BIOLOGICAL FRAMEWORKS FOR ENGINEERS

Session #28 [nm-m: Wrap-up]

General Objectives:

- ✓ Discuss the replacement of biologic tissues in the body with synthetic biomaterials or engineered tissues
- ✓ Provide an overview of the strengths and weakness of replacement parts

Central Framework:

- ✓ When tissues or systems in the body fail, our response is to replace that tissue with a synthetic or biological analog to perform the function of the original tissue.

Session Outline:

Replacement Body Parts

Why?

What do we need to know about the natural part to replace it?

Biologic or synthetic?

Biomaterial Science

From Temenoff & Mikos, *Biomaterials,* 2008 *(*Ch. 1)
http://www.coursesmart.com/9780136037835/chap01

A wide-ranging field that encompasses aspects of basic biology, medicine, engineering, and material science, that has developed to since World War II with the intent to develop materials that interface with biological systems to evaluate, treat, and augment, or replace any tissue, organ, or function of the body.

Common Examples:

Materials (Biocompatibility)

Choosing the Correct Material

Inert

Bioactive

Integration with the Body

Inflammation

Immune Response

Blood Clotting

Infection

Tumor formation (neoplasia)

Calcification

Types of Biomaterials

Metals

Ceramics

Polymers

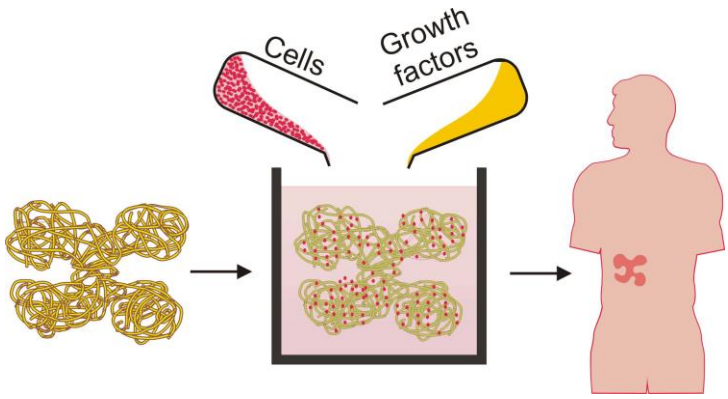
Biomaterial Properties

Tissue Engineering

A field that seeks to replace, repair or enhance biological function at the scale of a tissue or organ by manipulating cells via their extracellular environment.

Central Hypothesis:

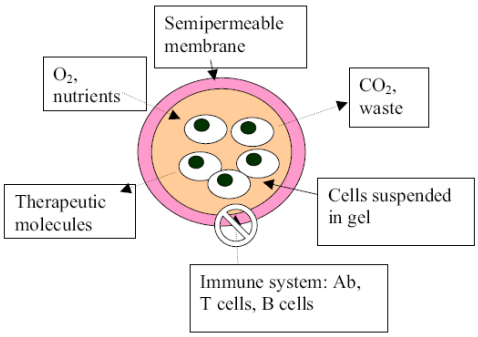
Cells + ECM + GF = New Tissue



Objectives:

Success Stories:

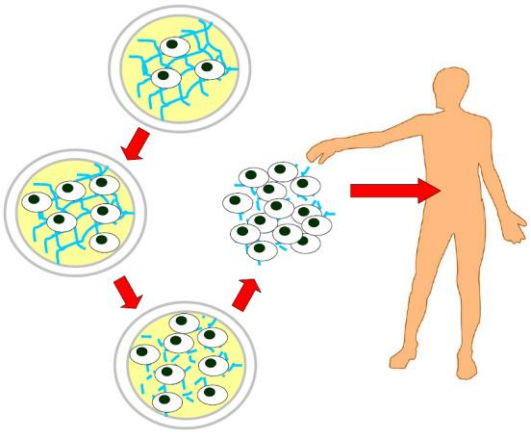
1. Extracorpeal/Microencapsulation Method:



Advantages:

Issues:

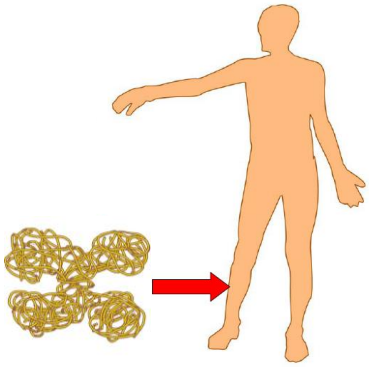
2. *In vitro* Synthesis *Method:*



Advantages:

Issues:

3. In vivo synthesis Method:



Advantages:

Issues:

Scaffolds for Tissue Generation

Purpose: replace functions of extracellular matrix (ECM)

ECM functions:

Materials:

Design issues:

Fabrication:

The Big Picture

Scale of Life

Coding

Signaling

Structure-Function

System Integration

Structural Integration

Biology vs. Engineering