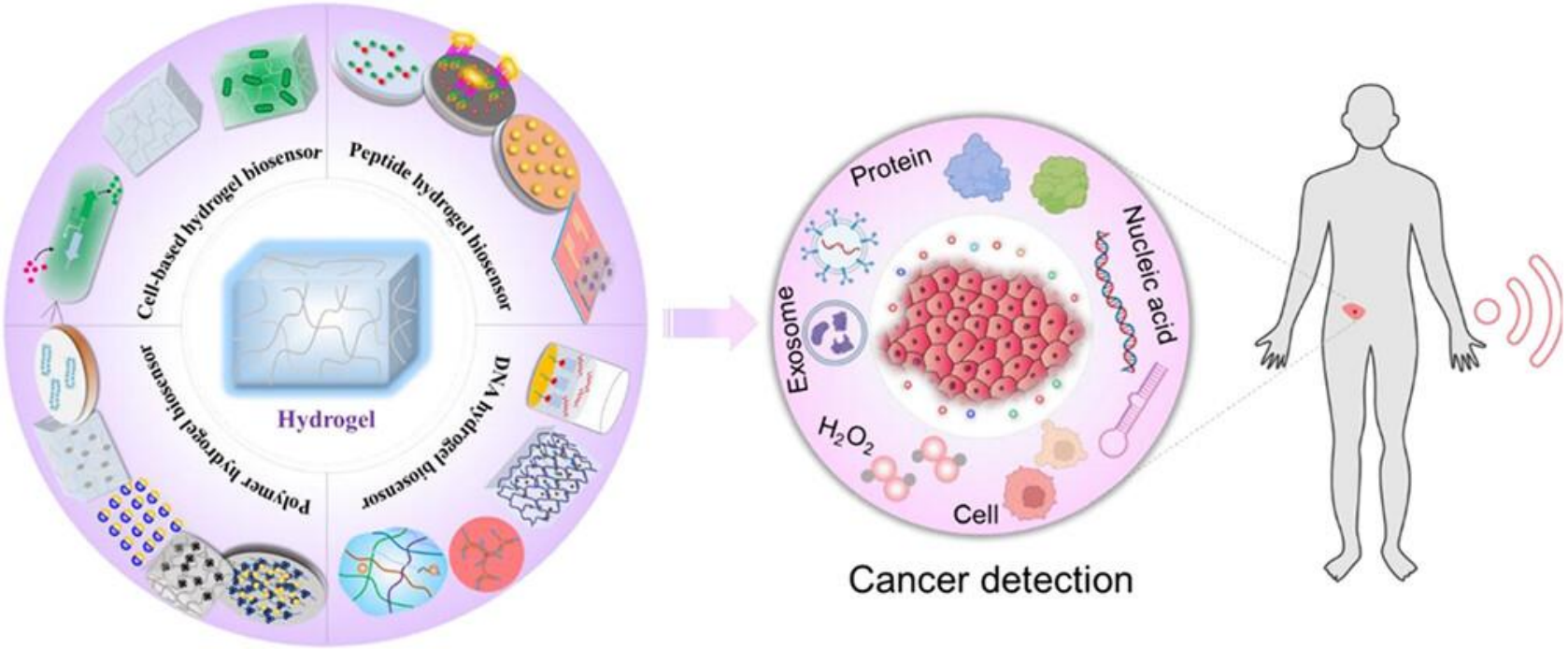
Signal Transduction

Wearable Sensors

Cellular Sensing

Targeted Biosensors

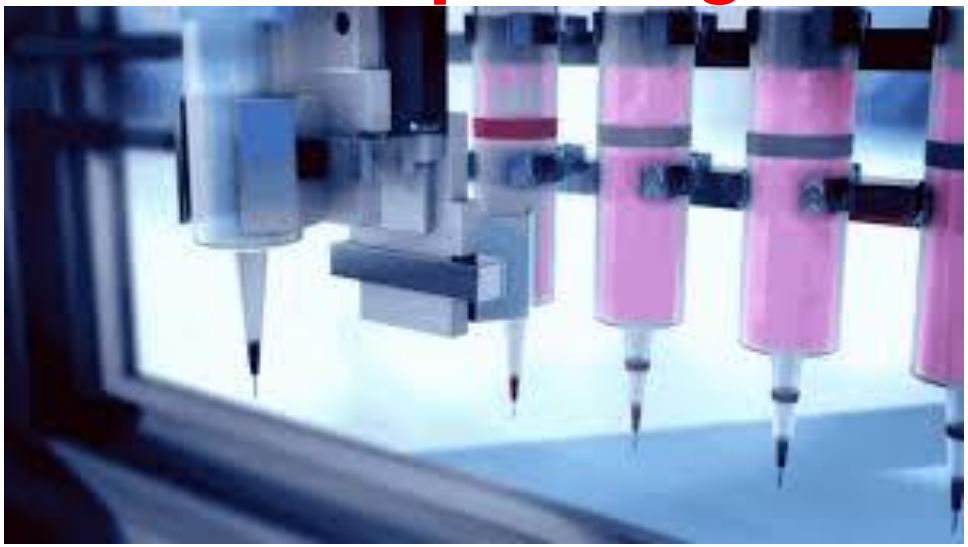
Enzyme Stabilization



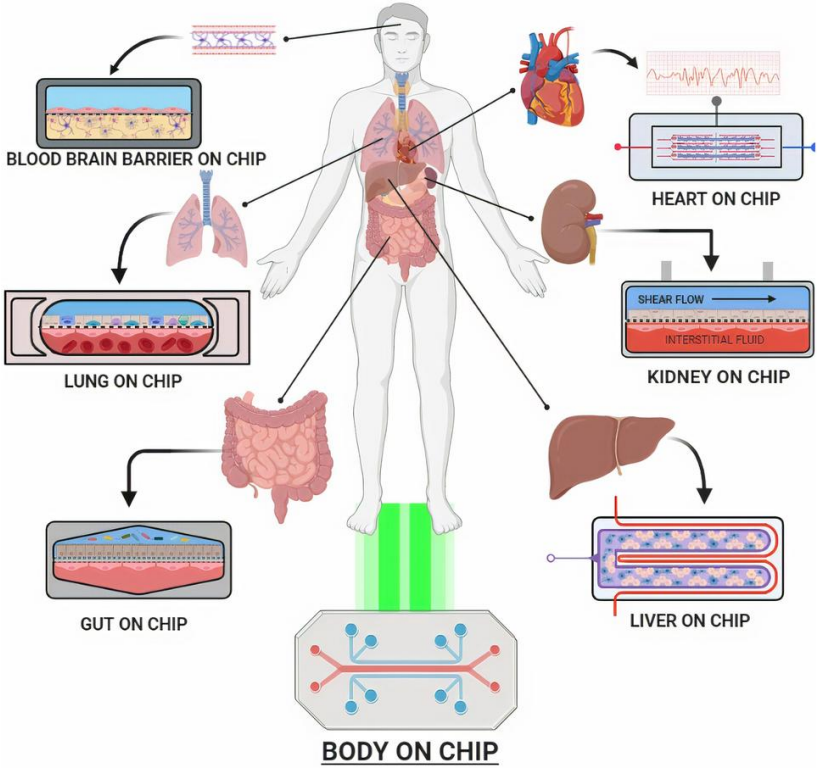
Hydrogel-based biosensor

Trends in Biomaterials

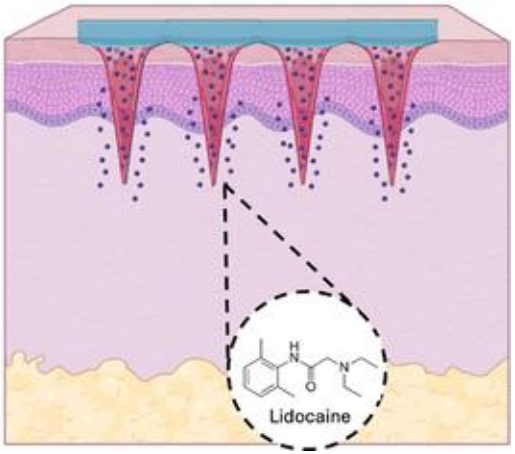
Bioprinting



Organ on chip

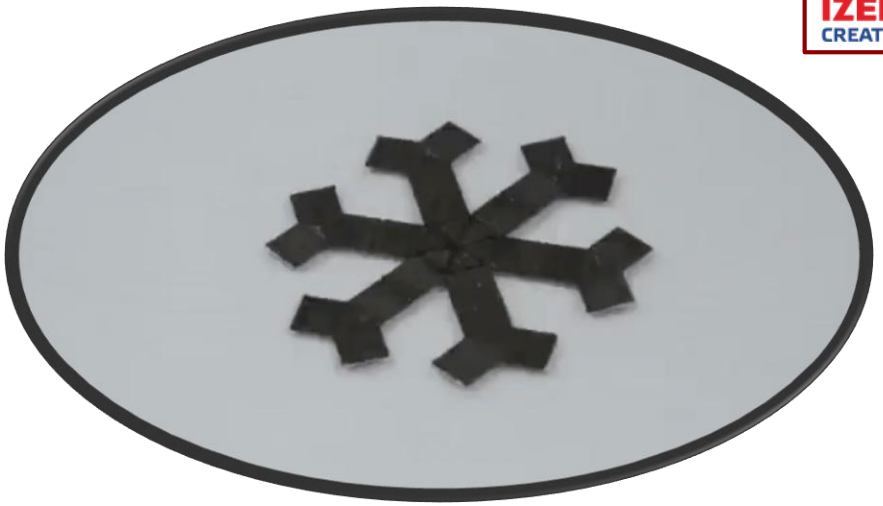


Microneedles



Trends in Biomaterials

Smart materials and 4D printing



Multifunctional biomaterials