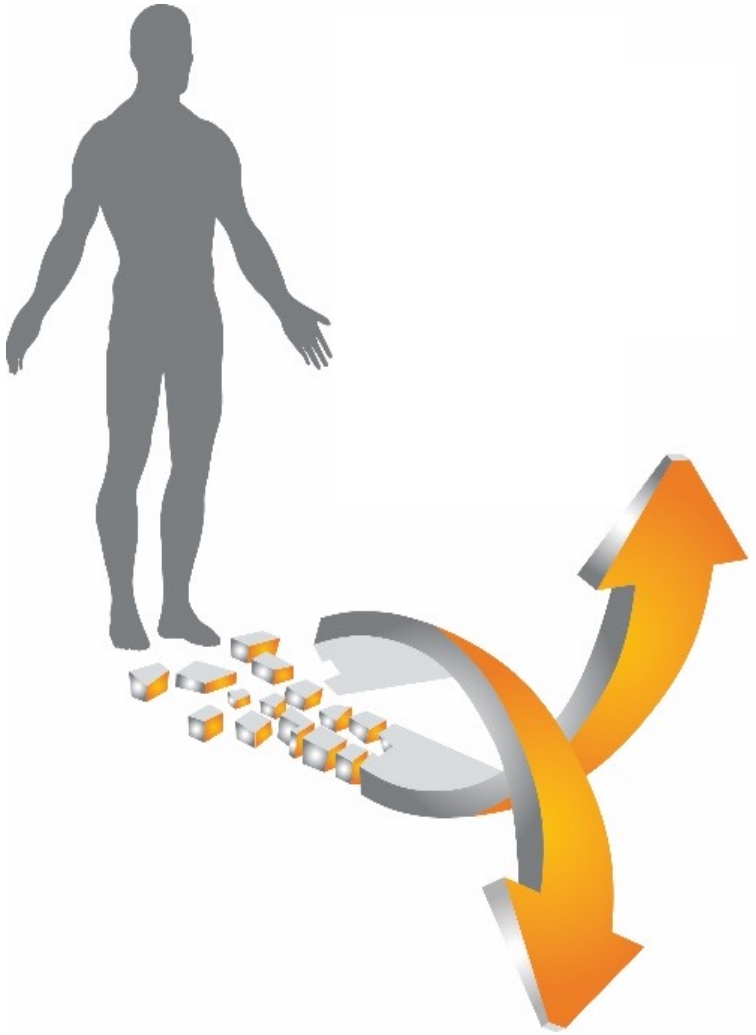
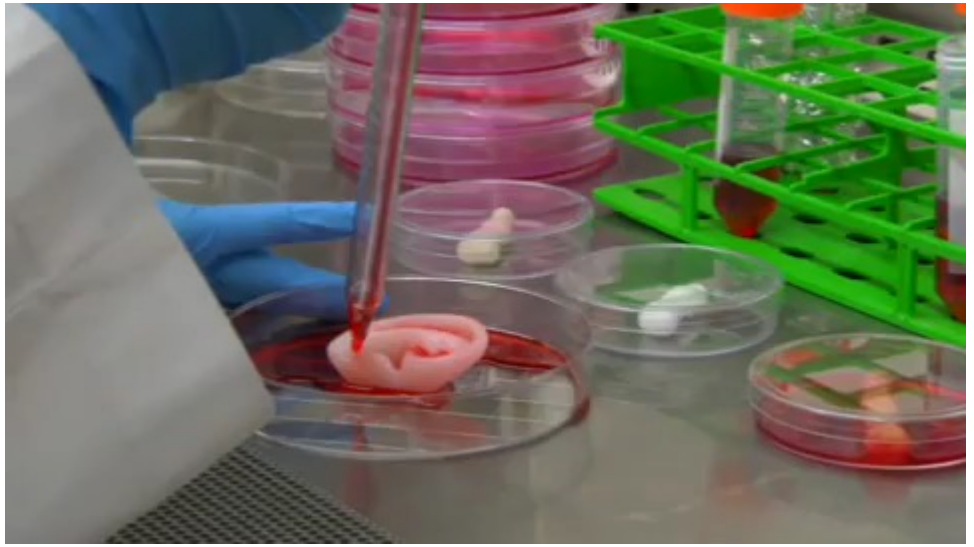


Tissue Engineering: an overview

REGENERATIVE MEDICINE and TISSUE ENGINEERING



http://www.ndep.us/Building-Body-Parts

REGENERATIVE MEDICINE…Nature teaches

http://www.ndep.us/Building-Body-Parts

MEDICINA RIGENERATIVA

disciplina innovativa, che si propone di **riparare organi adulti danneggiati** con l'intento di restituire loro l'integrità strutturale e funzionale dell'organo sano

.

Il traguardo che la medicina rigenerativa si prefigge può essere raggiunto attraverso:

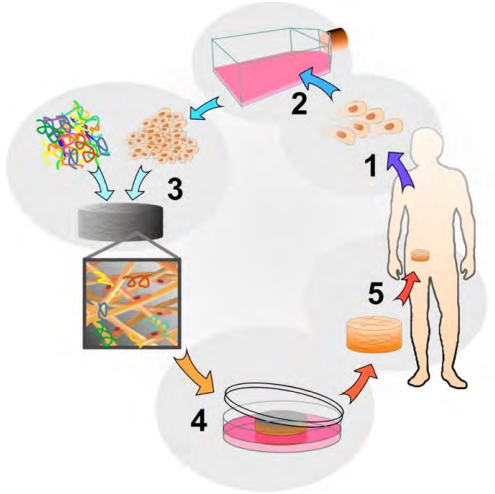
•l'identificazione delle cellule che meglio di altre possono sostituire le cellule colpite dalla malattia, come per esempio le cellule staminali;

•**la ricostruzione del microambiente più adatto capace di ospitare e istruire le cellule rigeneranti (ingegneria dei tessuti)**

Branca della medicina rigenerativa.

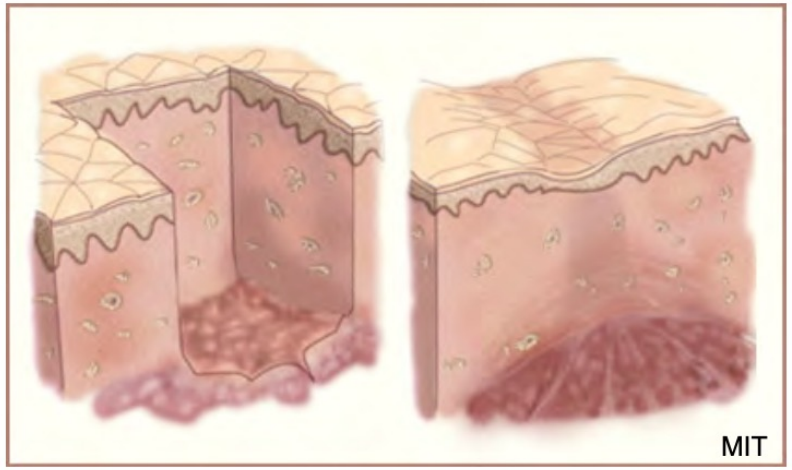
TISSUE ENGINEERING

È un settore terapeutico interdisciplinare che si riferisce alla pratica di combinare scaffold, cellule e molecole biologicamente attive (assemblare costrutti funzionali) al fine di ricostruire tessuti danneggiati o interi organi.

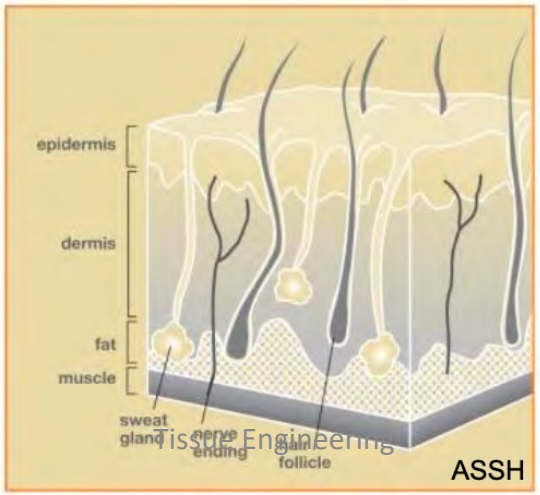


Repair vs regeneration

Repair = reestablishing lost or damaged tissue to ***retain continuity***



Regeneration = replacement of lost or damaged tissue with an exact copy so that ***morphology and function are restored***



Tissue Engineering is...

landmark study from 1997 that helped launched the field

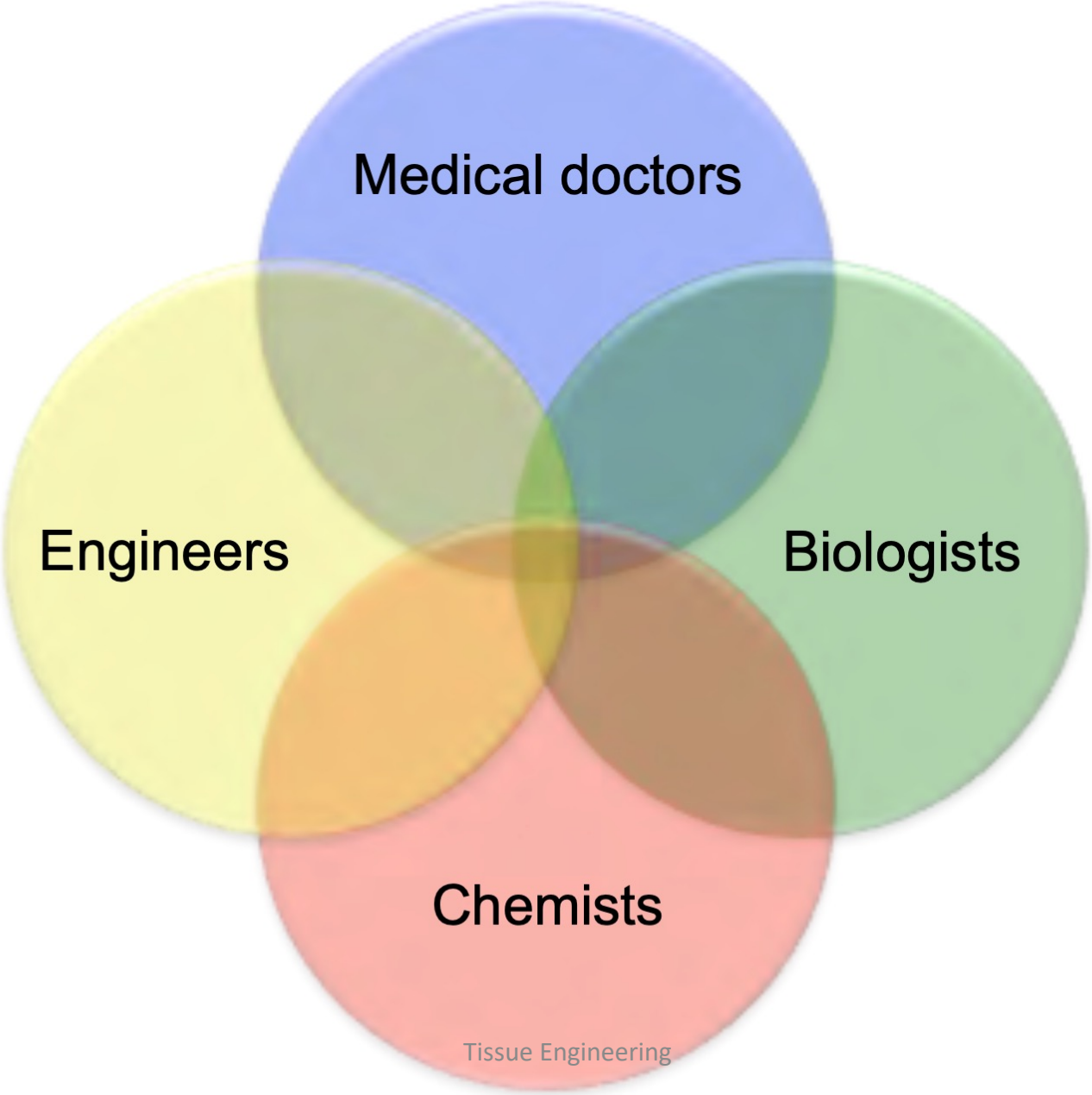

The Vacanti Mouse

"an **interdisciplinary** field that applies the **principles of engineering and life sciences** towards the development of biological substitutes that **restore, maintain, or improve tissue function or a whole organ**"

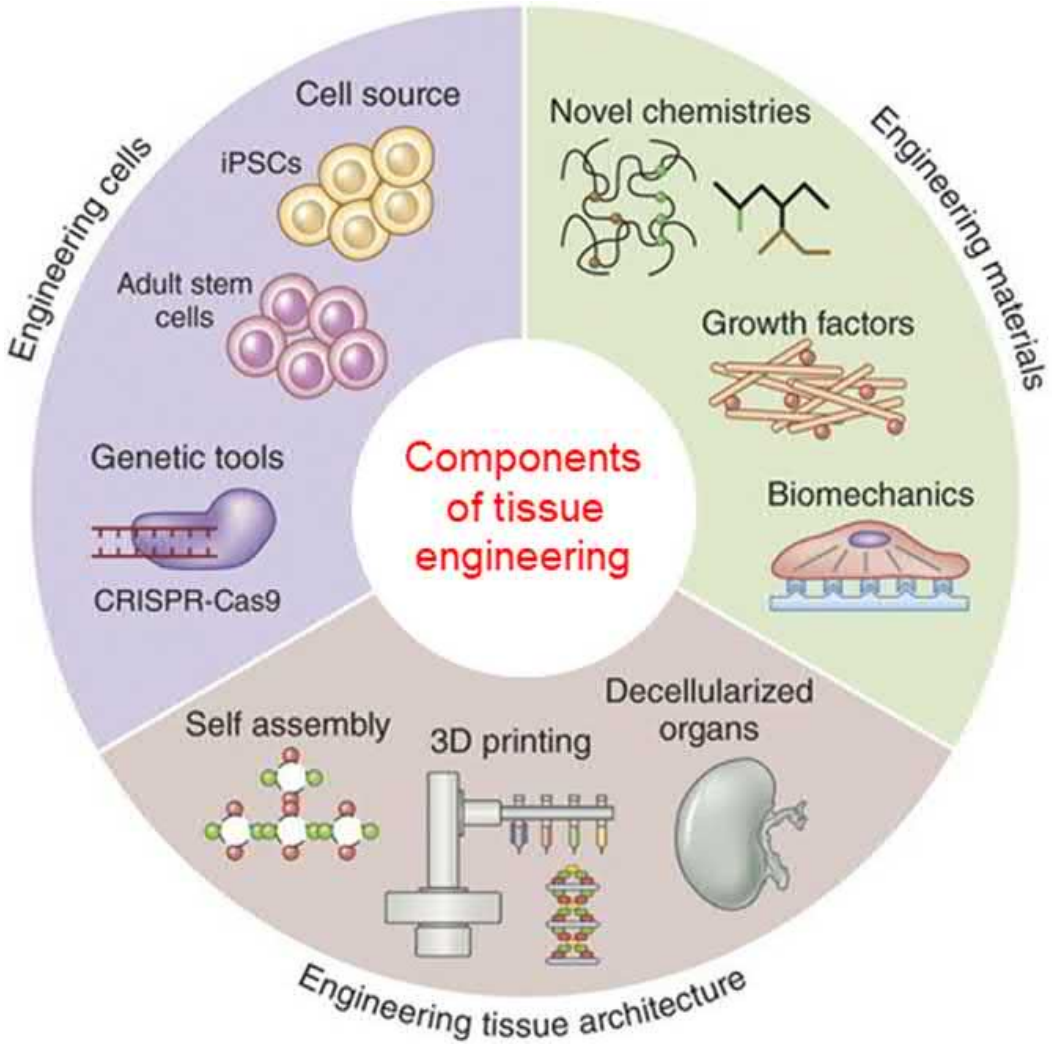
Langer and Vacanti, Science 1993

Interdisciplinary study involving materials science, chemistry, biology, and medicine

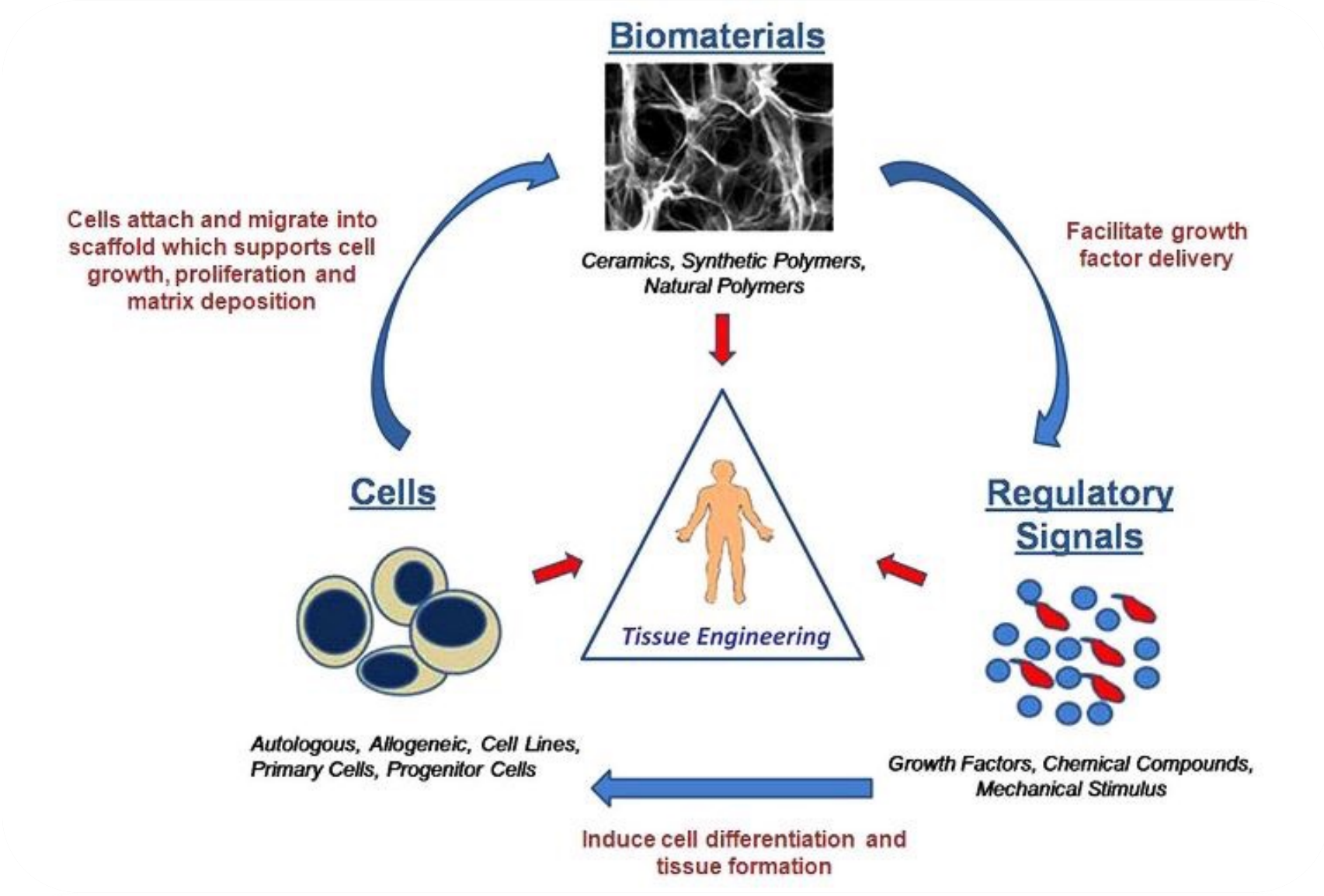
Tissue engineering is multidisciplinary by necessity

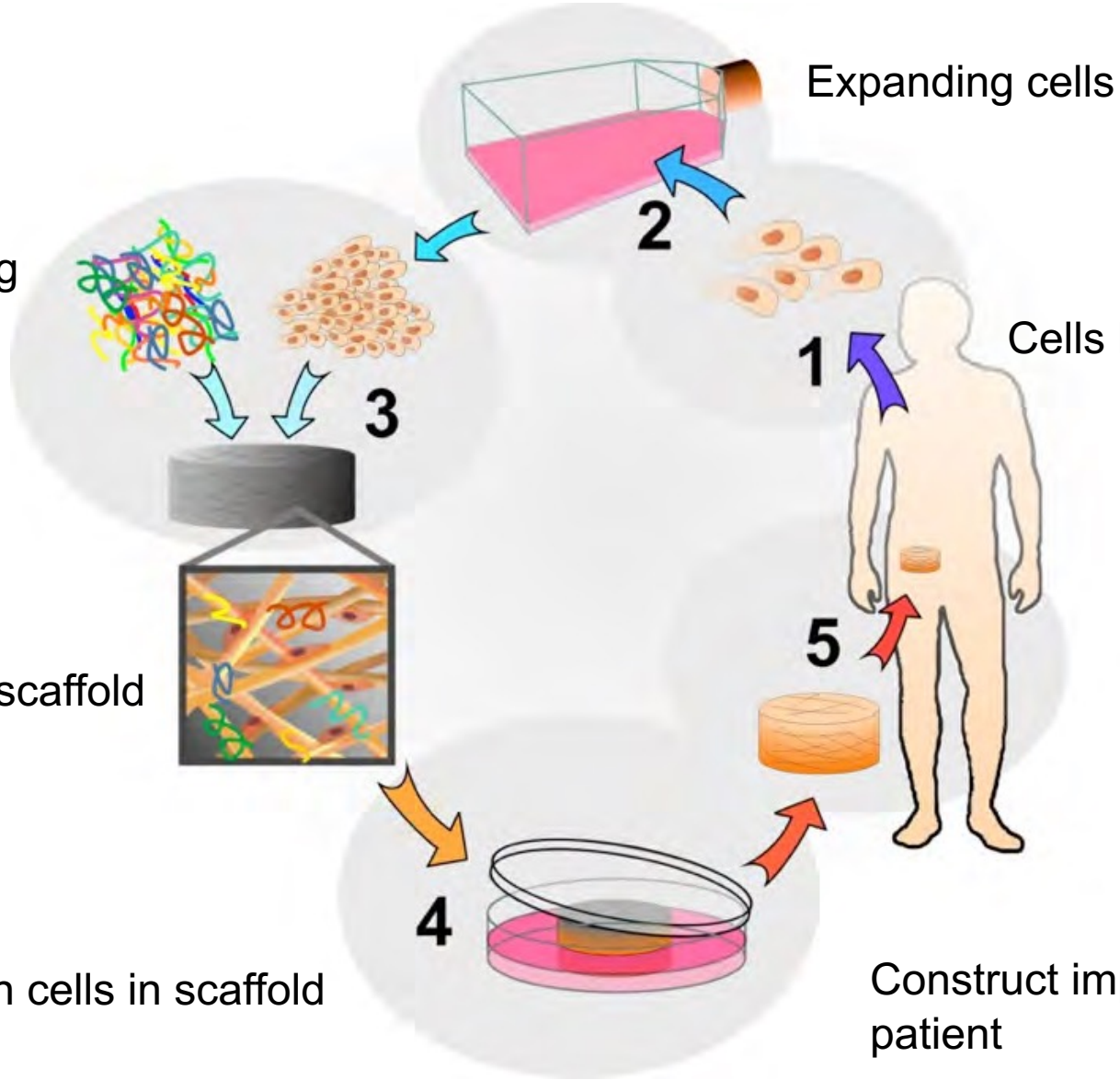


The tissue engineering paradigm

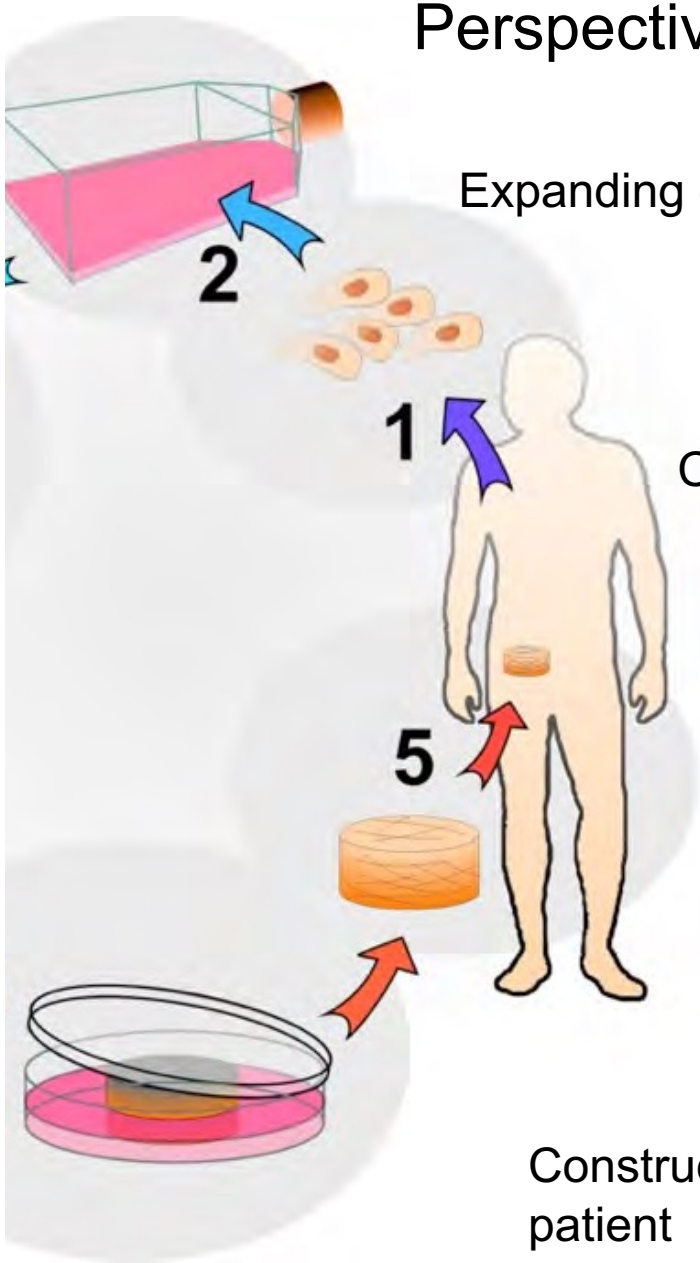


Tissue engineering




Expanding cells
Mechanical and/or molecular signalling
2
1
Cells harvested from patient
3
Cells seeded on scaffold
5
4
Construct with cells in scaffold cultured
Construct implanted in patient

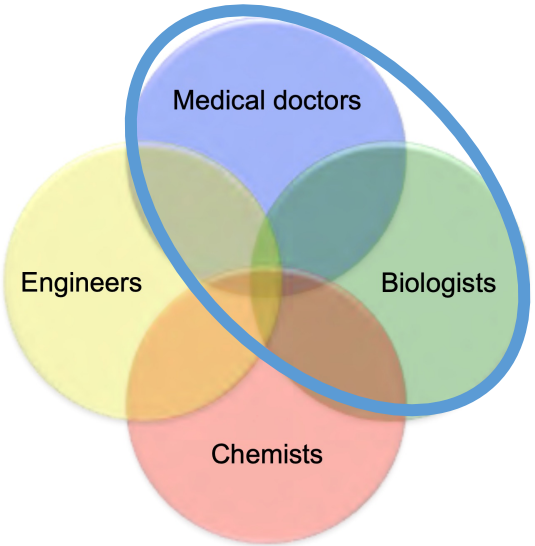
Perspective from a life science scientist



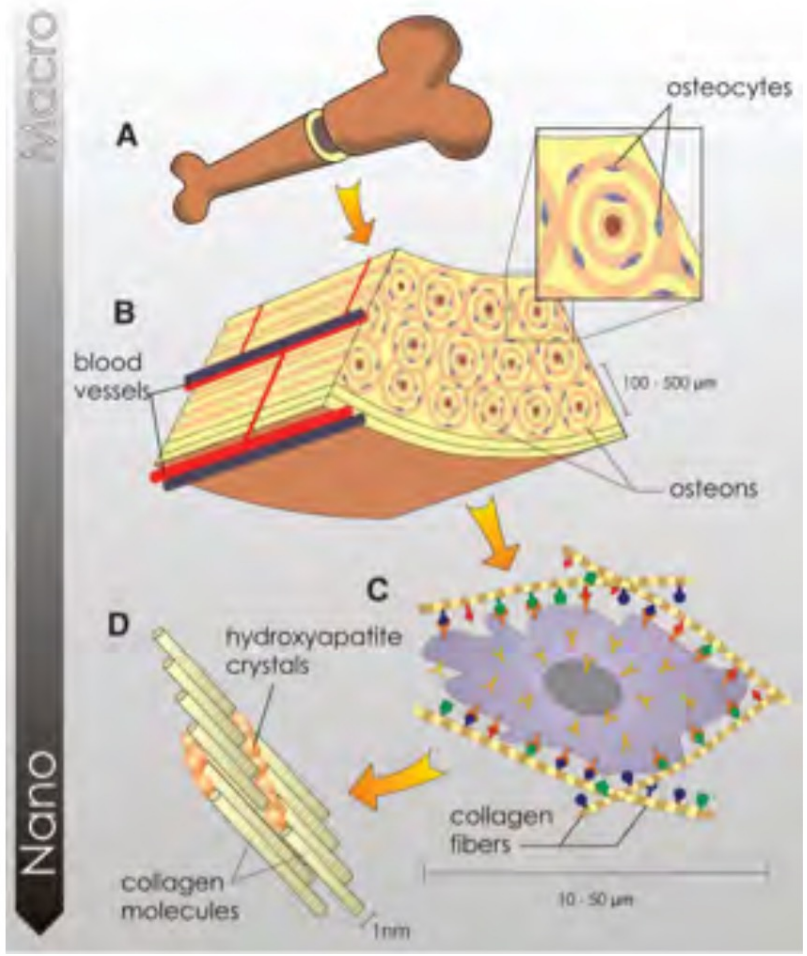
Expanding cells

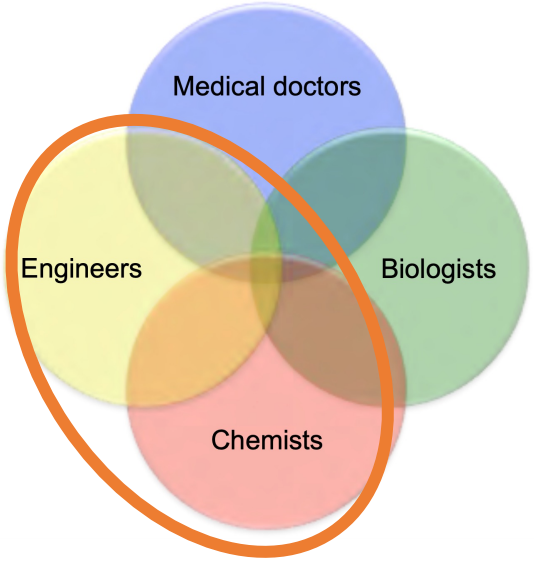
Cells harvested from patient

Construct implanted in patient



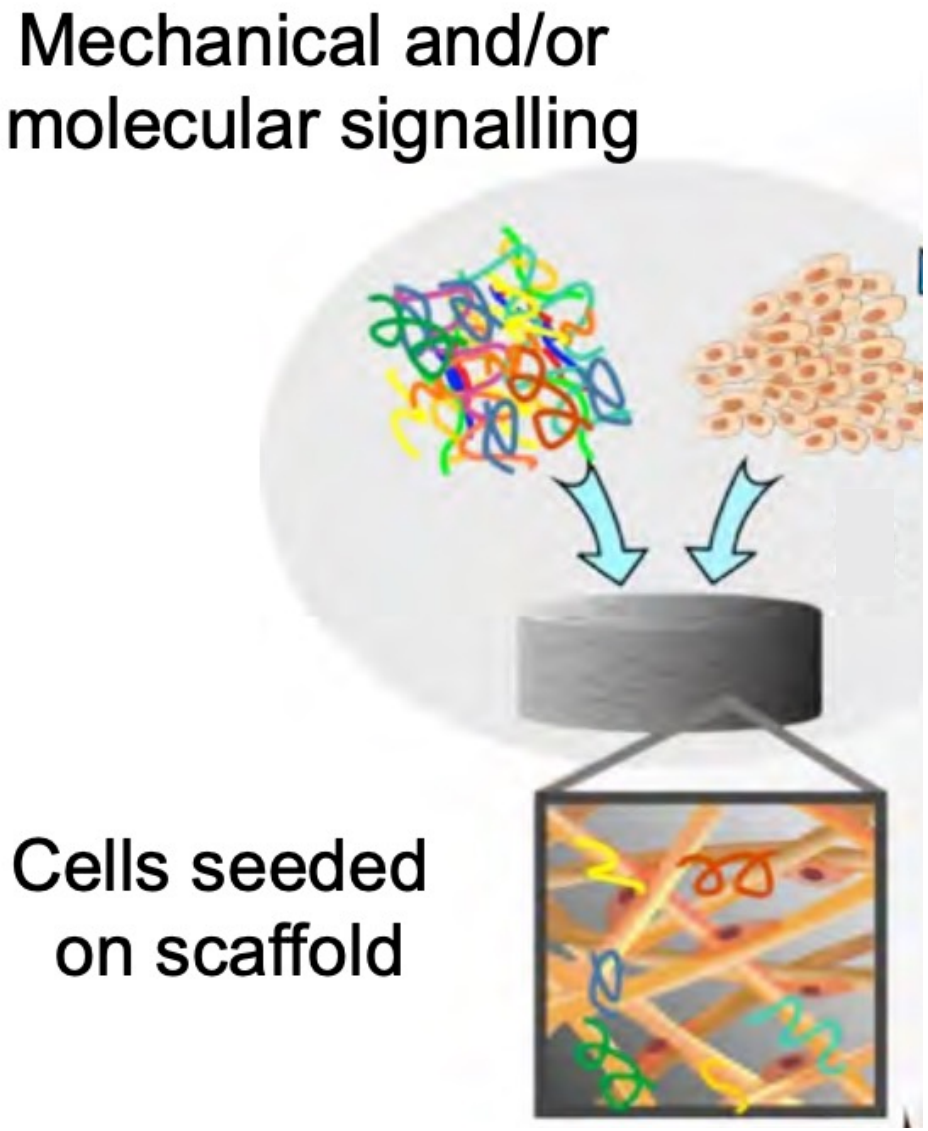
Perspective from a materials scientist



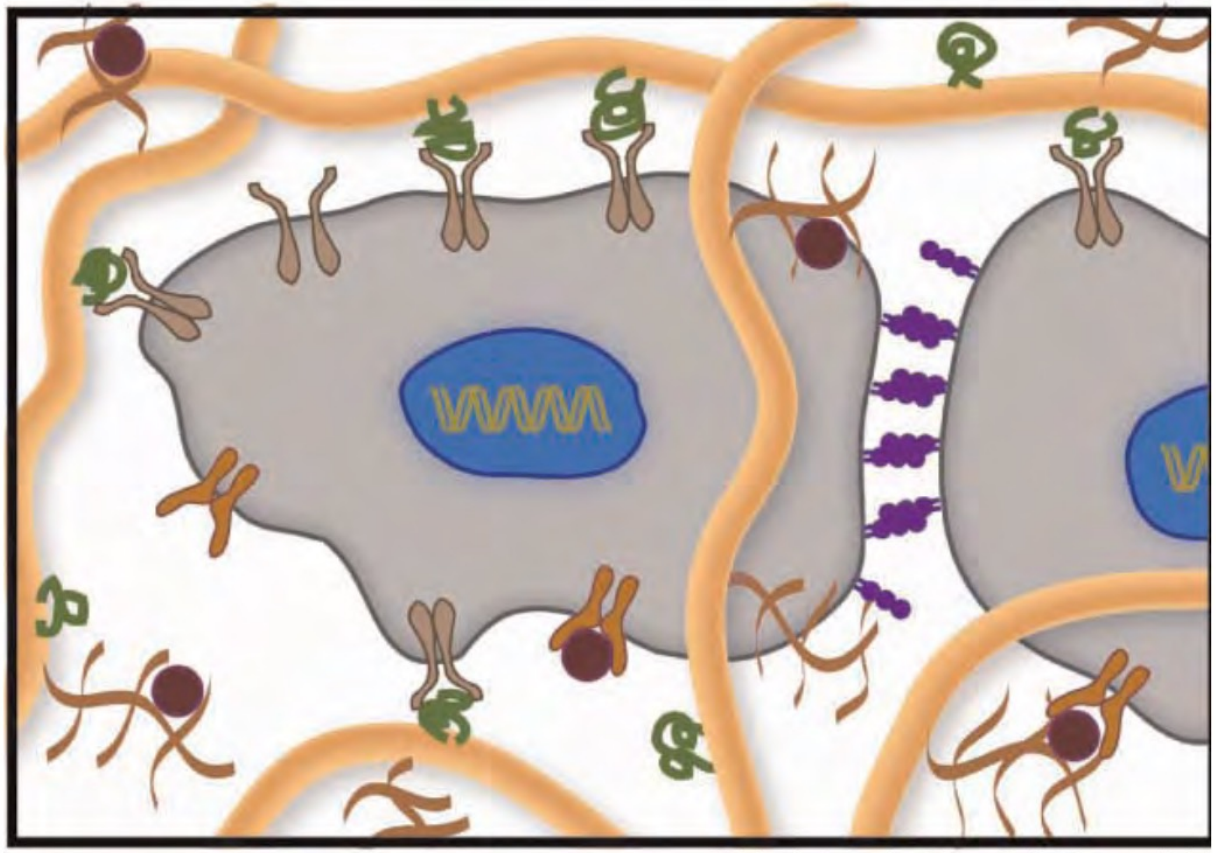


look at biological tissues as materials

Can we create biomaterials to stimulate regeneration?



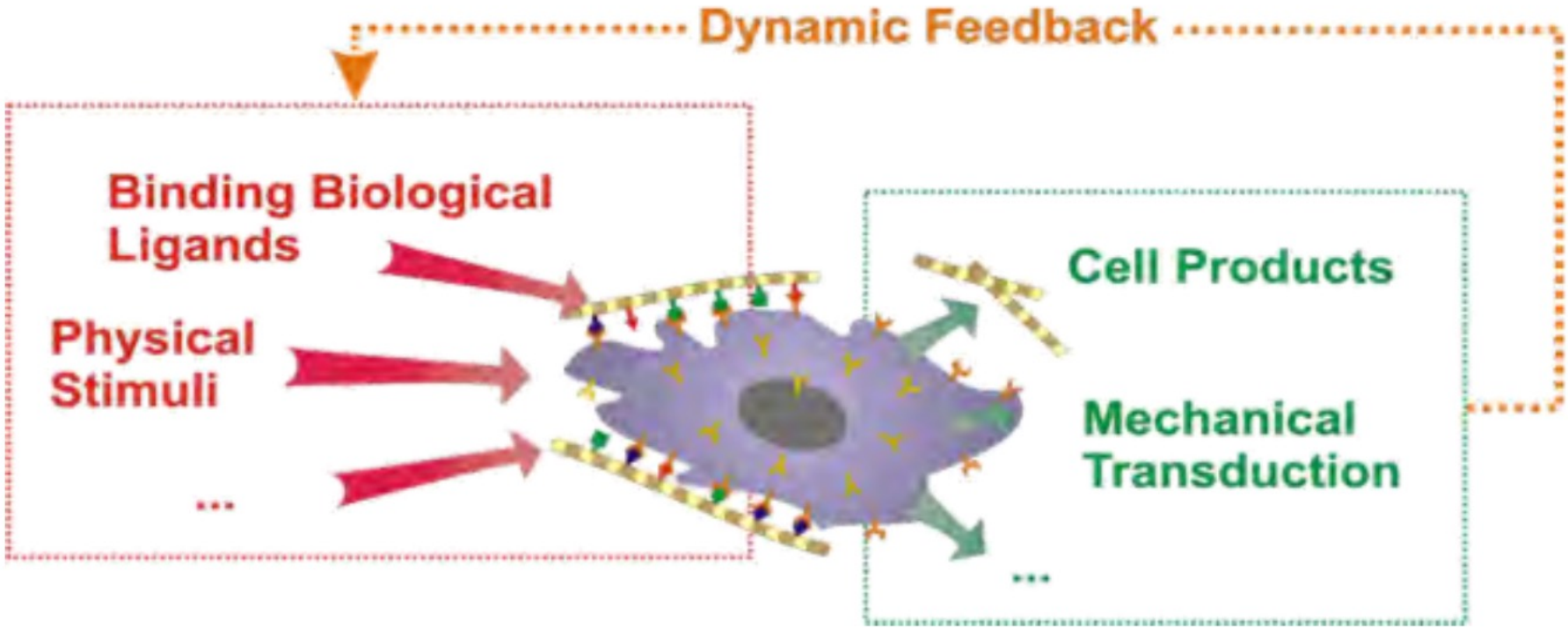
Extracellular matrix (ECM): home for cells



Tibbitt & Anseth, *Biotech & Bioeng* 2009

- composed of many cross-linked proteins and biopolymers
- provides mechanical support
- regulates biological functions such as cell adhesion, proliferation, migration, differentiation, etc.

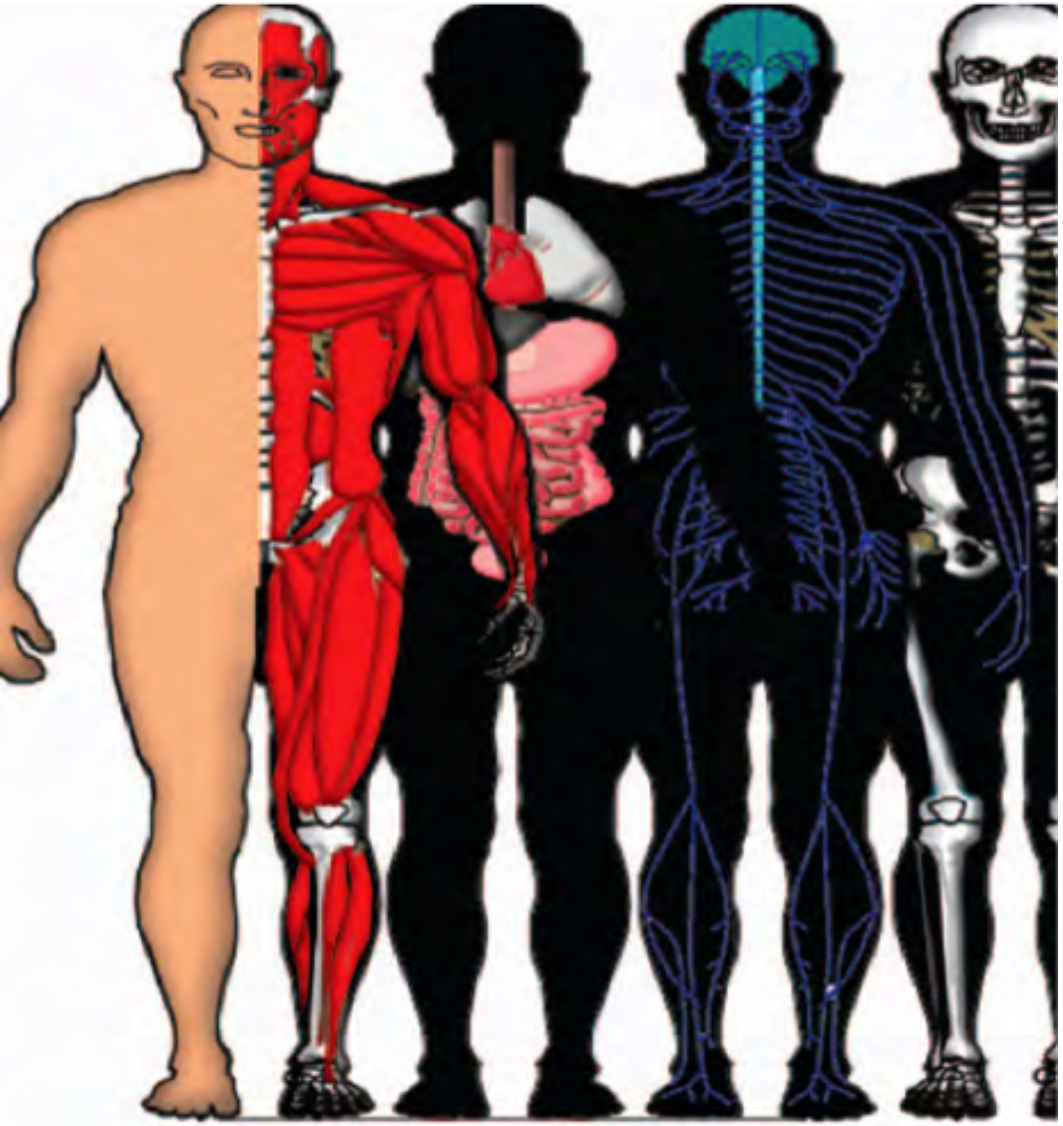
Designing materials to mimic ECM to regenerate tissues



- take what we learn from nature to create ***biomimetic materials*** that can "jumpstart" regeneration
- apply principles and techniques from ***materials science and engineering*** to design systems and help understand biological processes

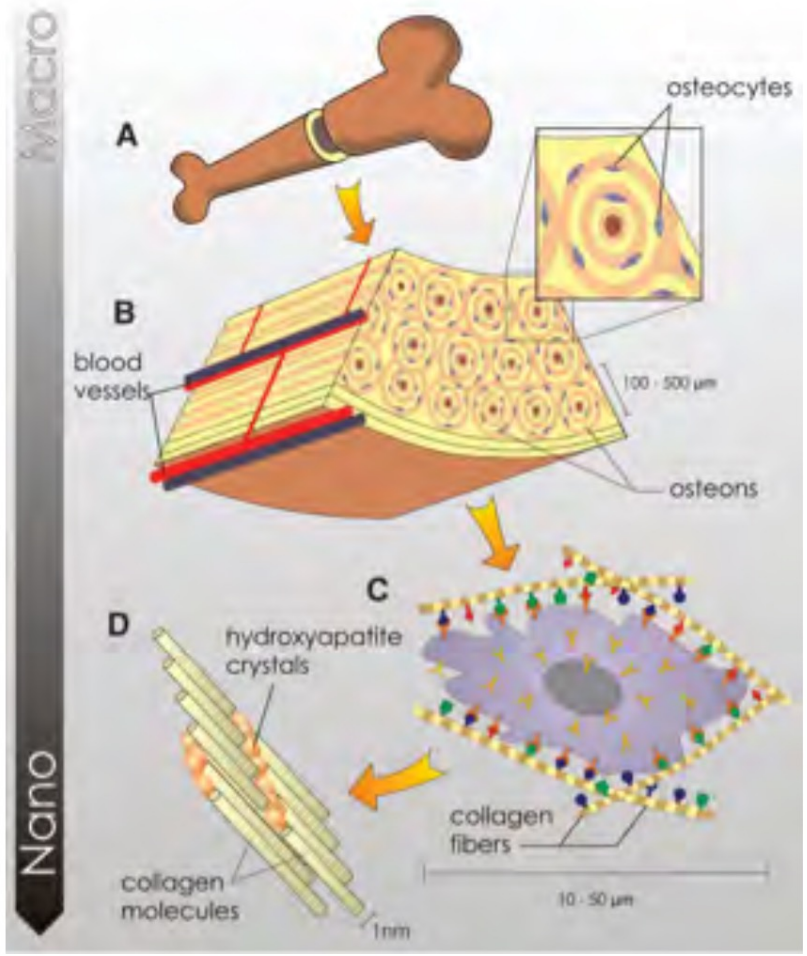
Can we mimic the ECM of biological tissues to ***direct the body to heal itself***?

Tailoring biomaterials to the specific tissue



- tissue type
- biochemical and mechanical functions
- size and scale of defect
- age of the patient
- disease conditions
- etc...

Biological tissues are complex



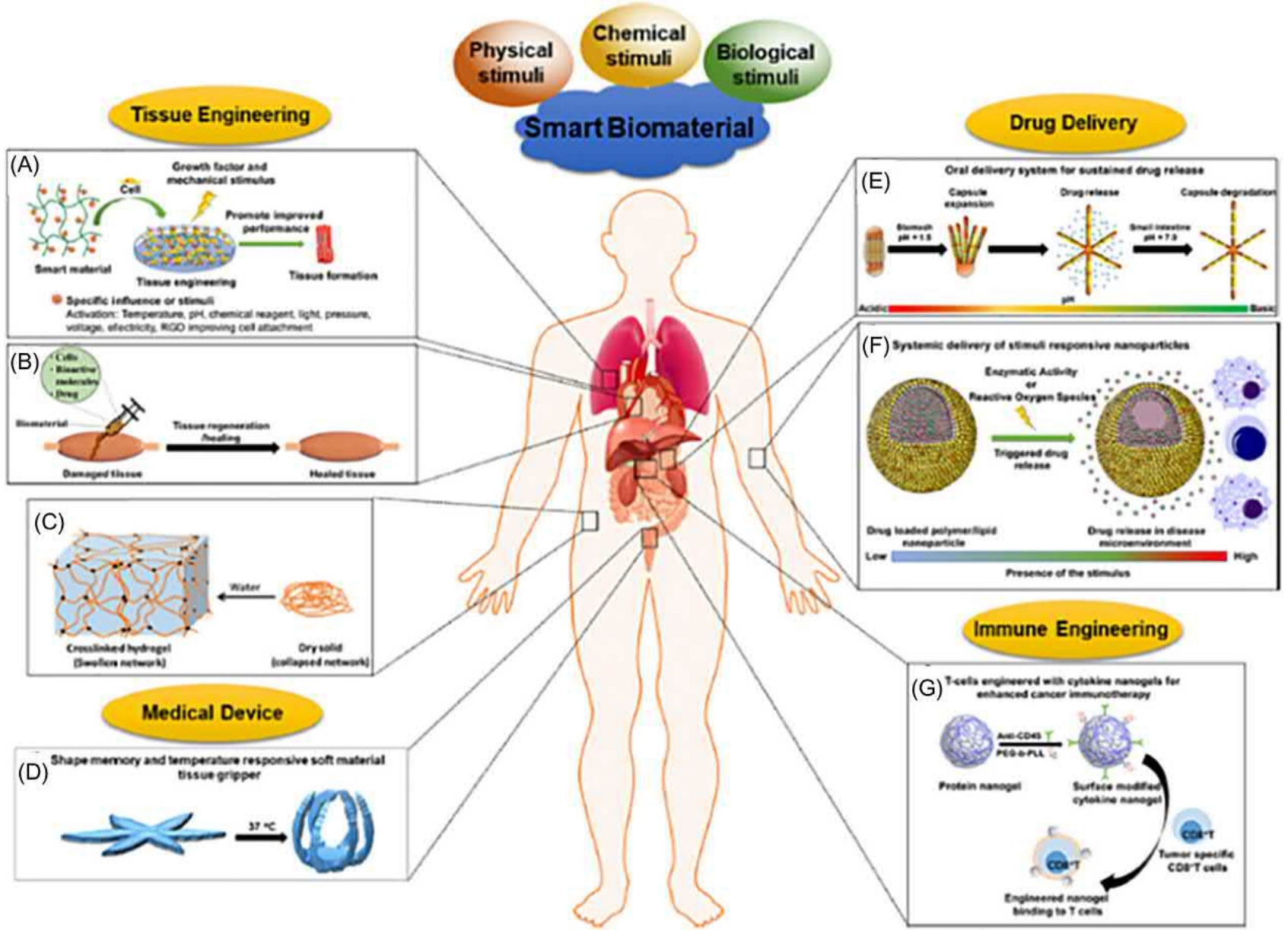
tissue composition and organization leads to biological function

Can we design synthetic biomaterials that ***regenerate functional native-like tissues***?

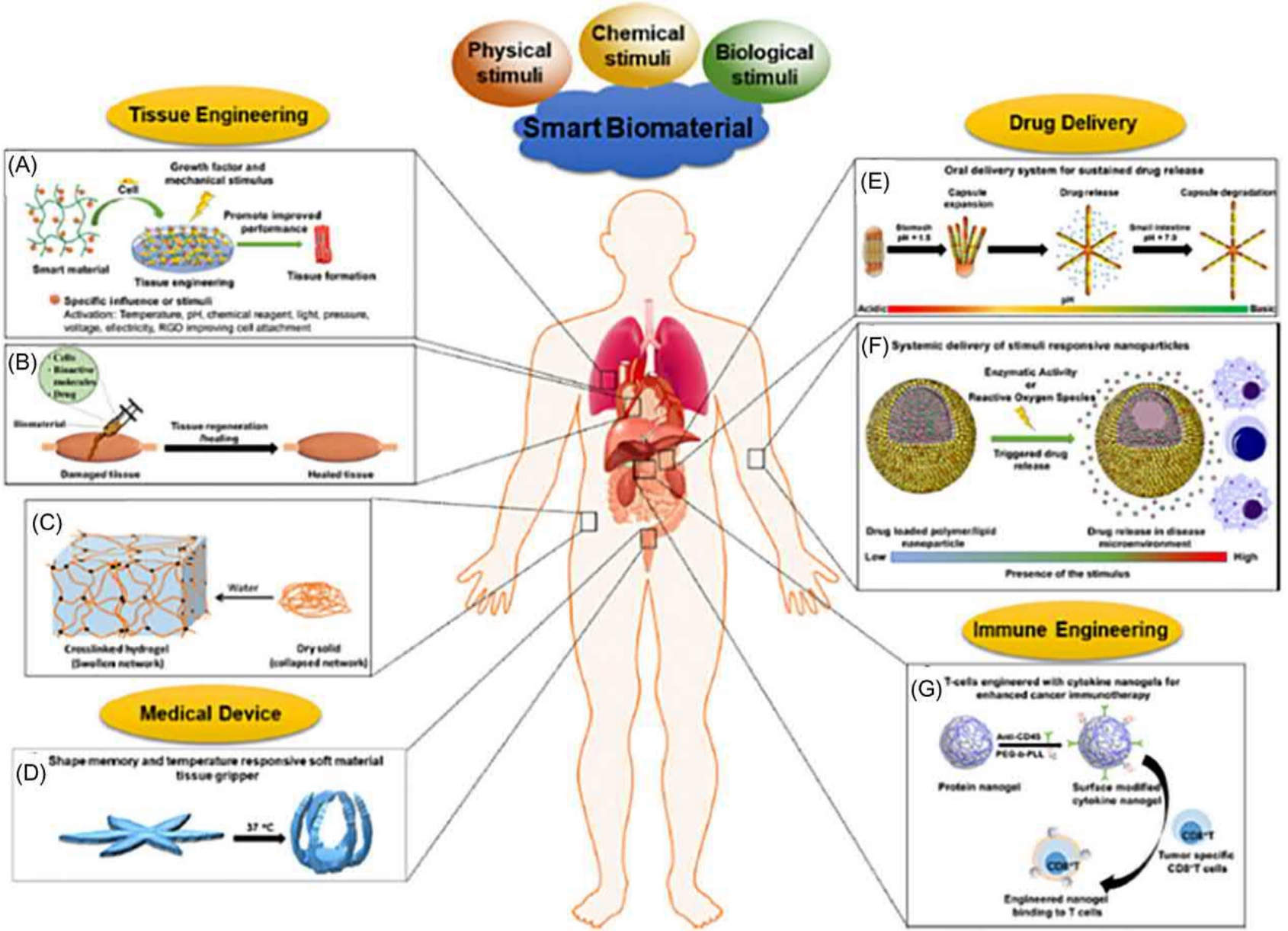
TISSUE ENGINEERING: Regulatory signals

GROWTH AND DIFFERENTIATION FACTORS

Growth Factor	Most representative function
Platelet-derived growth factor	Chemotaxis, inducing cells to migrate to the wound bed.[1]
Transforming growth factor-β	Cell proliferation inhibition, increase in synthesis of extracellular matrix and inhibition of its degradation; it favors neutrophil and monocyte chemotaxis,[6] although its specific action also depends on the cell environment.
Bone morphogenetic proteins	Repair of epidermis in more superficial layers of skin and inhibition of keratinocyte proliferation in deeper layers.[65]
Fibroblast growth factor	Mitogenic for endothelial cells, fibroblasts, chondroblasts, and osteoblasts[7]; it favors angiogenesis.
Epidermal growth factor	Proliferation and mobility of fibroblasts and keratinocytes.[66]
Vascular endothelial growth factor	Angiogenesis and increase in capillary permeability.[67]
Insulin-like growth factor	Favoring reepithelization and production of granulation tissue.[30]
Interleukins	General proinflammatory function, regulation of immunological cell growth and/or differentiation.[68]



Kowiaski PS, Bhattacharya C, Afewerki S, Langer R. Smart biomaterials: recent advances and future directions. ACS Biomater Sci Eng 2018;4(11):380917



Kowlaski PS, Bhattacharya C, Afewerki S, Langer R. Smart biomaterials: recent advances and future directions. ACS Biomater Sci Eng 2018;4(11):380917

THE LONG WAY TO GO