



JOHNS HOPKINS

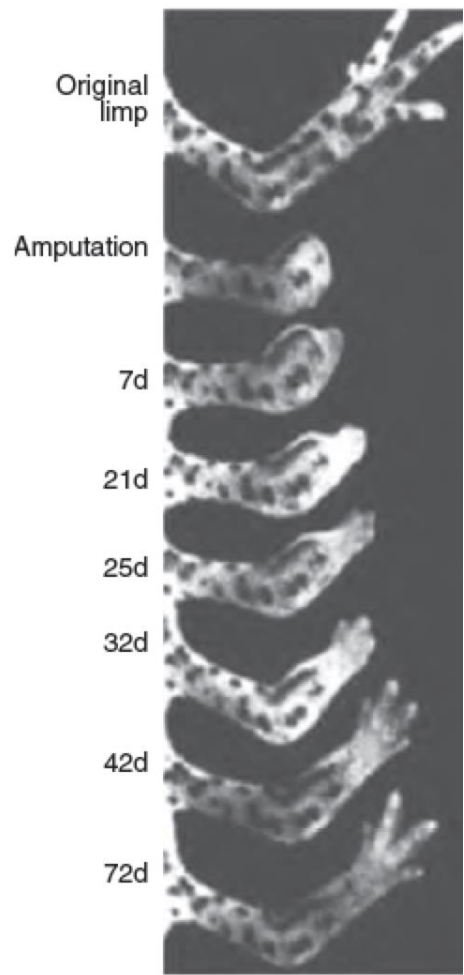
WHITING SCHOOL
of ENGINEERING

Cell and Tissue Engineering

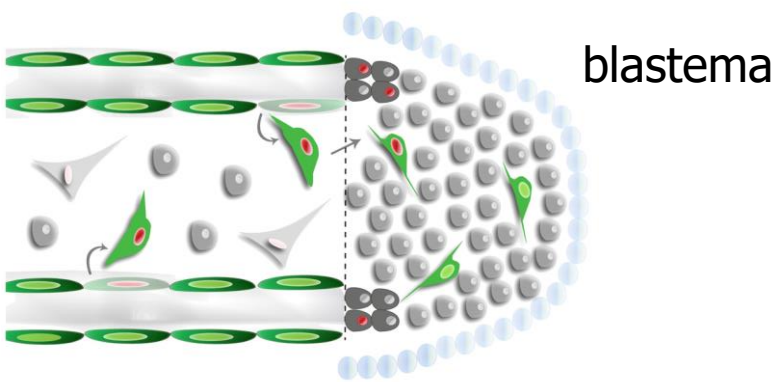
Tissue Organization and Dynamics

Part 2 Tissue Dynamics

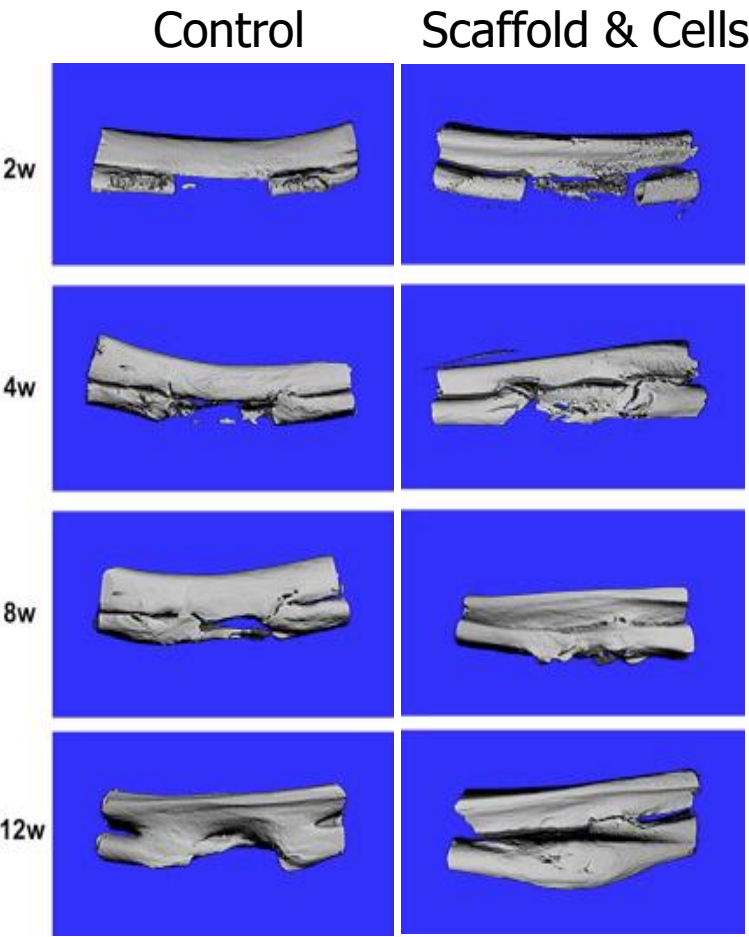
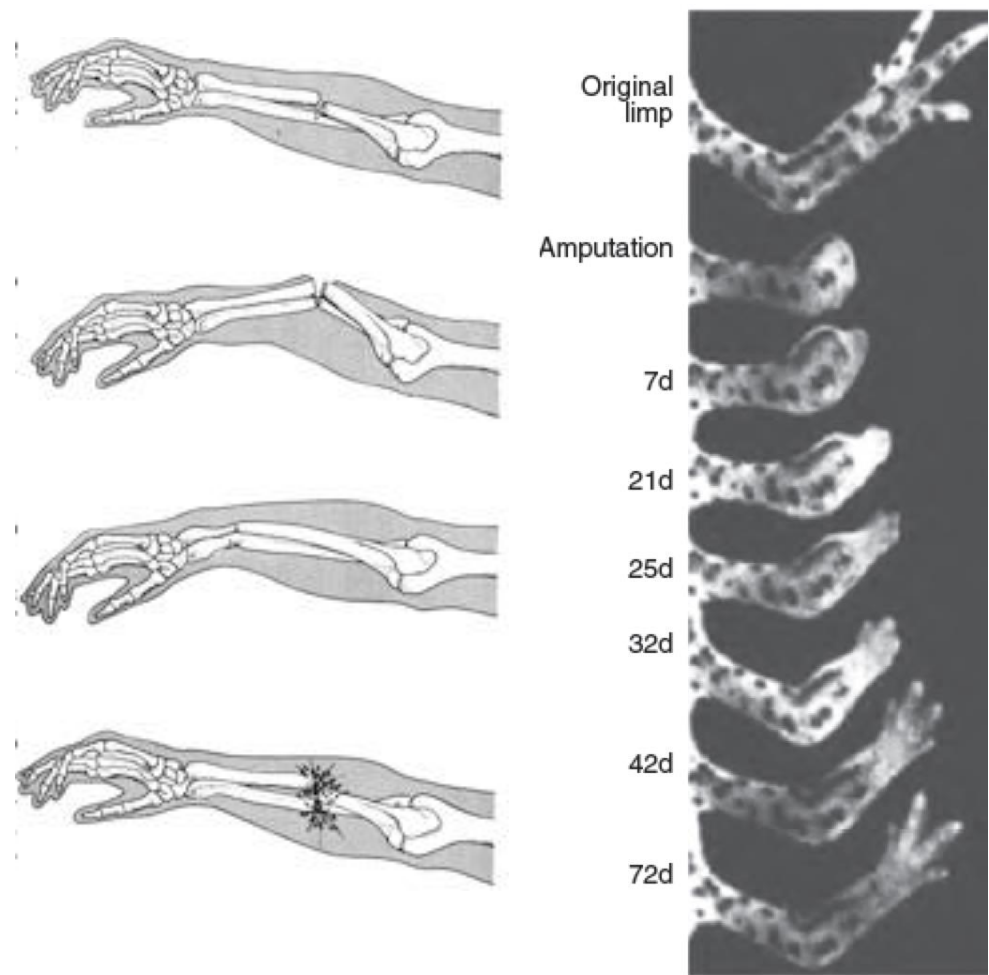
Tissue Regeneration

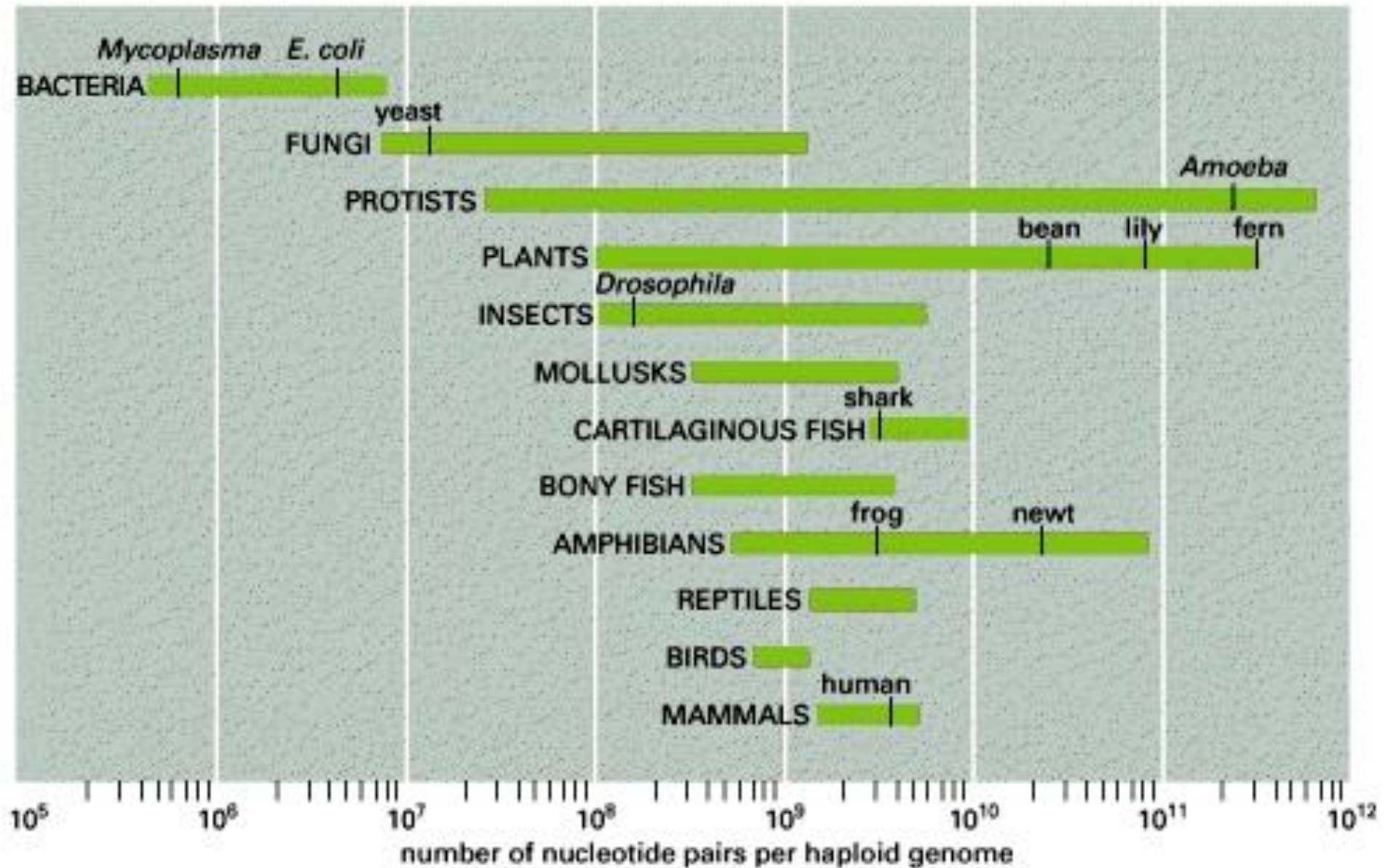


Epimorphosis

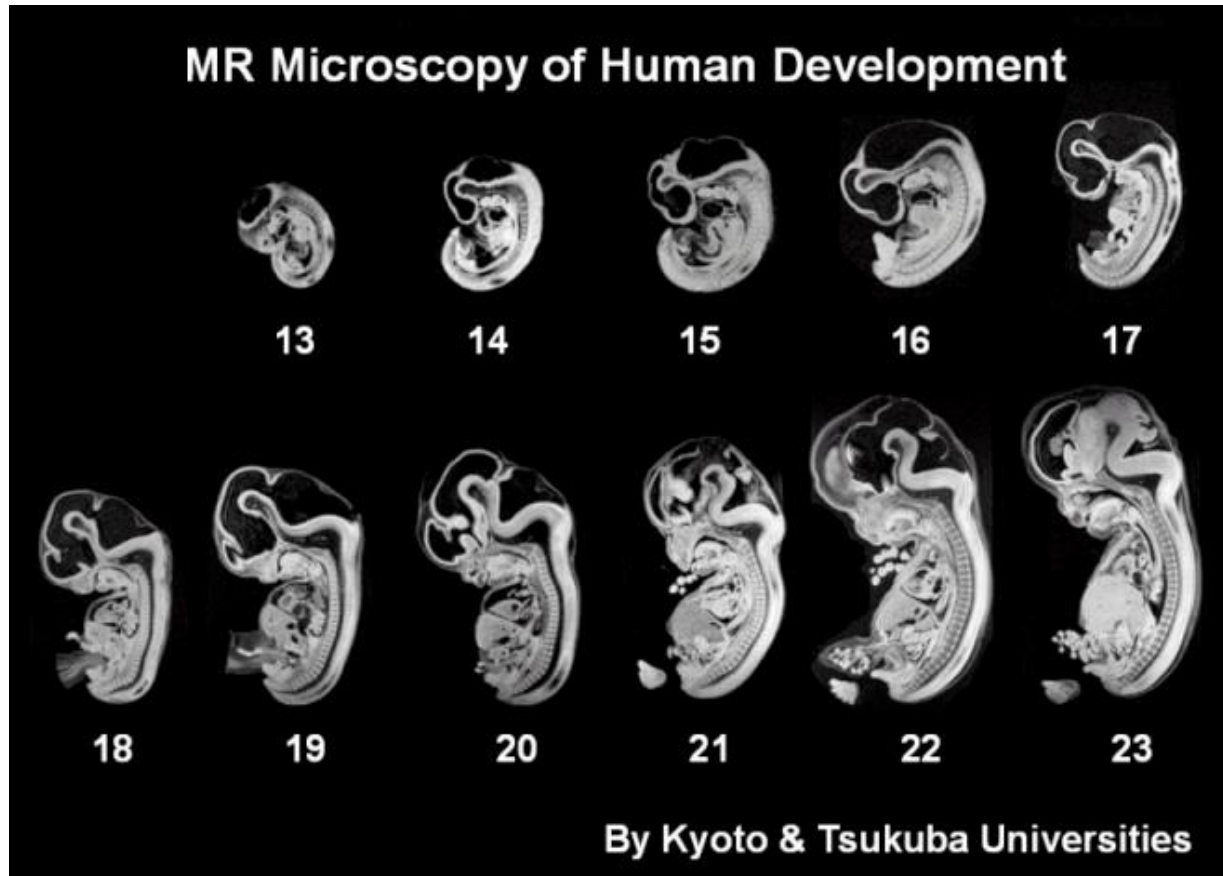


Tissue Regeneration



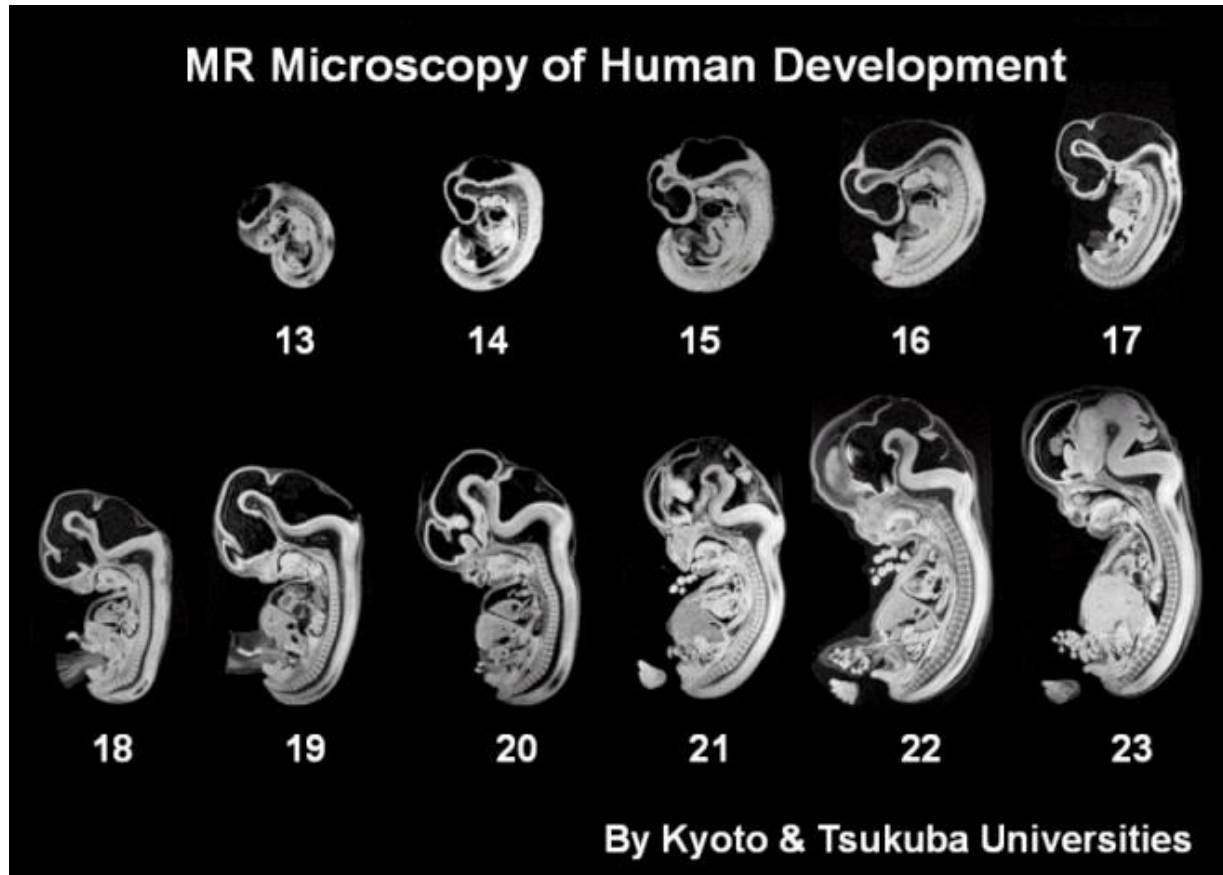


Human Tissue Regeneration Potential



1% of our body weight/day

Human Tissue Regeneration Potential

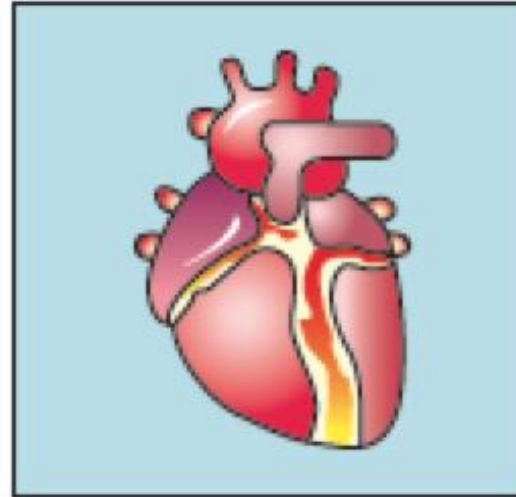


1% of our body weight/day

Dynamic States of Tissues
Tissue Homeostasis
Tissue Repair
Tissue Formation

Tissue Homeostasis

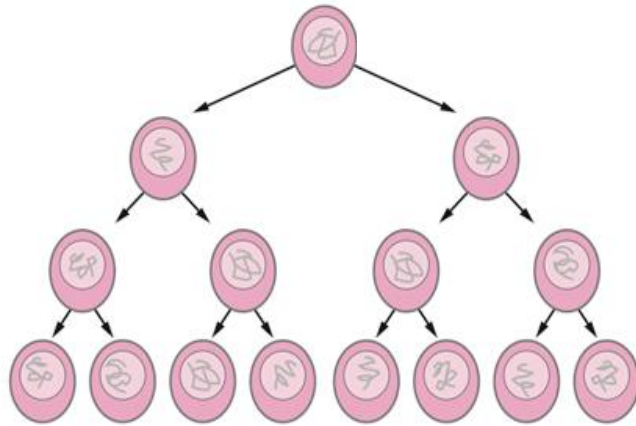
Cell proliferation or
replenishment



Apoptosis,
cell death

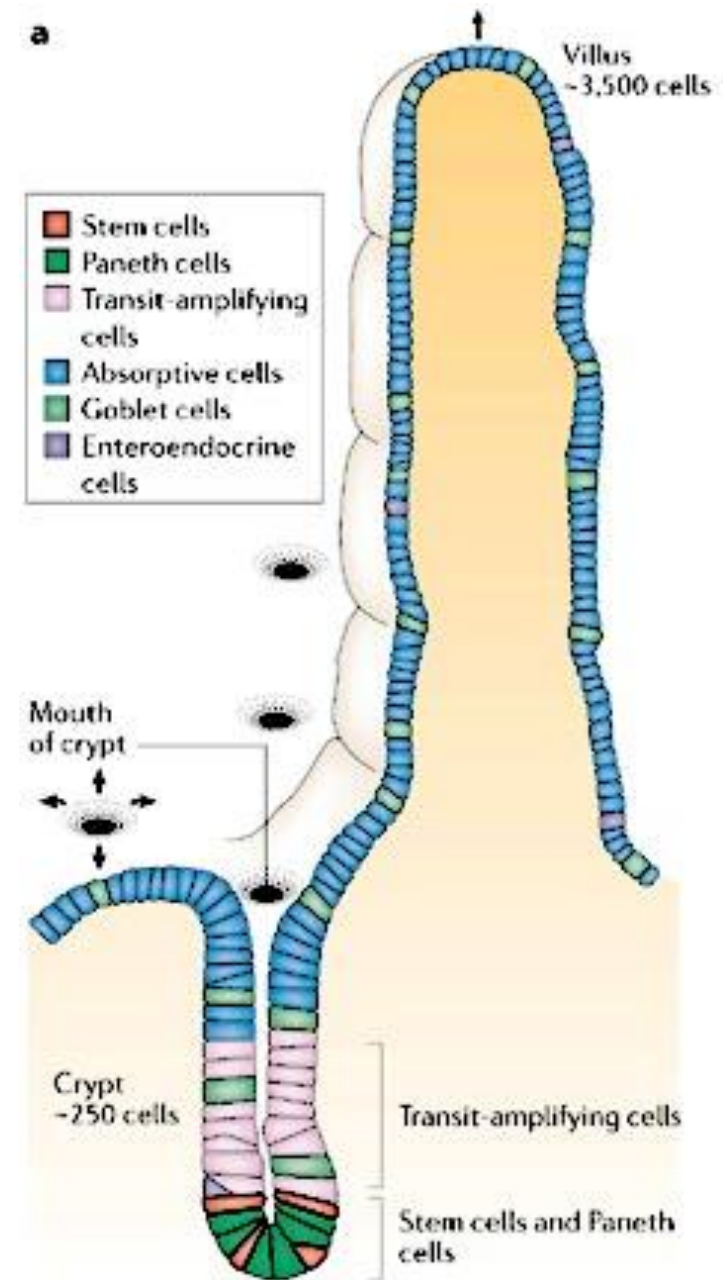
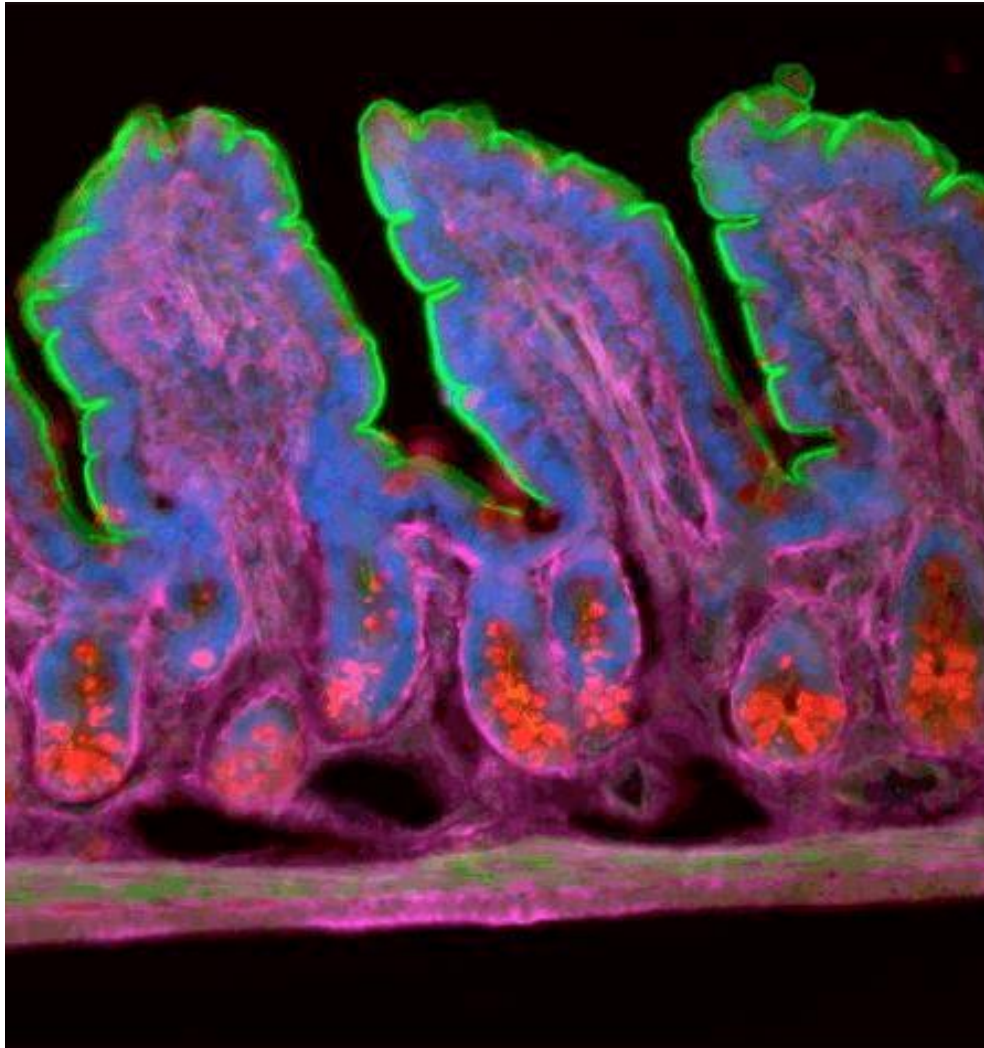


Tissue Homeostasis

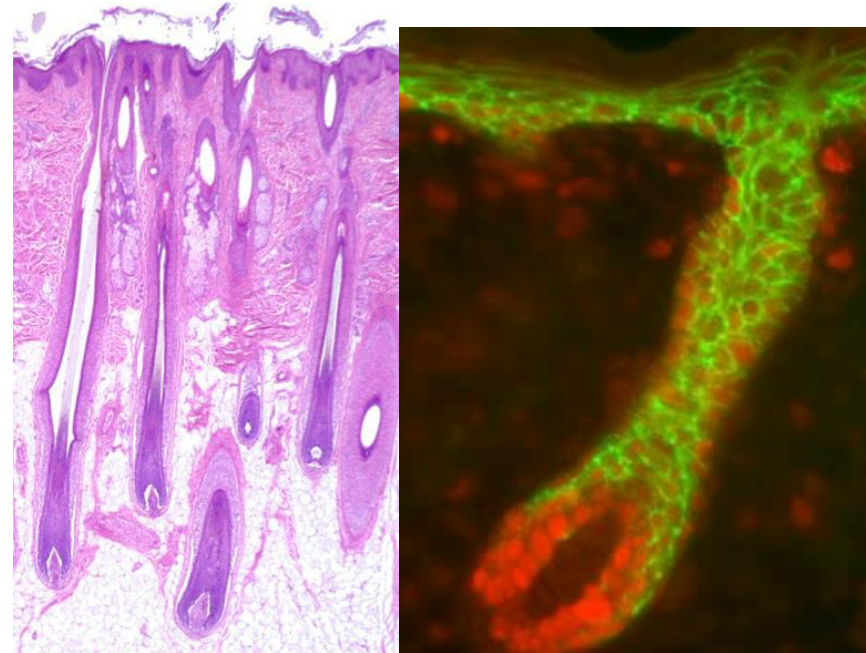
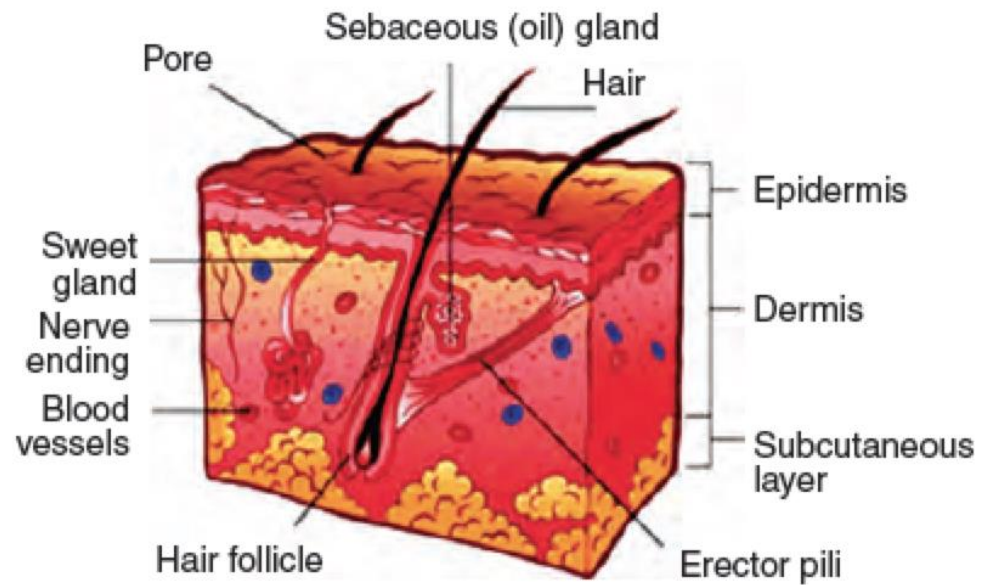


Tissue or Cell production process	Species	Characteristic Time (days)
Erythropoiesis	rat	2.5
Myelopoiesis	rat	1.4
Hematopoiesis	human	2.3
Small intestinal epithelium	human rate	4-6 1-2
Epidermis	human	7-100
Corneal epithelium	human	7
Lymphatic cells	rat (thymus) rat (spleen)	7 15
Epithelial cells	rat (vagina) human (cervix)	3.9 5.7
Spermatogonia	human	74
Renal intestinal cells	mouse	165
Hepatic cells	rat	400-500

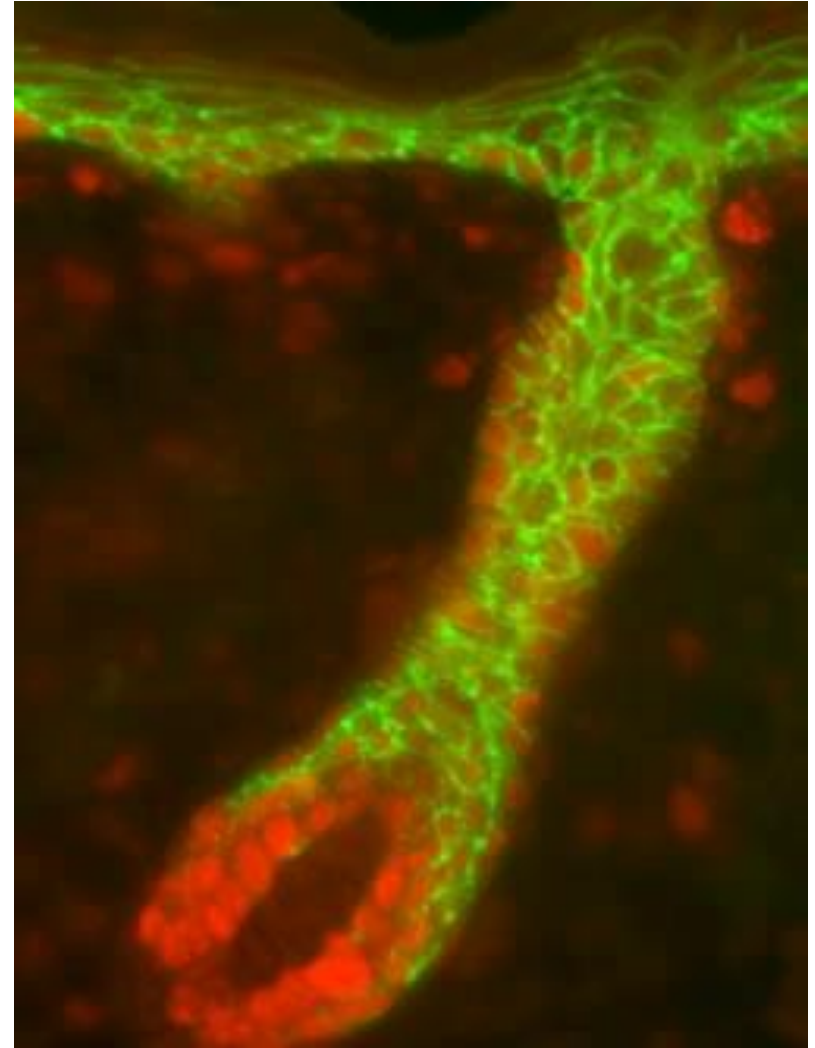
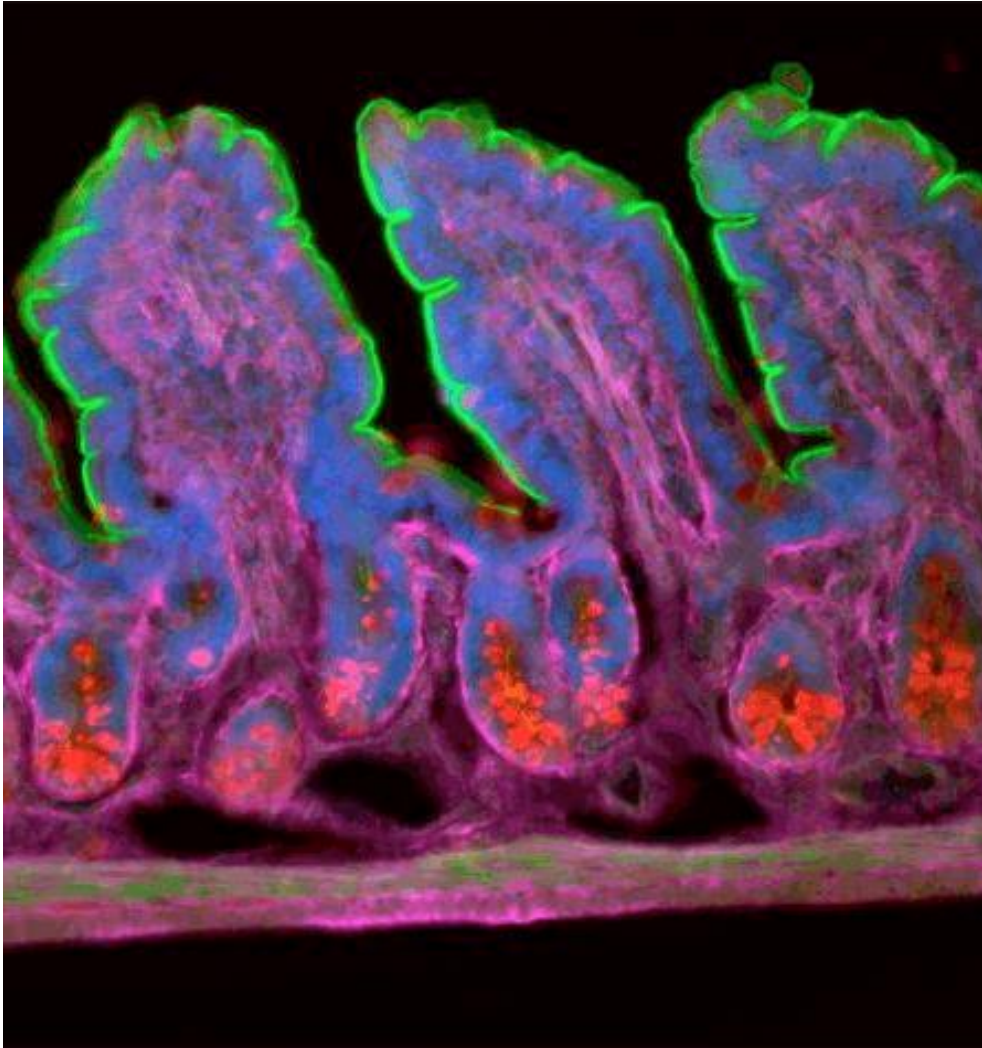
Tissue Homeostasis



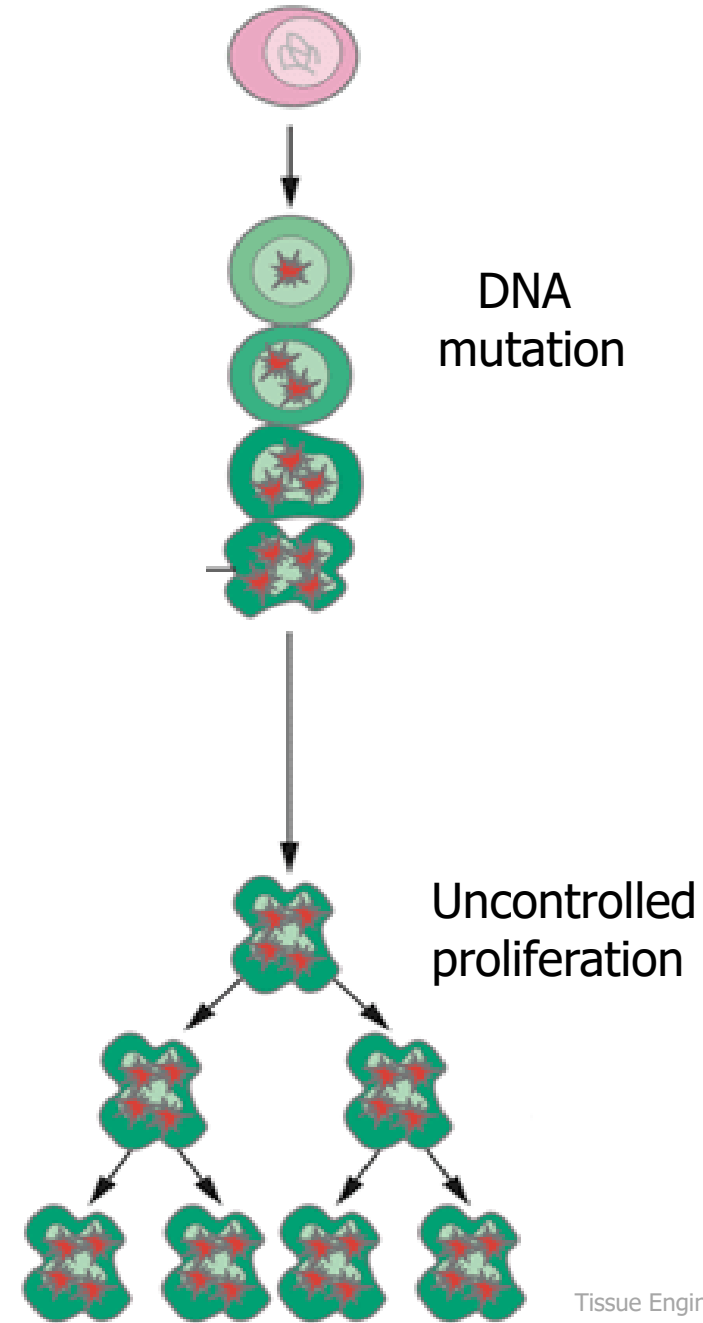
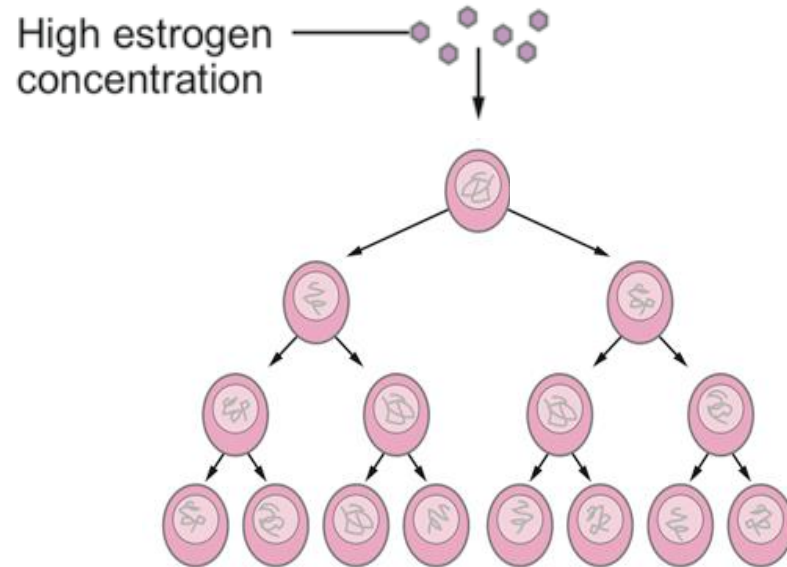
Tissue Homeostasis



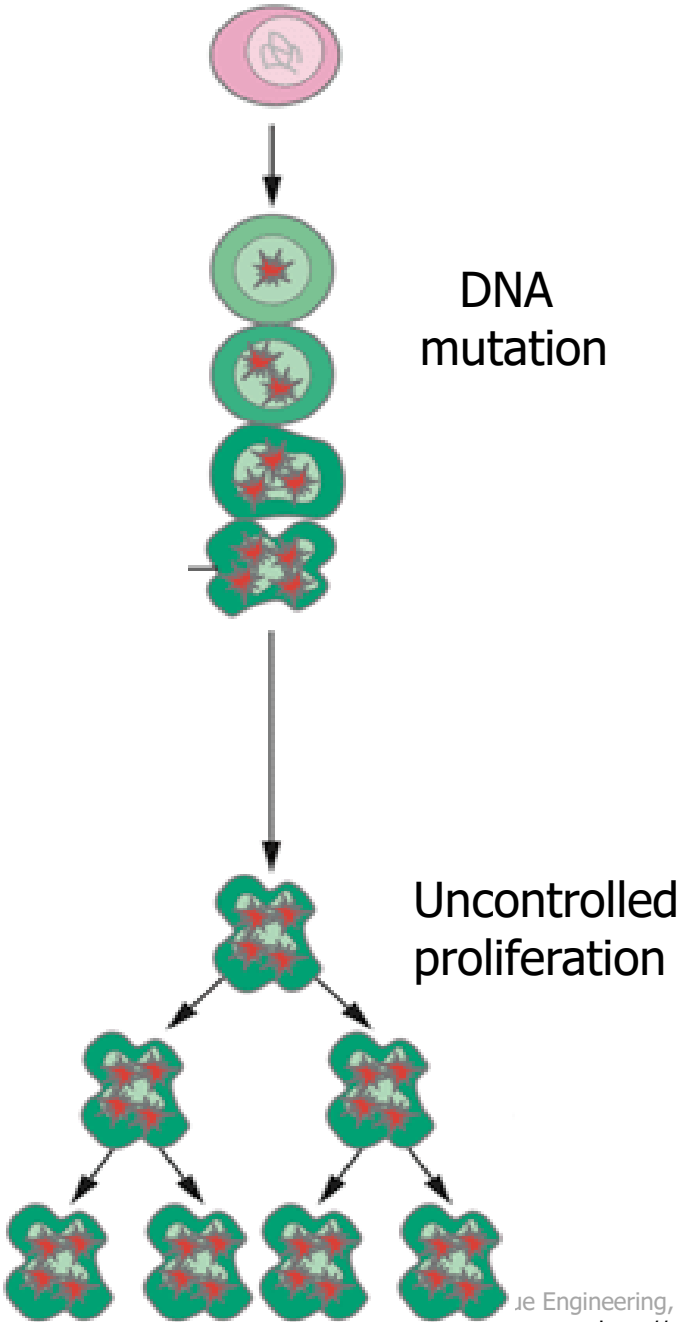
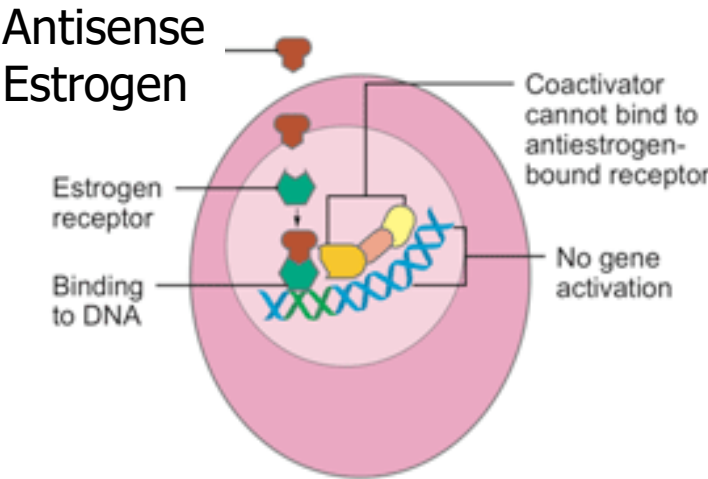
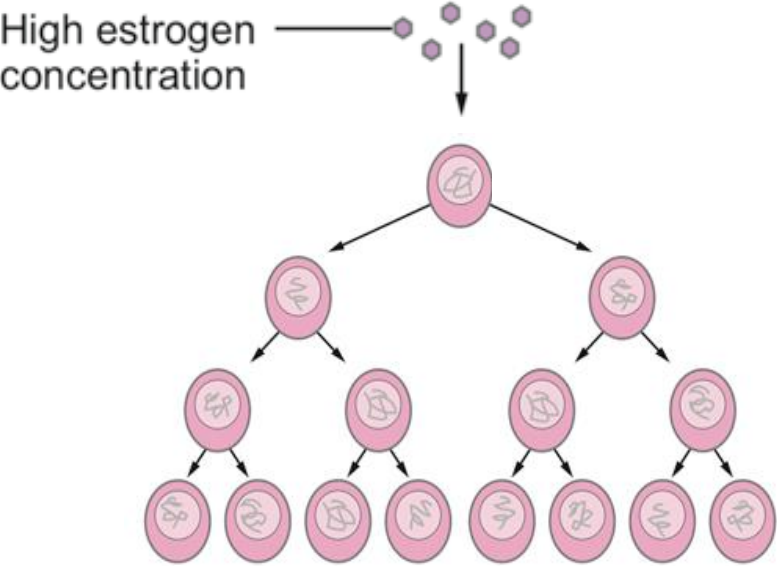
Tissue Homeostasis



Tissue Homeostasis

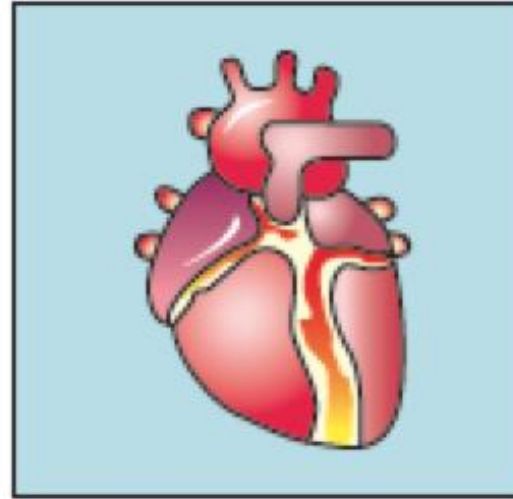


Tissue Homeostasis

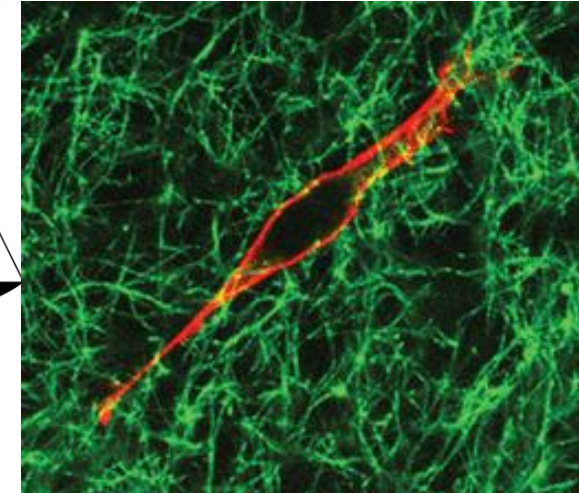
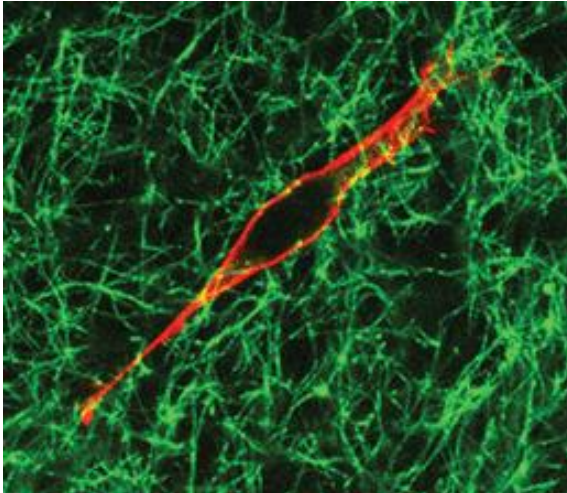


Tissue Homeostasis

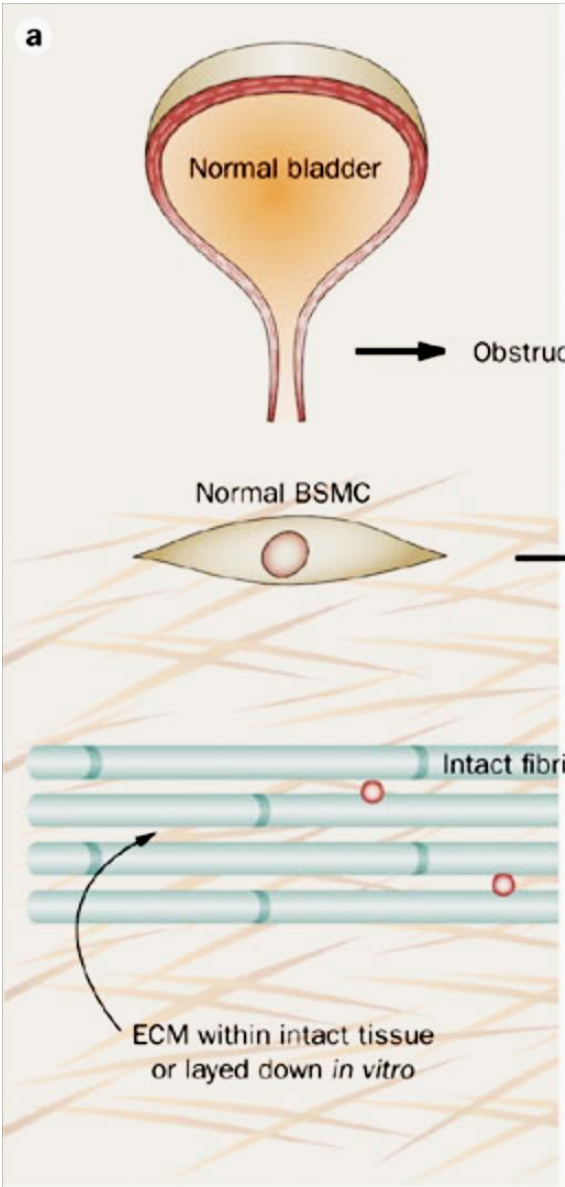
Cell proliferation or
replenishment



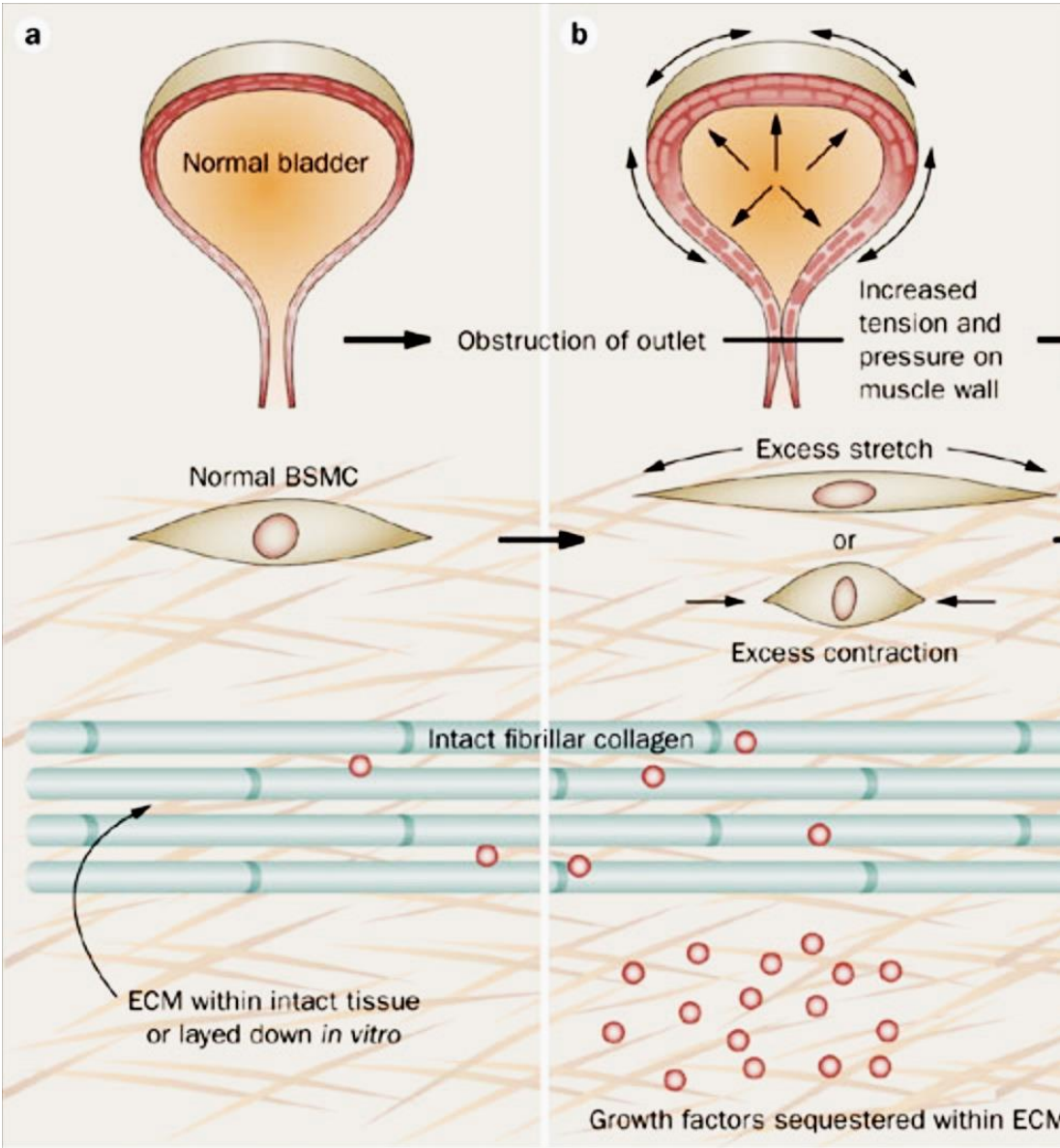
Apoptosis,
cell death



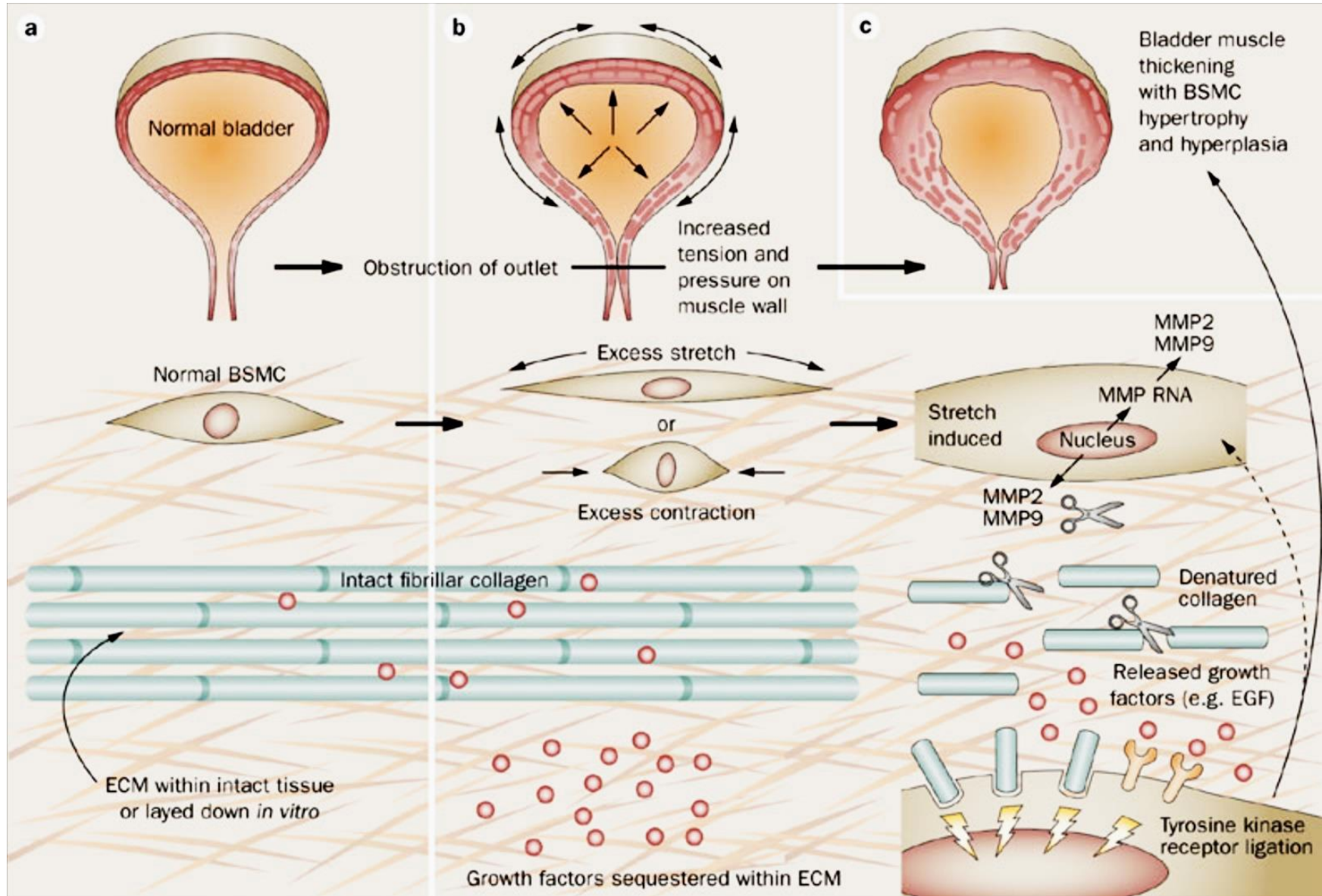
Tissue Homeostasis



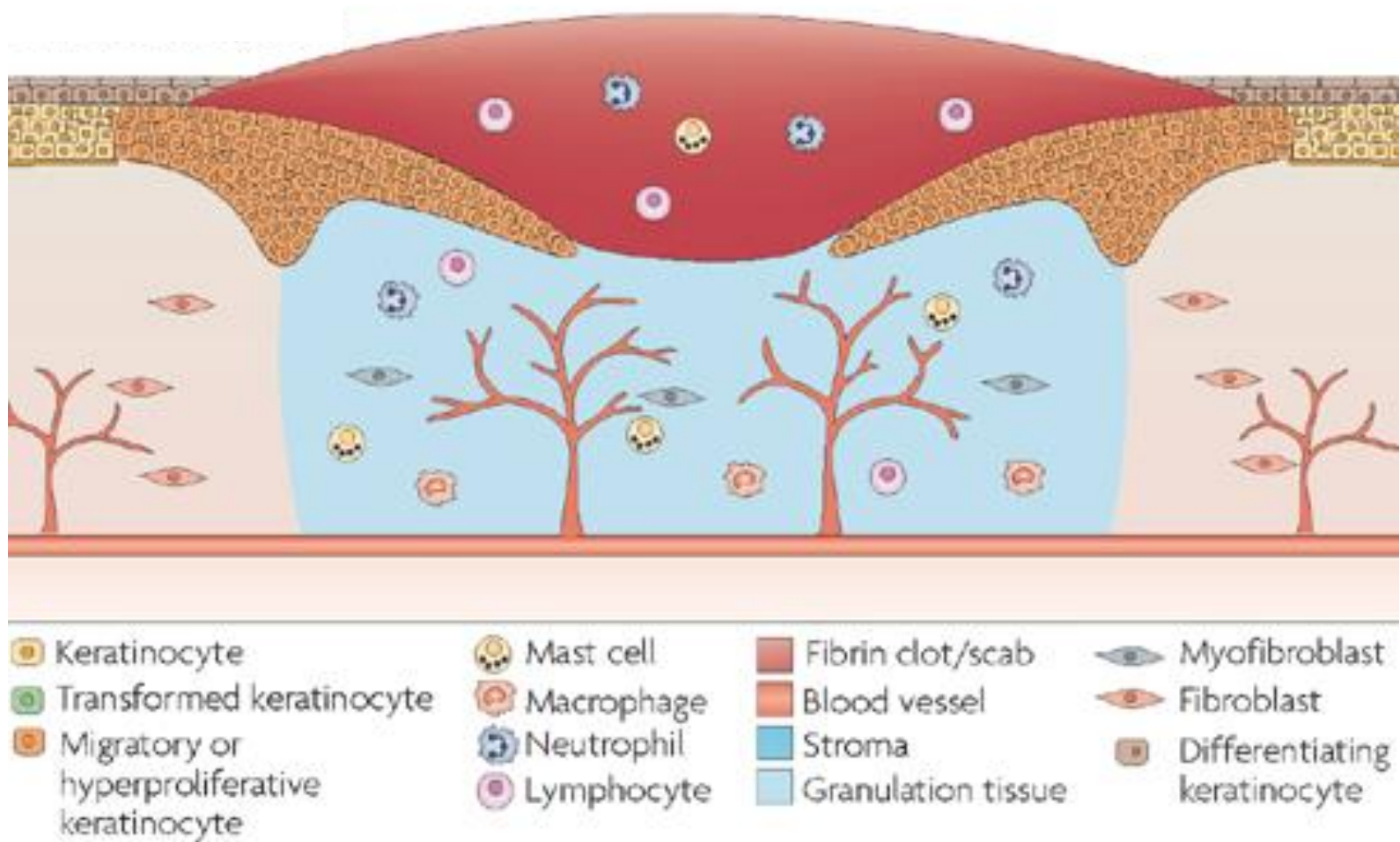
Tissue Homeostasis



Tissue Homeostasis

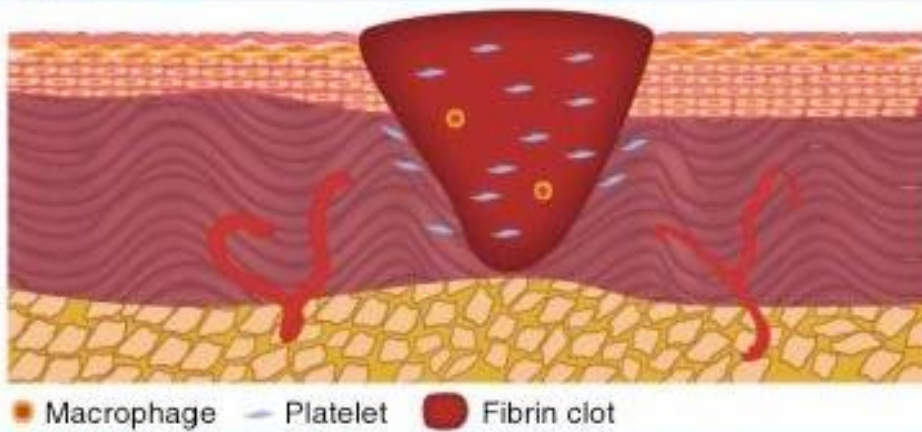


Tissue Repair

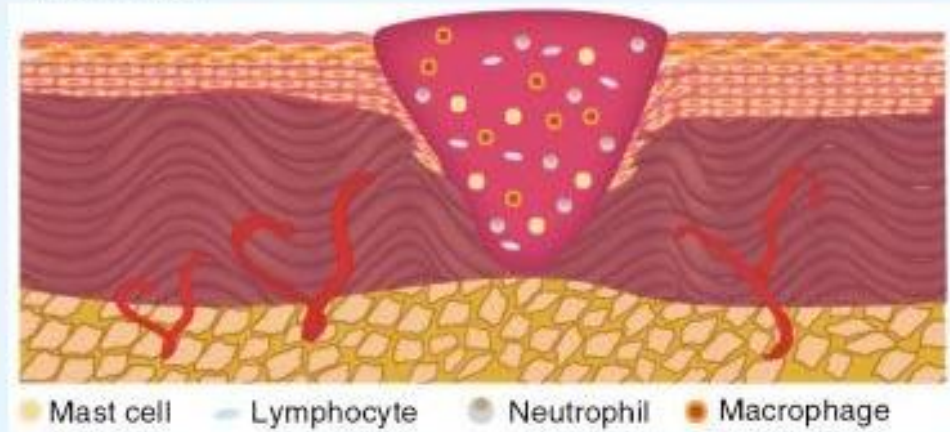


Tissue Repair – wound healing

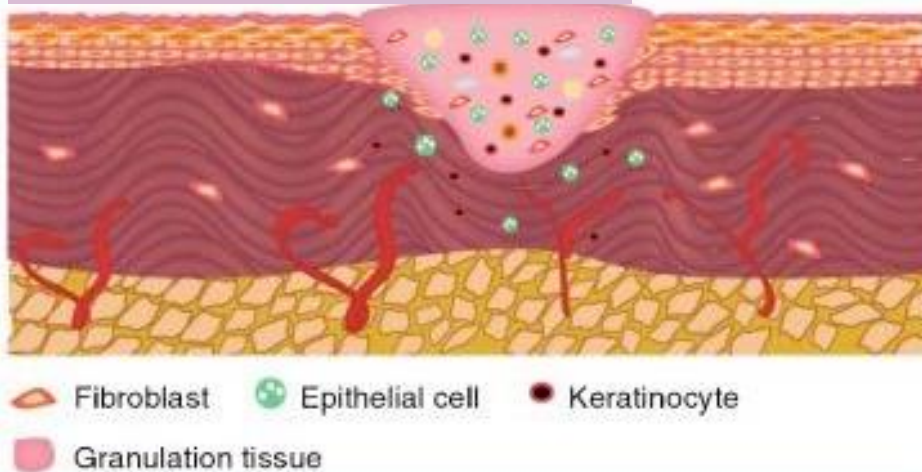
1. Hemostasis



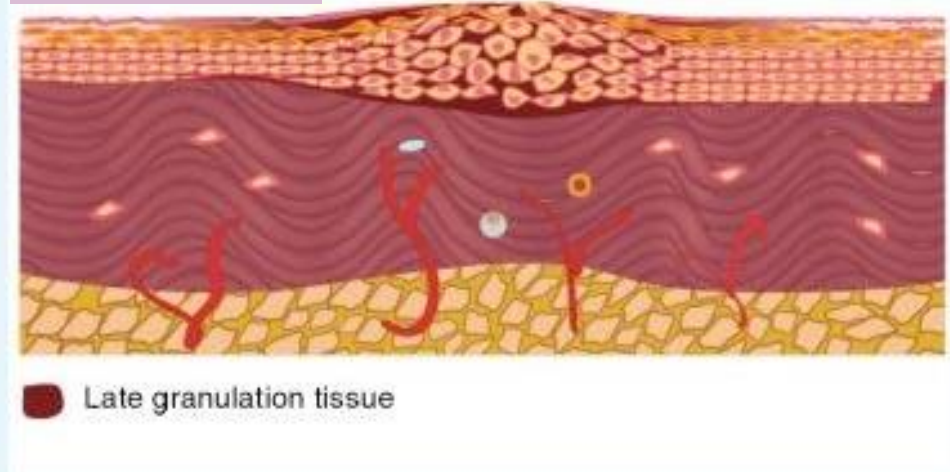
2. Inflammation



3. Migration and Proliferation

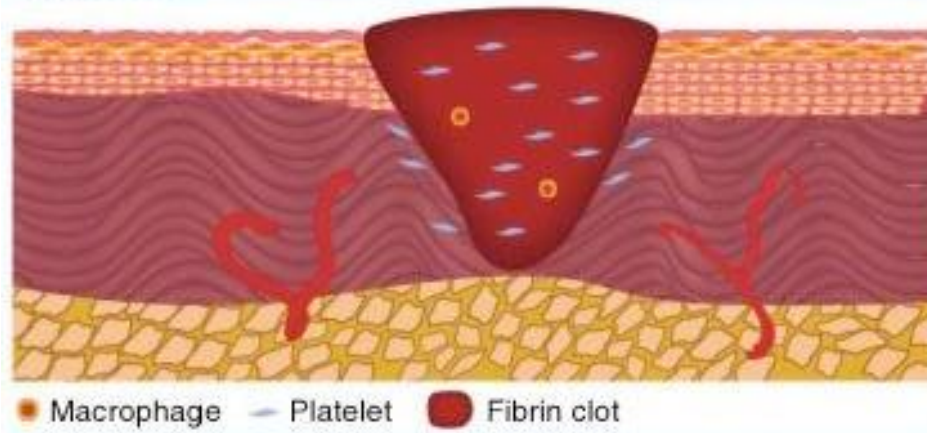


4. Maturation

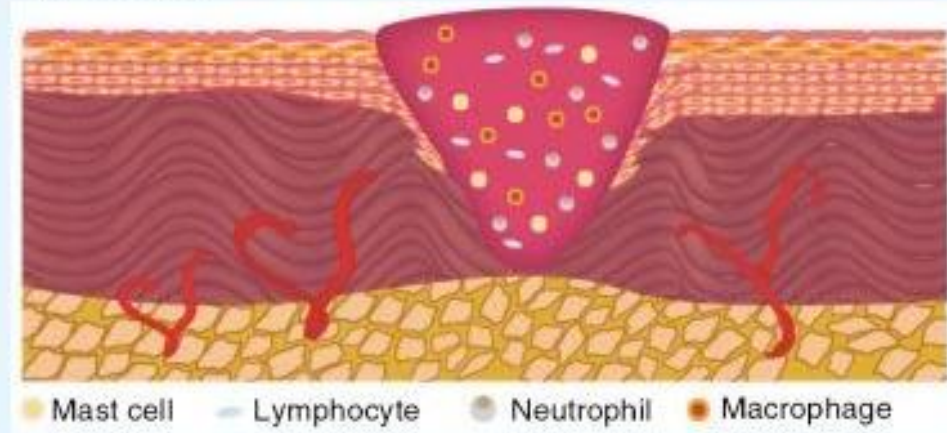


Tissue Repair – wound healing

1. Hemostasis

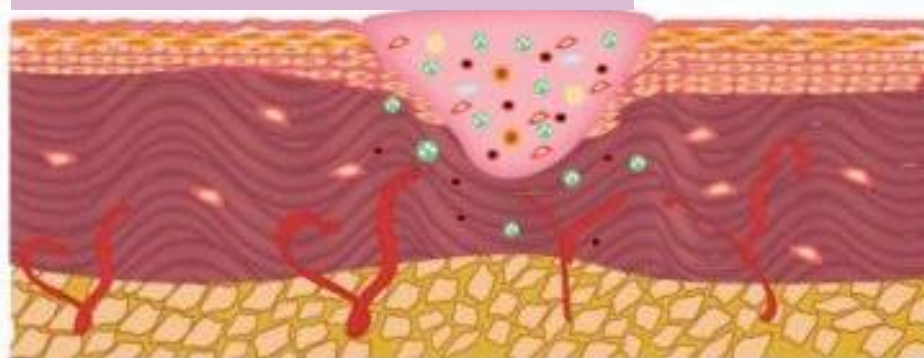


2. Inflammation



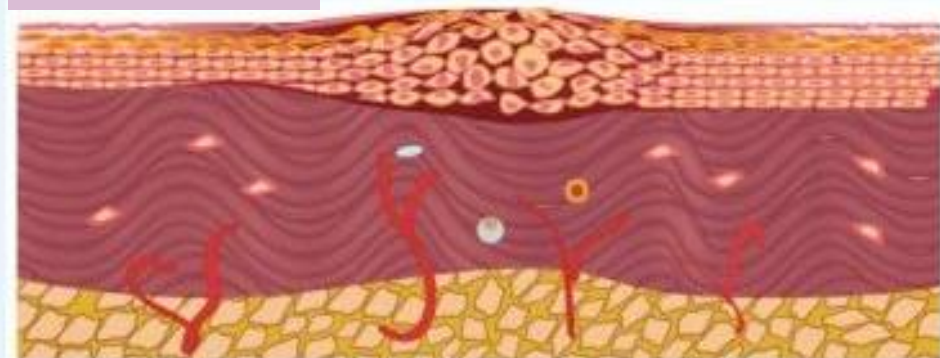
Tissue Repair – wound healing

3. Migration and Proliferation



- Fibroblast
- Epithelial cell
- Keratinocyte
- Granulation tissue

4. Maturation

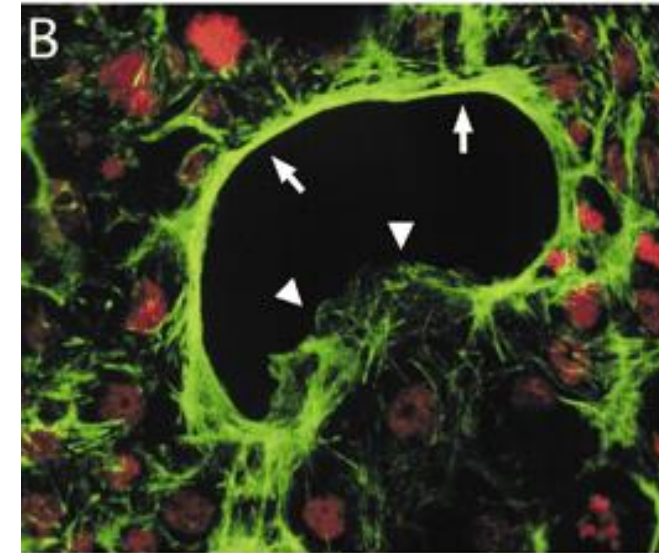


- Late granulation tissue

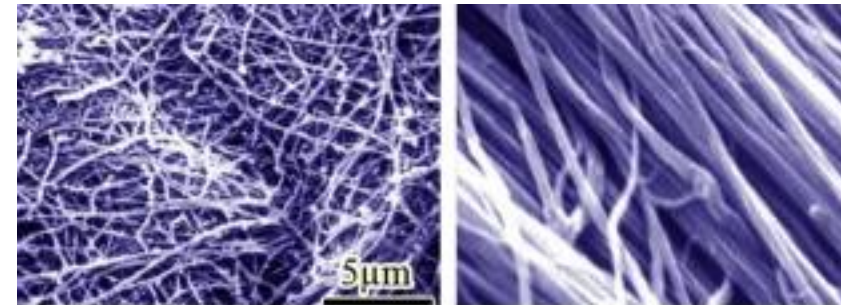
Tissue dynamics differ in adult and fetal wound healing

Adult	Fetal
Slow	Rapid
Imperfect	Efficient, minimal scarring
Contraction via myofibroblasts	Contraction via fibroblasts
Epithelial migration	Epithelial purse string
High inflammation	Minimal inflammation
High epithelial proliferation	Low epithelial penetration
Bundled collagen	"Basketweave" collagen
ECM – fibronectin and tenascin	ECM – Collagen III and hyaluronic acid
High tension	Low tension

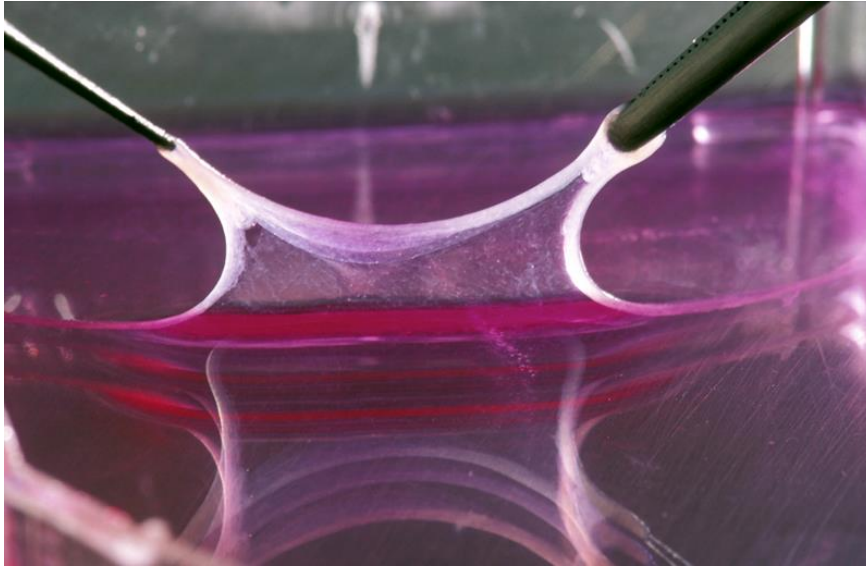
Actin "purse-string" closure



Collagen alignment

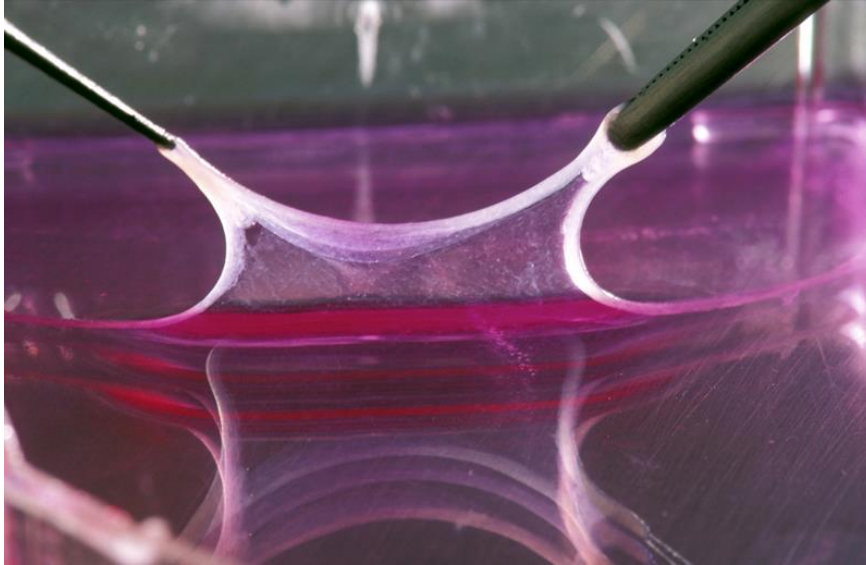


Tissue engineered solutions to wound healing

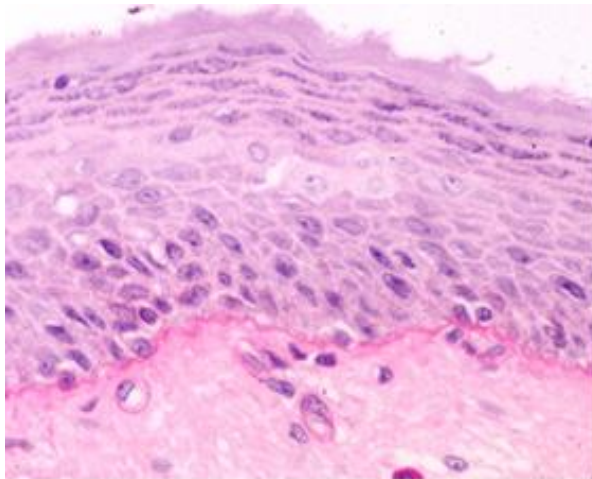


Xenograft
Allograft
Autograft

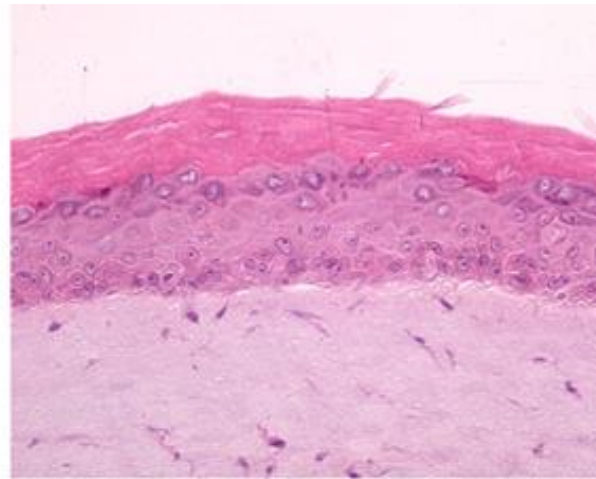
Tissue engineered solutions to wound healing



Xenograft
Allograft
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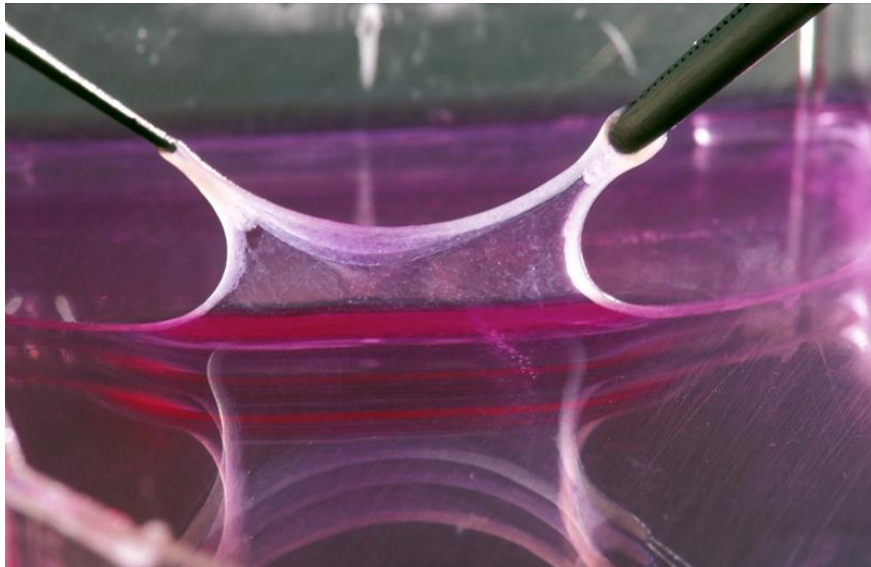


Human Skin

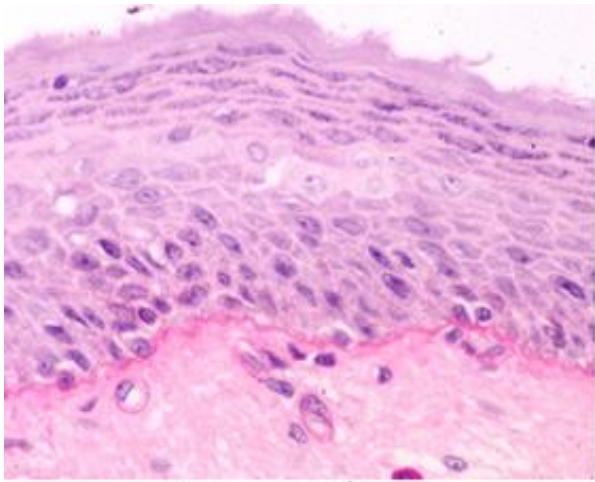


Human skin equivalent

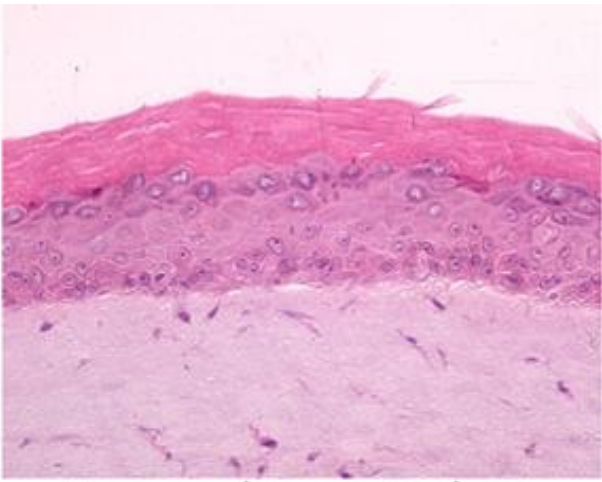
Tissue engineered solutions to wound healing



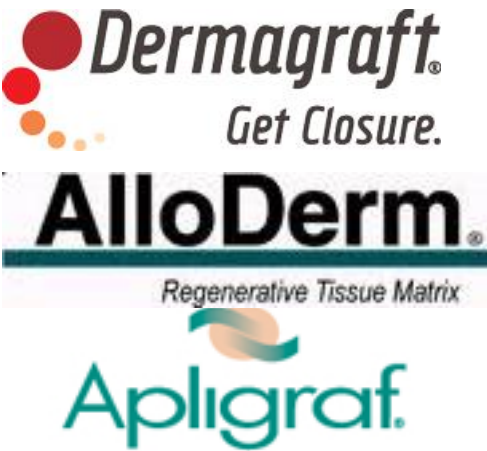
Xenograft
Allograft
Autograft



Human Skin



Human skin equivalent

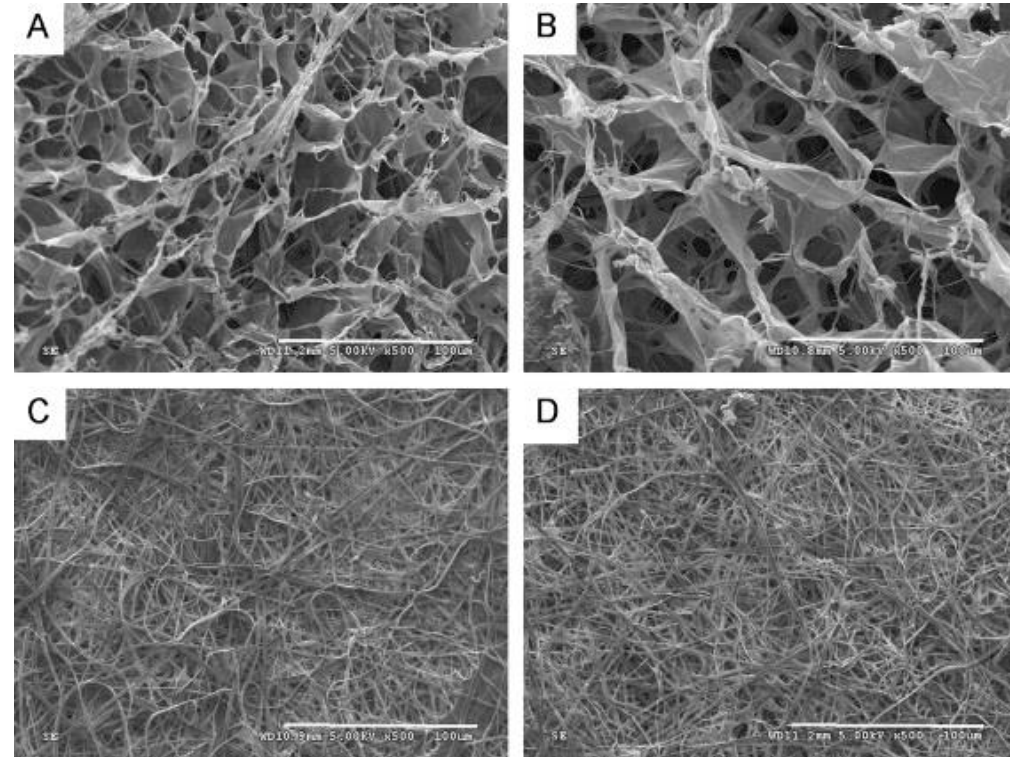


http://www.burnsurvivor.com/skin_substitutes.html
www.drshingledecker.com

<http://www.mdbiosciences.com/in-vitro/3d-human-skin-equivalent-model/>
<http://science.nationalgeographic.com/science/enlarge/skin-tissue-culture.html>

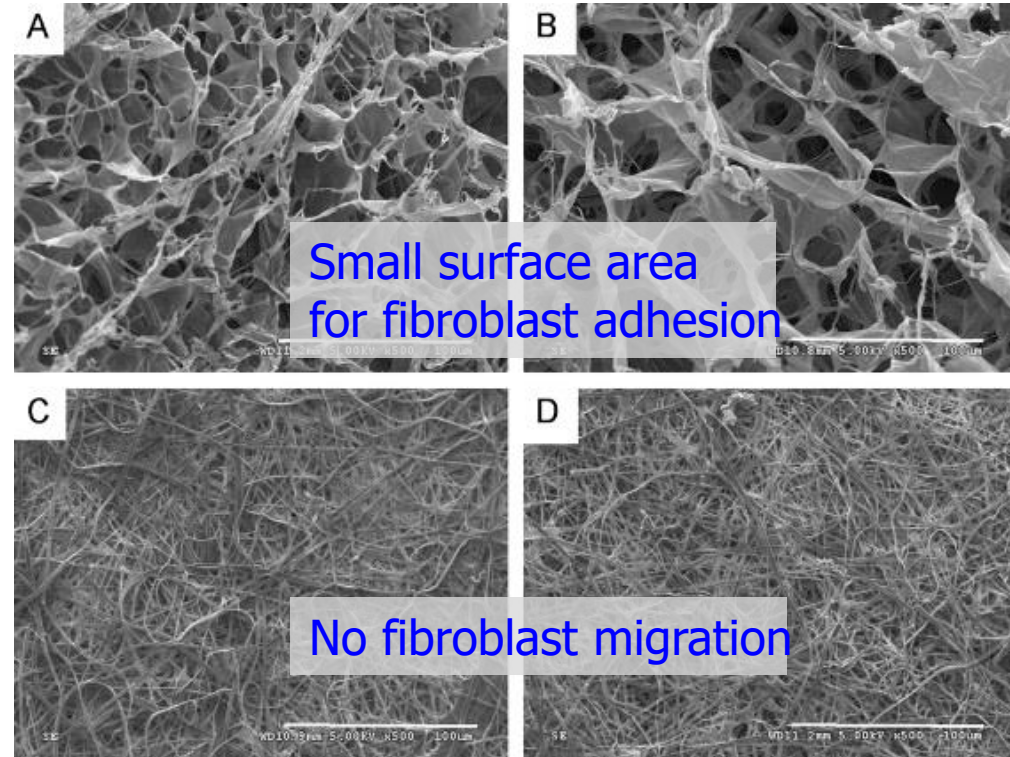
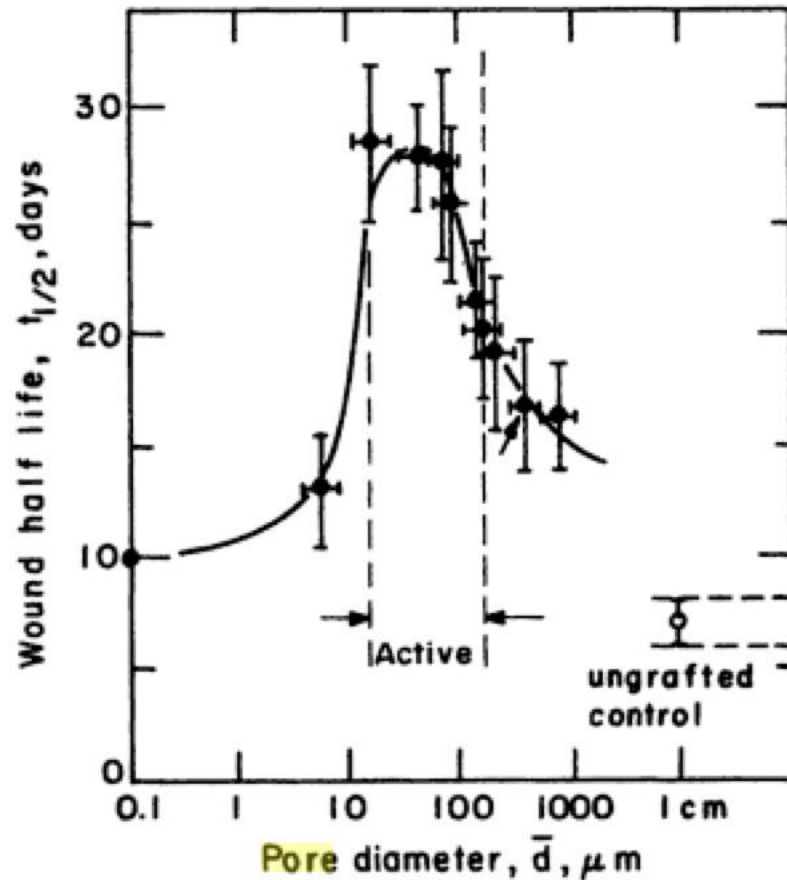
Tissue engineered solutions to wound healing

Pore size variation

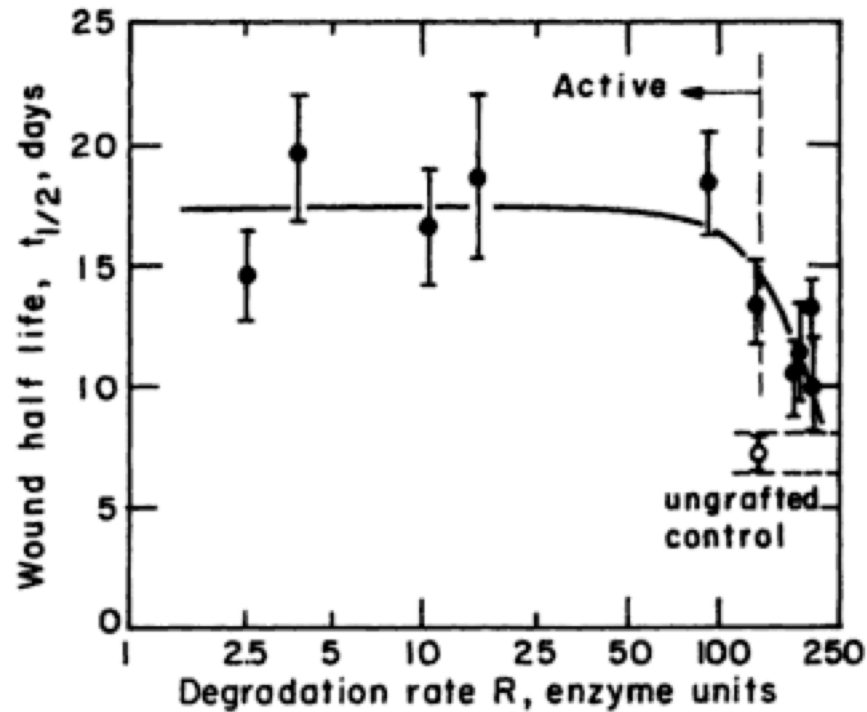


Tissue engineered solutions to wound healing

Pore size variation



Tissue engineered solutions to wound healing



$$\frac{t_d}{t_s} \approx 1$$

t_d - template degradation rate
 t_s - normal wound healing rate

Tissue Dynamics

Tissue Homeostasis
Tissue Repair
Tissue Formation

Cellular-fate
processes

1. Cell replication
2. Cell differentiation
3. Cell death
4. Cell motion
5. Cell adhesion

Next Module



- Cell and Tissue Engineering: Morphogenesis



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