

## Biomaterials - Tissue Interactions

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### Homework #1

1. Major problems with silicone breast implants (Fig. 1) are the thickening and contraction of the fibrous tissue (scar) capsule that forms around the device. Write the unit cell process(es) that are responsible for this thickening and contraction. Name possible regulators when they are known.
  
2. You have been hired by a firm to assist in the development of permanent (*i.e.*, nonabsorbable) porous coatings to be applied to joint replacement prostheses to facilitate the fixation of the implant to bone. Bone is to form within the pores of a metal mesh material (Fig. 2) and thereby form an interlocking bond with the metal mesh coating of the prosthesis (“bone ingrowth” for “biological fixation”).
  - a. Which unit cell process(es) are responsible for bone ingrowth? No need to name the regulators here.
  - b. Since the goal is to accelerate the bone ingrowth process your boss has suggested that certain regulators be incorporated into the coating in some way to be released after implantation. Which regulator(s) might be tried to achieve this goal, based on the UCP(s) in (a)?
  - c. It has also been suggested that the bone ingrowth process will proceed more rapidly if new blood vessels are encouraged to also invade the pores of the material. Could a single regulator be used to accelerate new blood vessel invasion and also bone ingrowth? If so, name the regulator if you know it and show which relevant UCPs for bone formation and blood vessel growth it would influence.



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Fig. 1. Retrieved silicone breast implant surrounded by a contracting fibrous capsule.

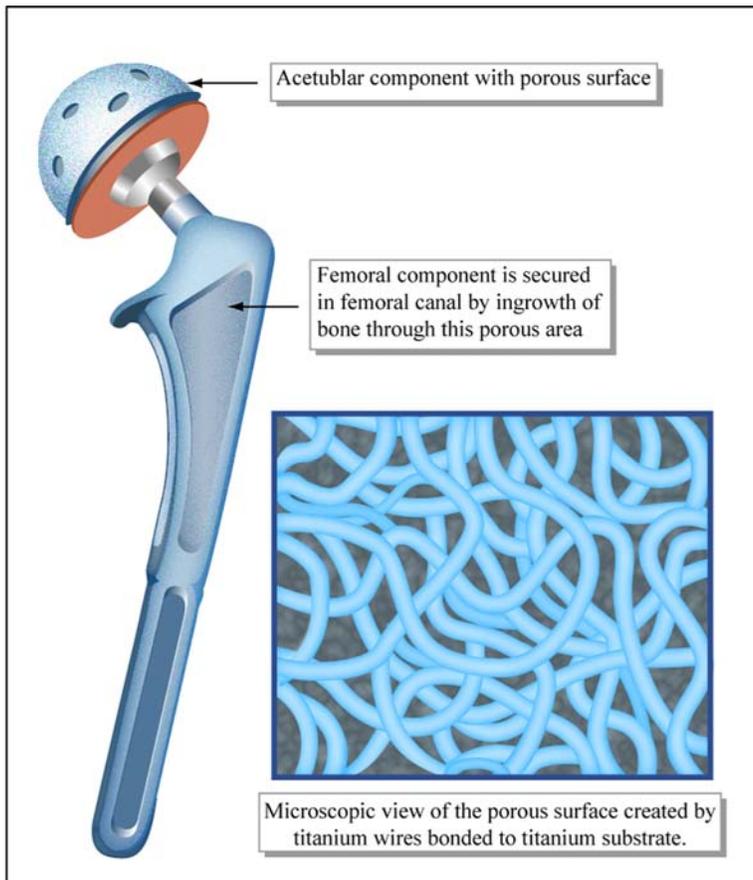


Photo of mesh acetabular cup removed due to copyright restrictions.

Fig. 2. a) Various forms of a metal mesh are used as coatings for certain hip prostheses to serve as the bone attachment vehicle. b) An acetabular cup in a higher magnification view shows such a coating. Bone tissue ingrowth into the metal mesh will allow fixation to be achieved.

Figure by MIT OpenCourseWare.

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20.441J / 2.79J / 3.96J / HST.522J Biomaterials-Tissue Interactions  
Fall 2009

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