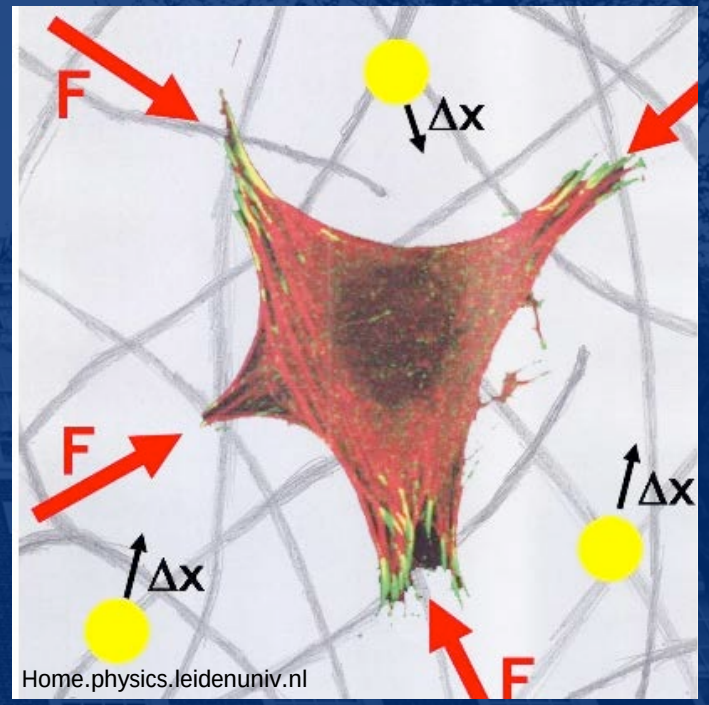
JOHNS HOPKINS
WHITING SCHOOL
of ENGINEERING

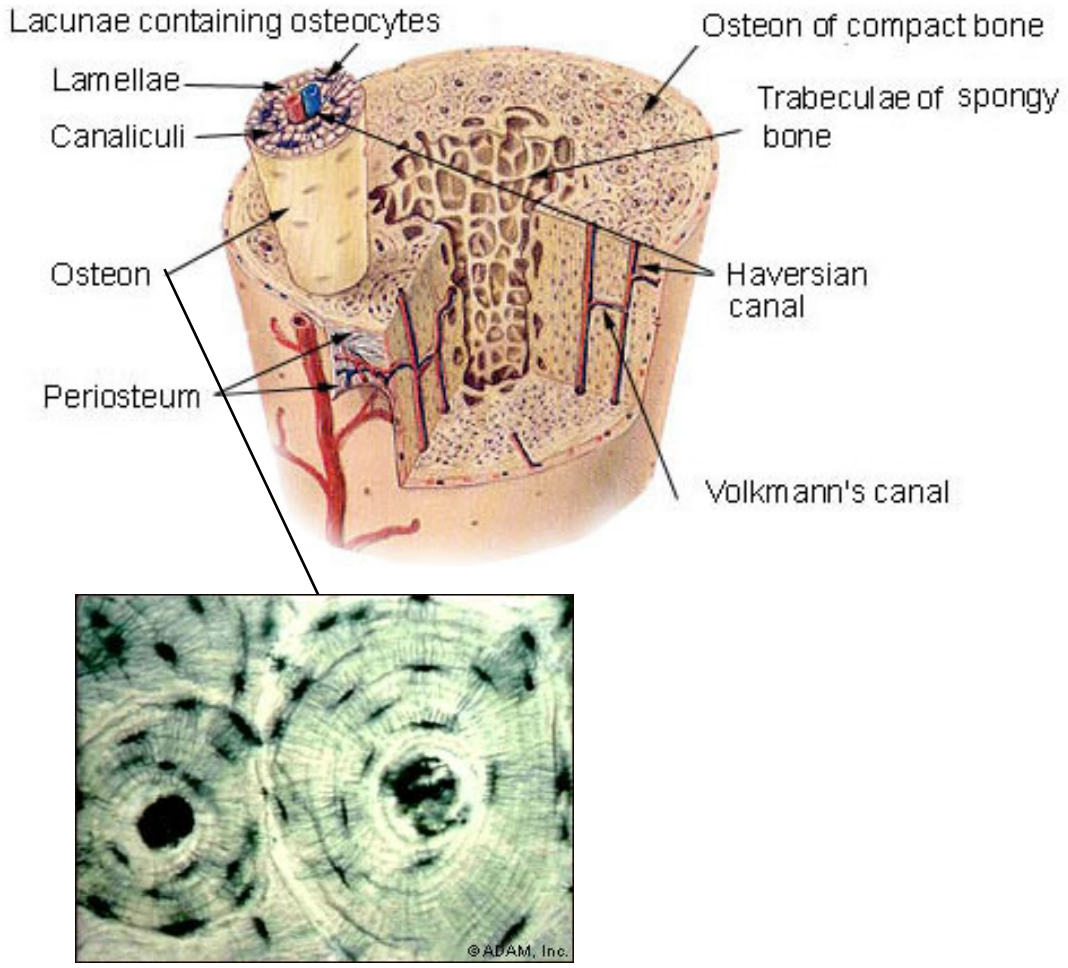
Cell and Tissue Engineering

Biomechanics of Bone and Cartilage



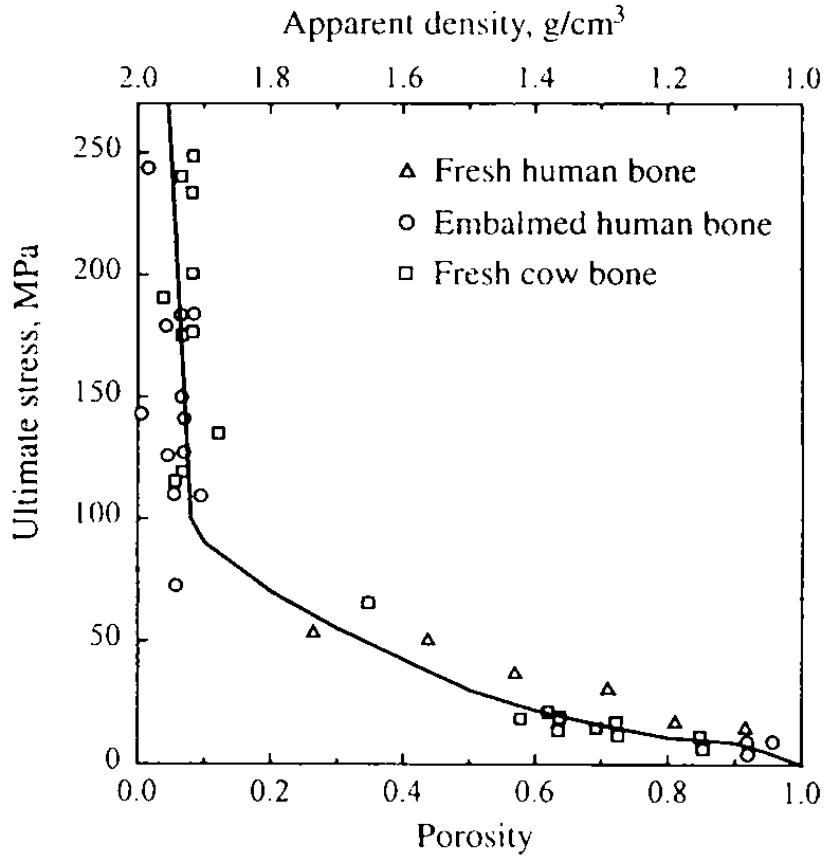
Home.physics.leidenuniv.nl

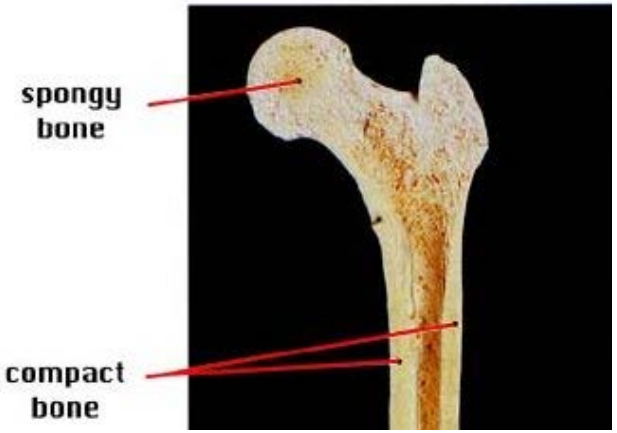
Biomechanics of bone

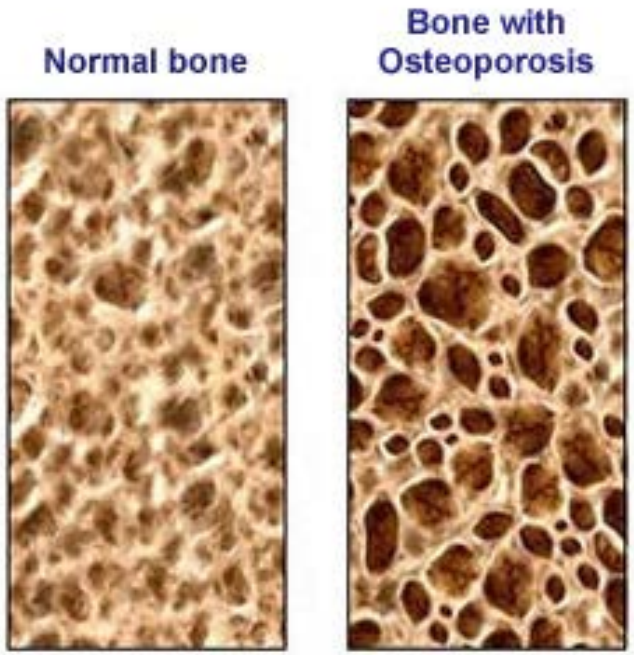


Wikipedia.org; Nytimes.com

Biomechanics of bone

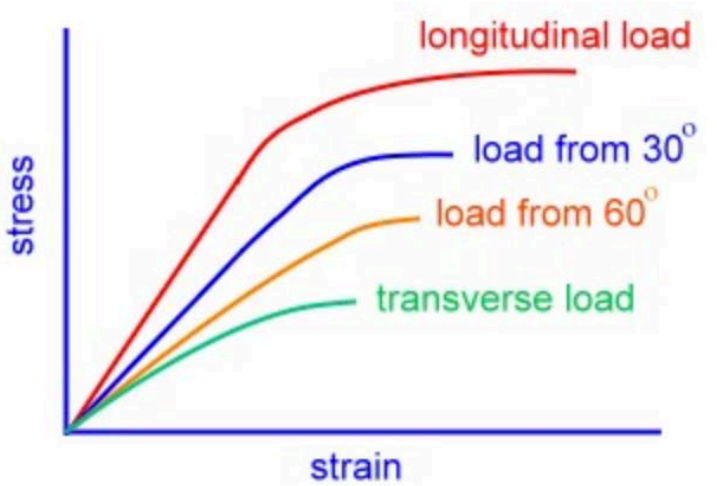




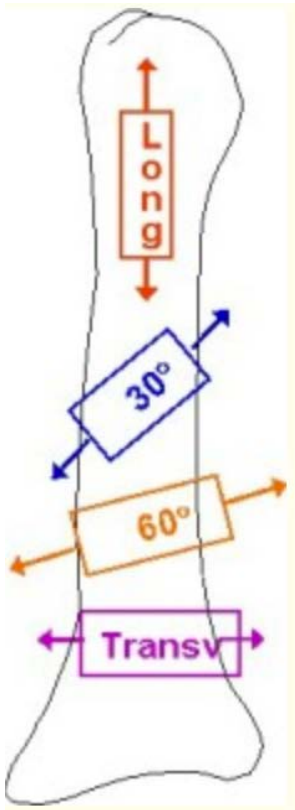


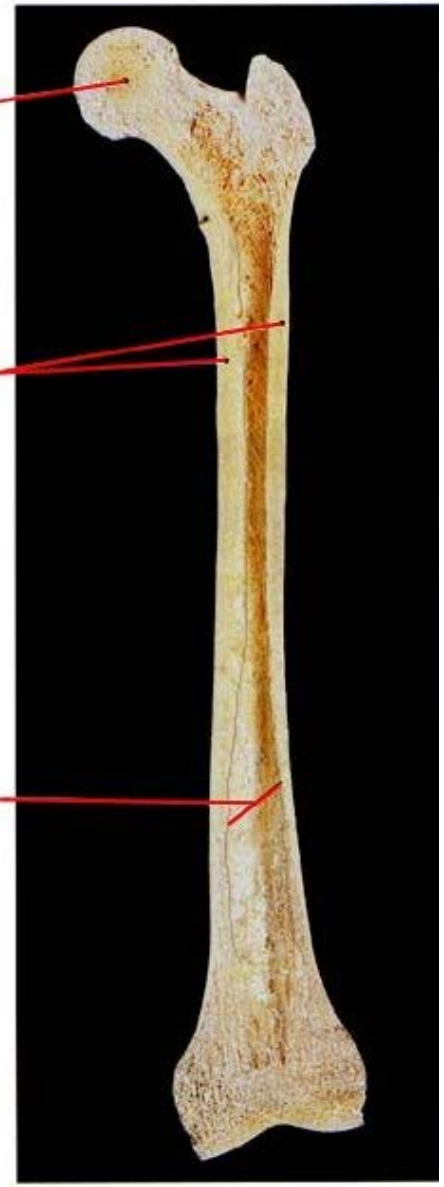
Porosity decreases bone stiffness and tensile strength

Biomechanics of bone



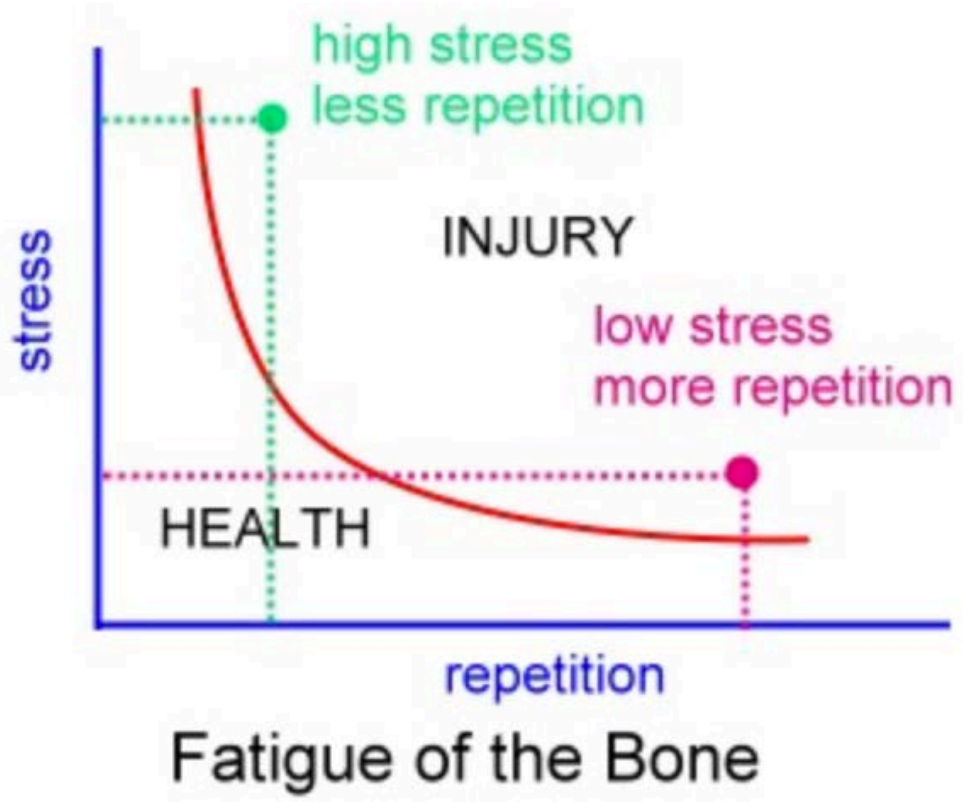
Anisotropic Behavior of the Bone





Pt.ndu.edu.tw; Daviddarling.info

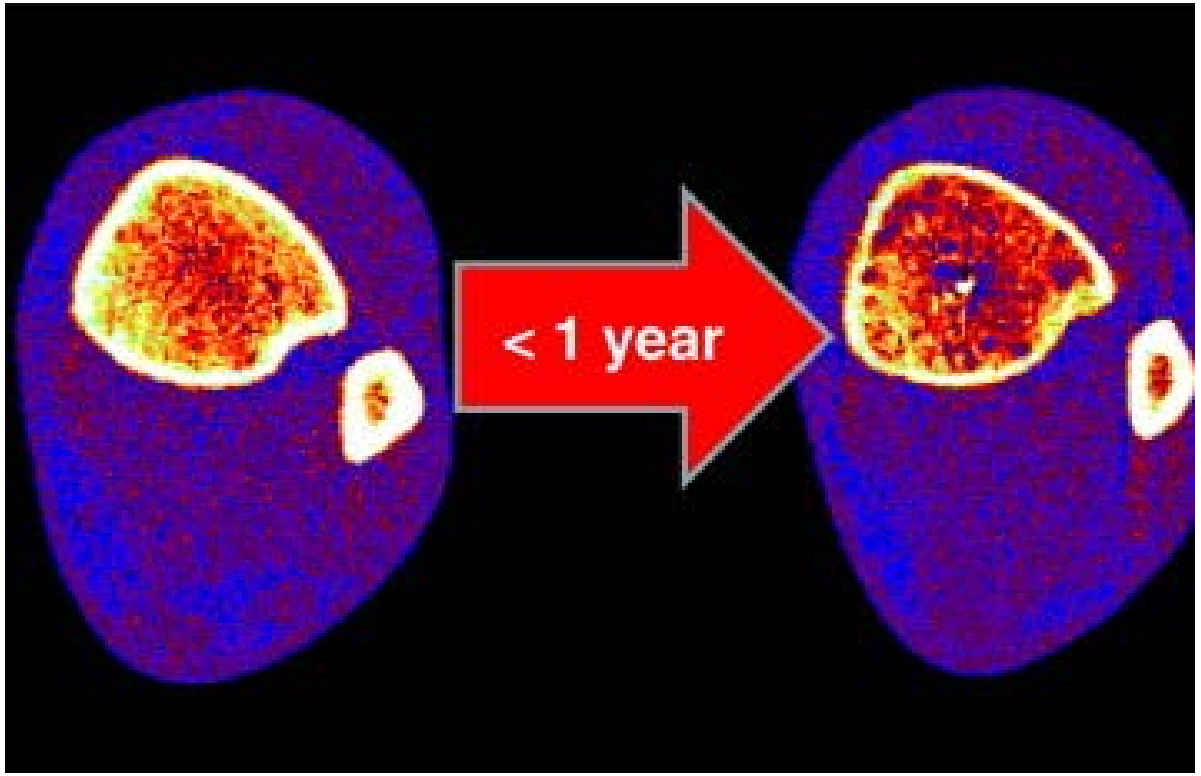
Biomechanics of bone

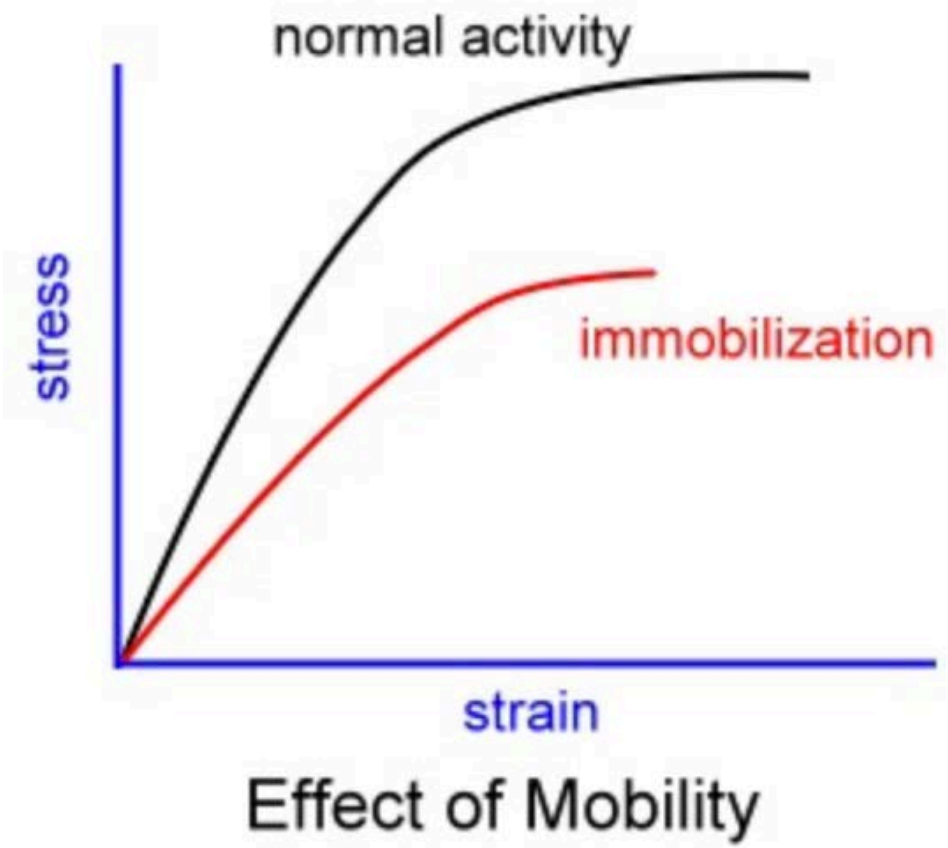


Fatigue of the Bone

Pt.ndu.edu.tw; Musculoskeletalnetwork.com

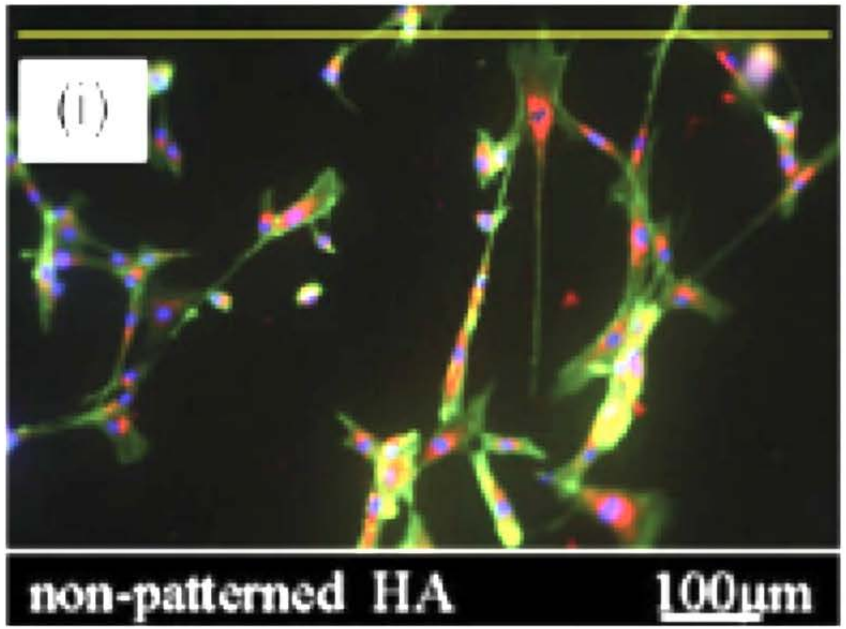
Biomechanics of bone

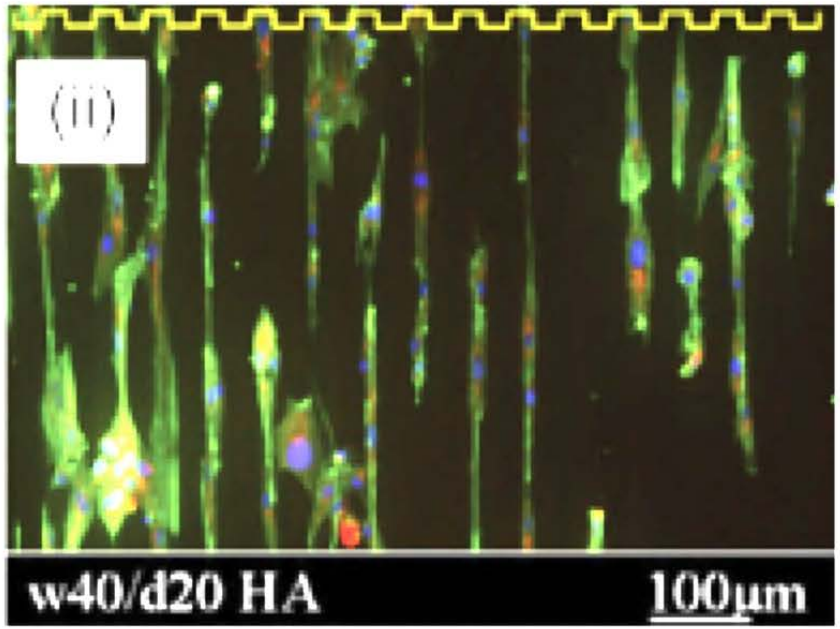


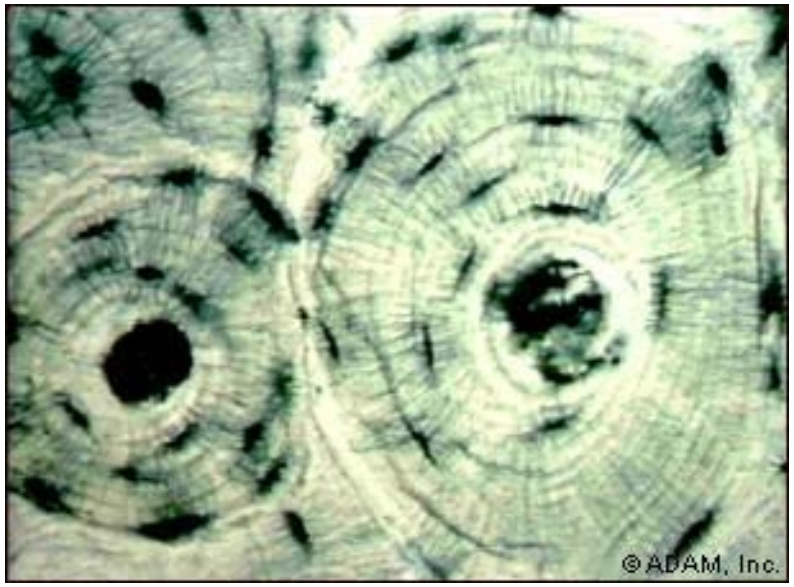


Effect of Mobility

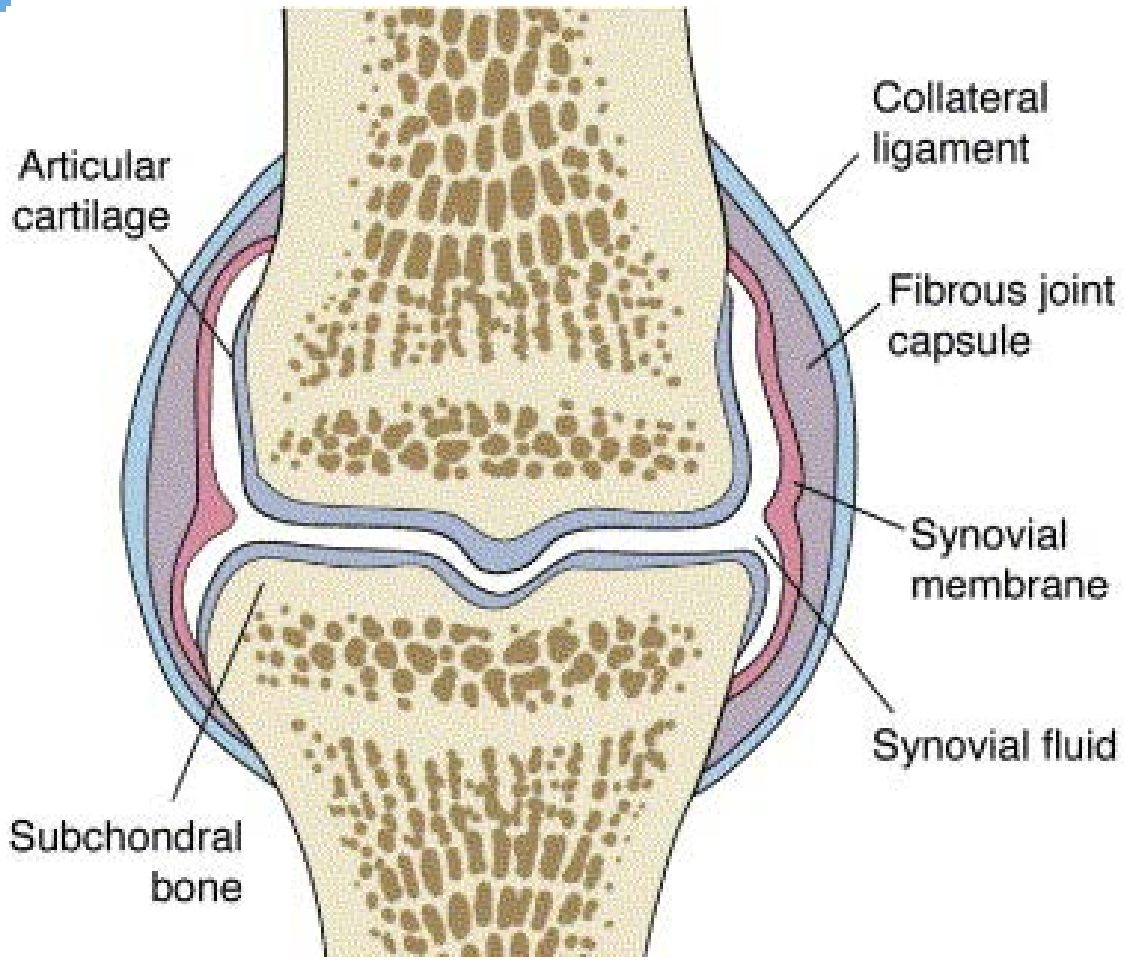
Biomechanics of bone







Biomechanics of cartilage



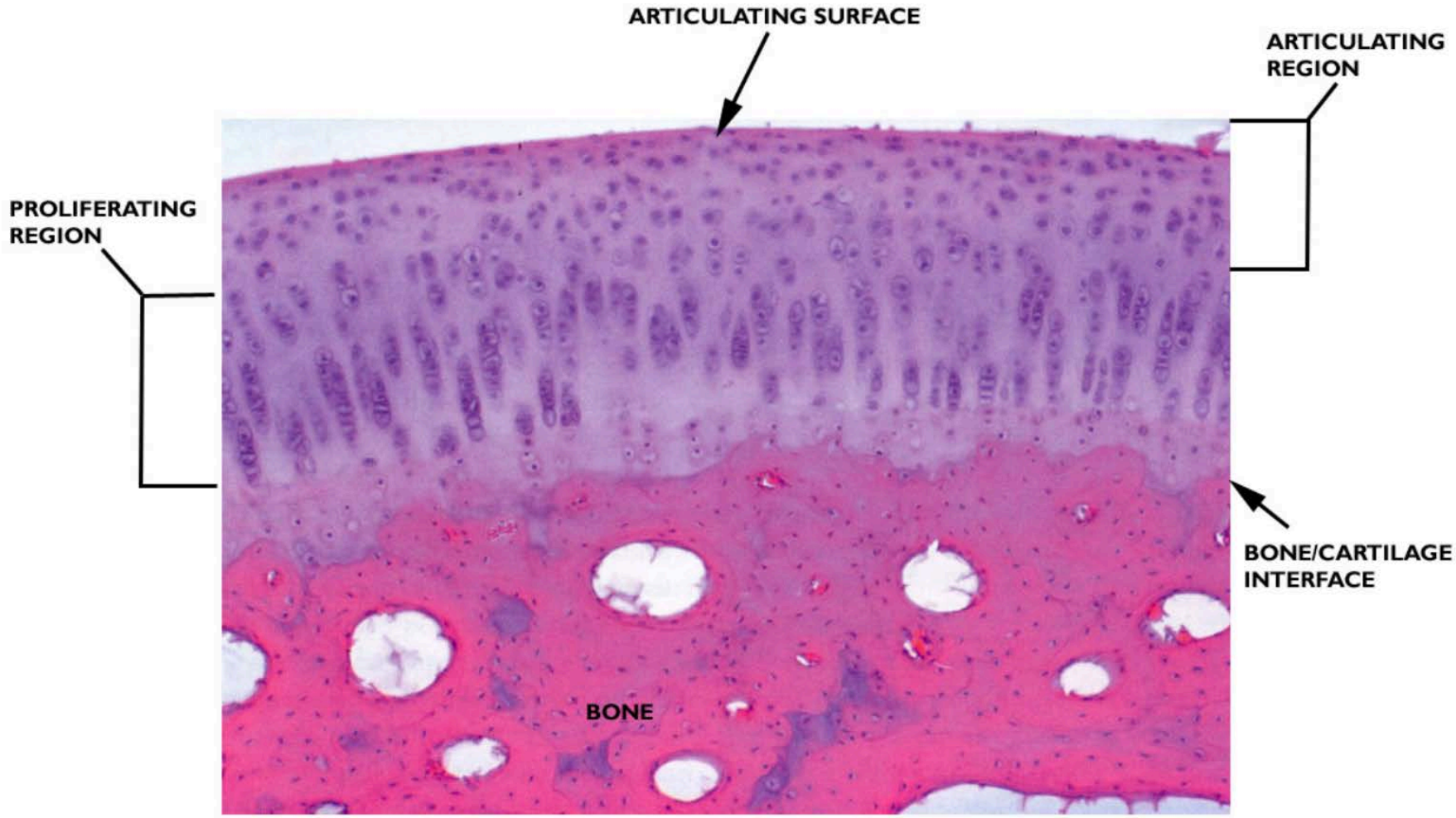
~200,000 knee replacements in 2010

~ 1,065,000 in 2020

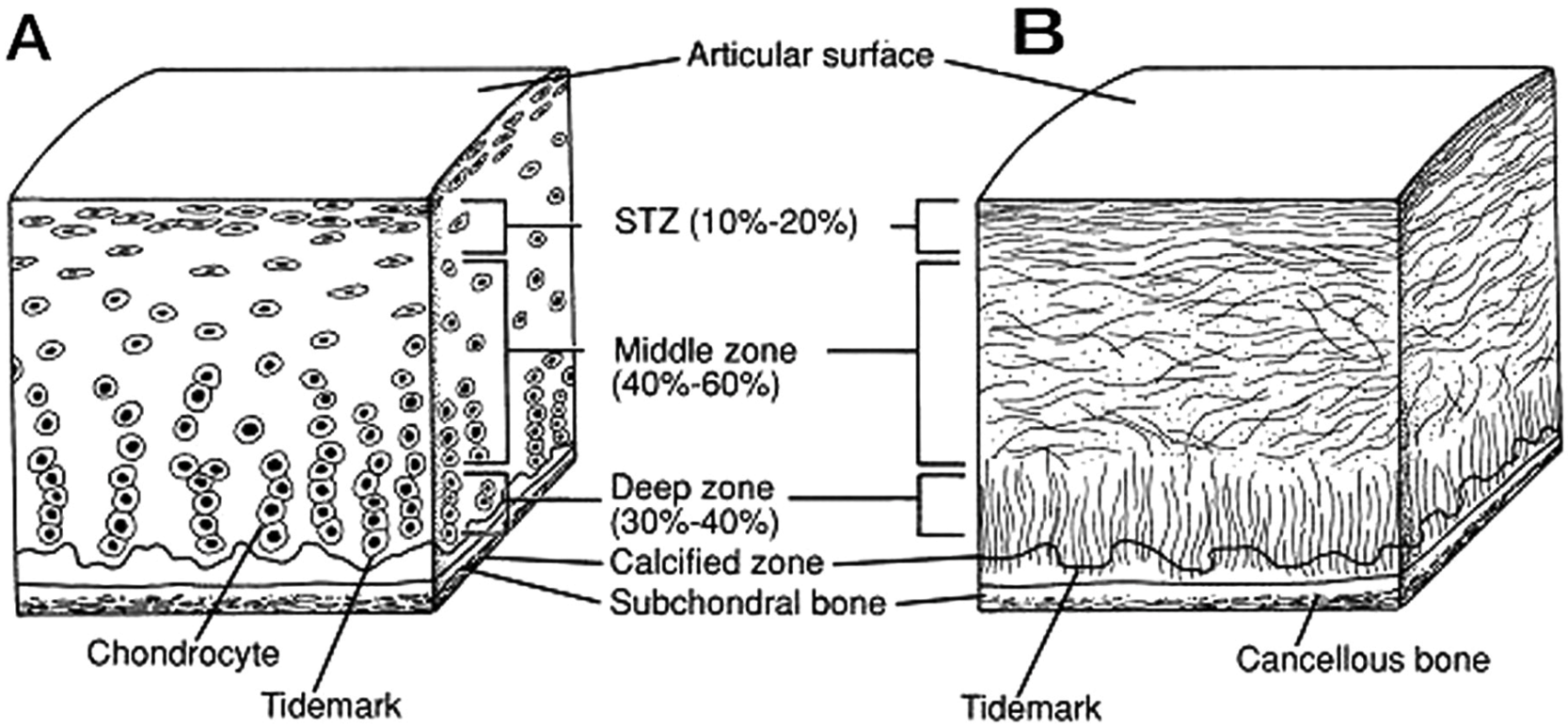
Expected to reach 3.5million by 2040

van Weeren 2006; Advisory.com; Cleveland 2019

Biomechanics of cartilage



Biomechanics of cartilage

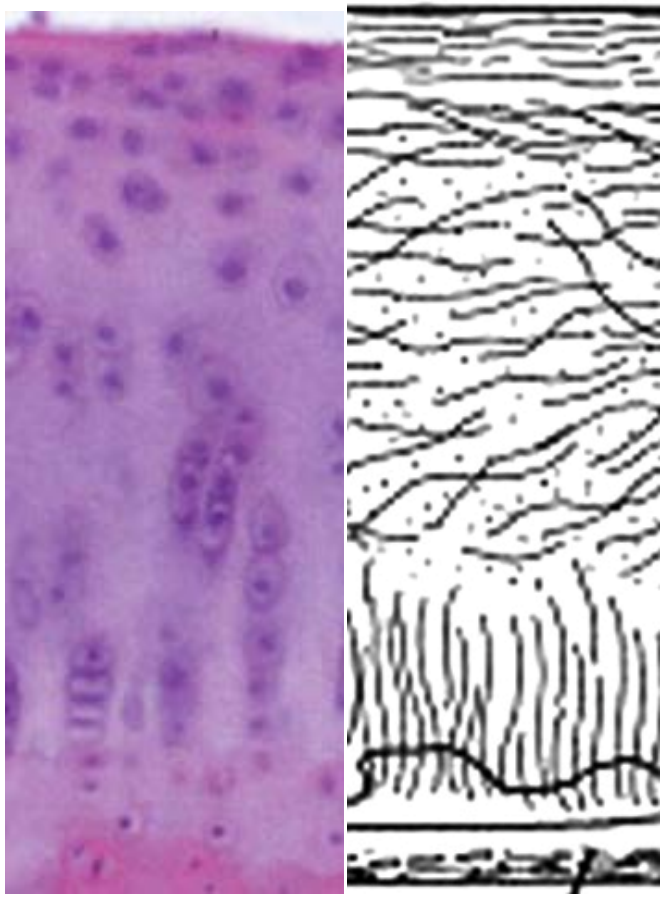


Structural homogeneity across three zones:

Superficial zone
Middle zone
Deep zone

Biomechanics of cartilage

Articular surface



Subchondral bone

Biphasic material

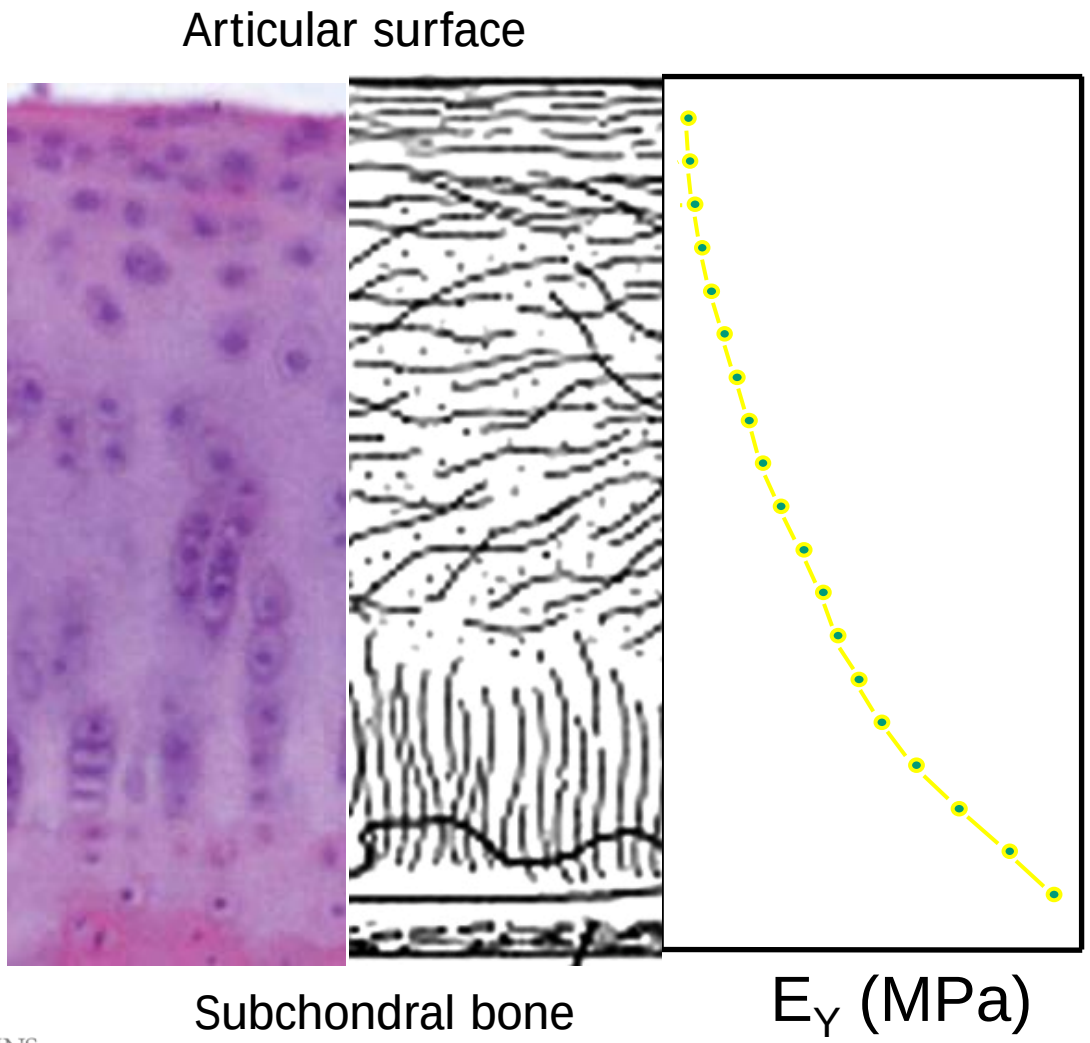
Solid phase - matrix

Fluid phase - water

Anisotropic

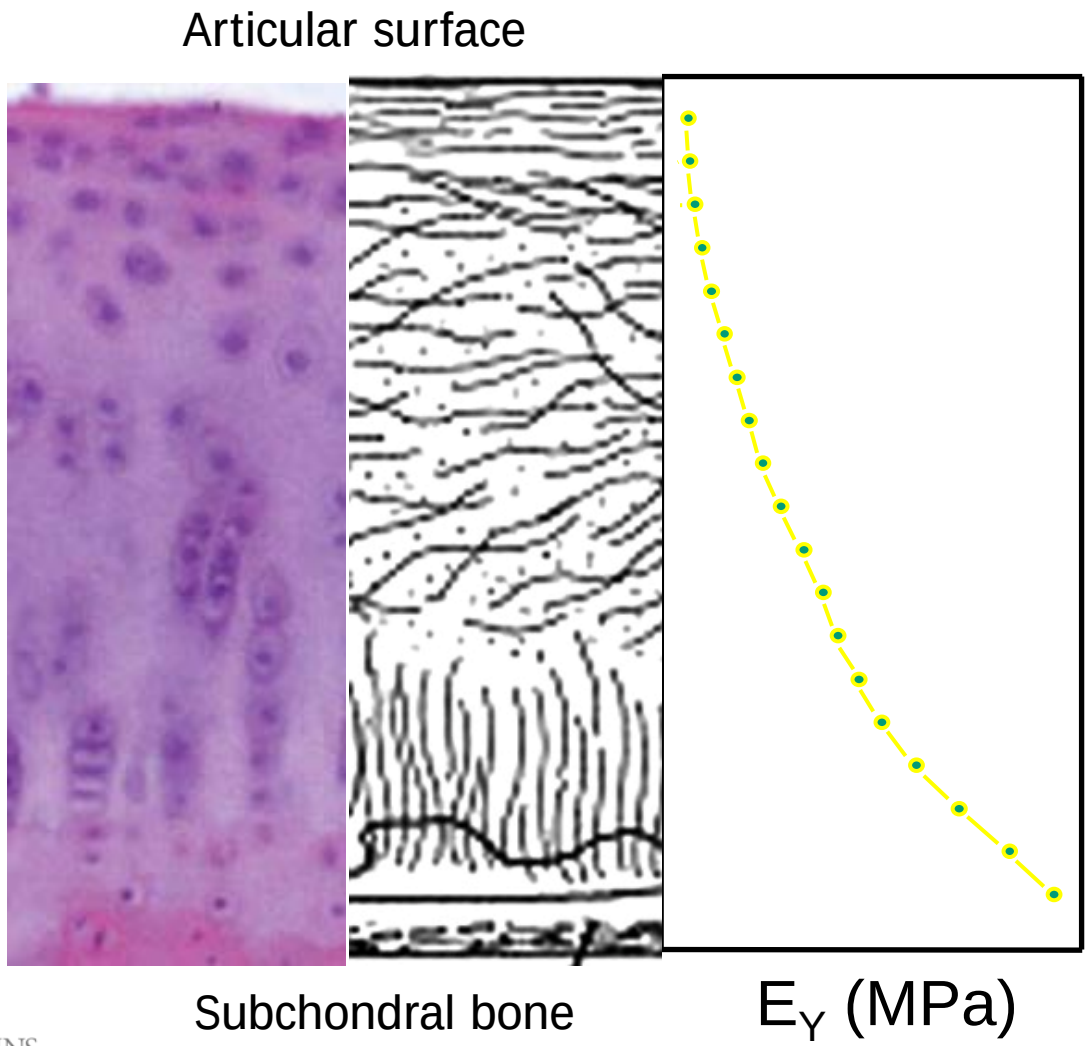
Non-linear

Biomechanics of cartilage

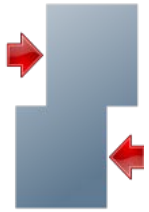


Young's modulus is a function of distance from the surface

Biomechanics of cartilage



RESISTS:
Shearing loads

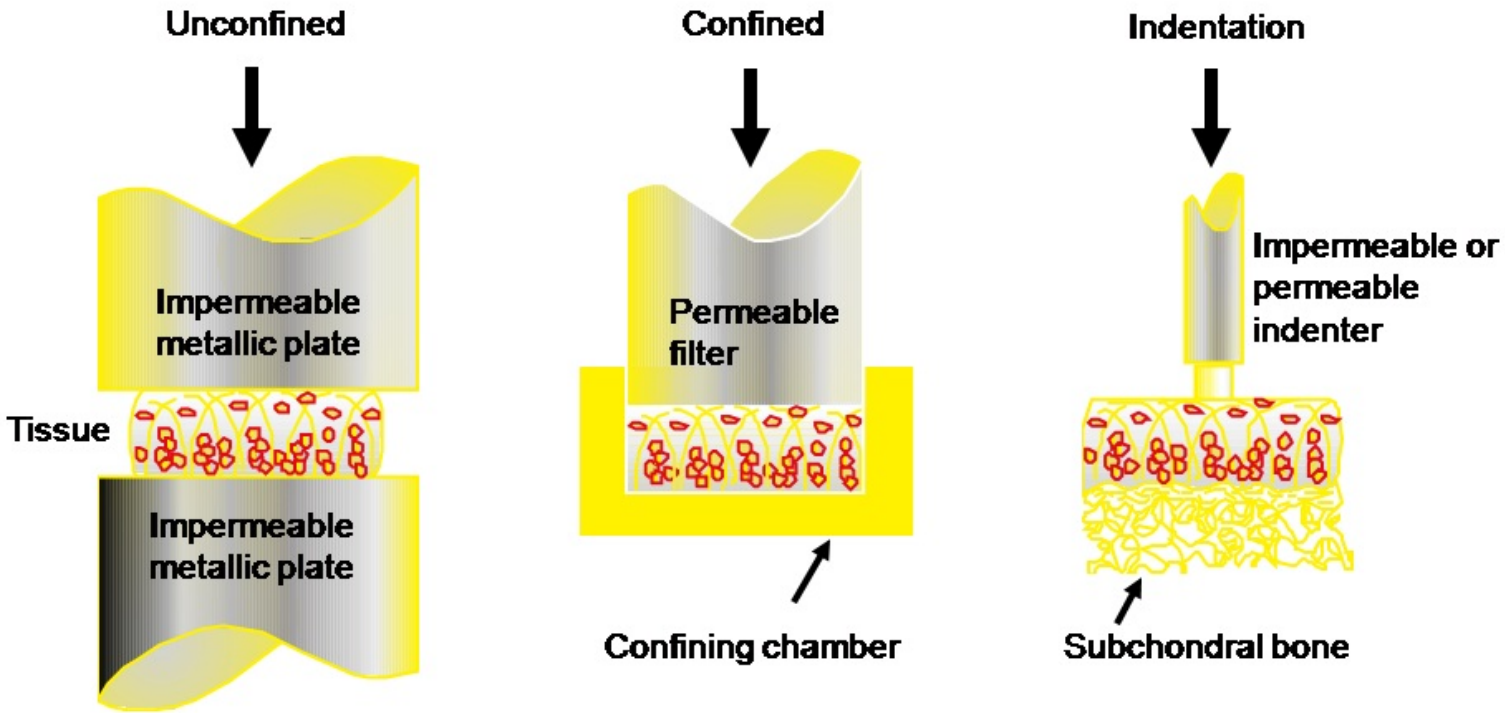


Compressive loads

Tensile loads

Biomechanics of cartilage

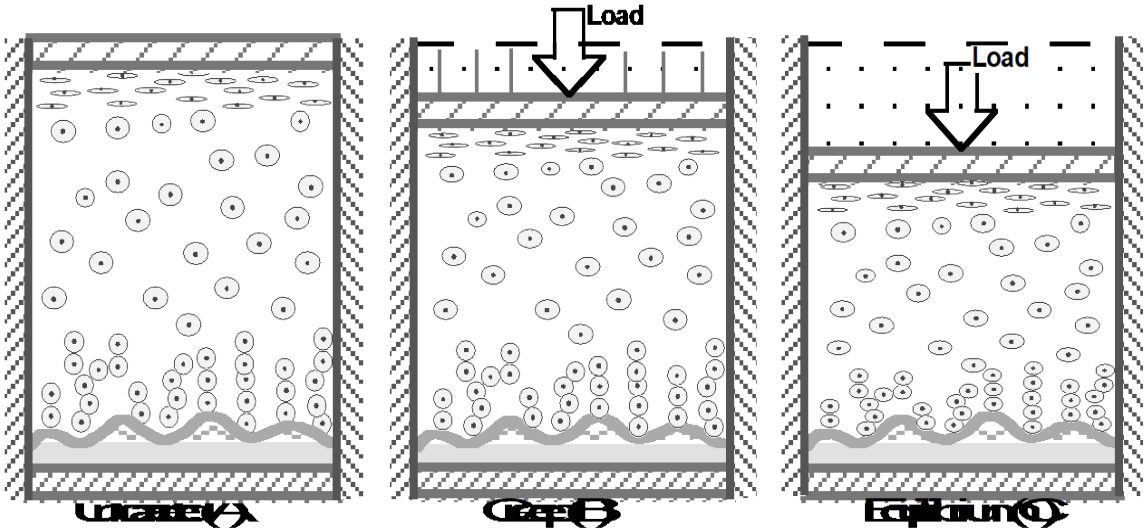
Indentation test
Unconfined compression test
Confined compression test



Korhonen and Saarakkala, 2011

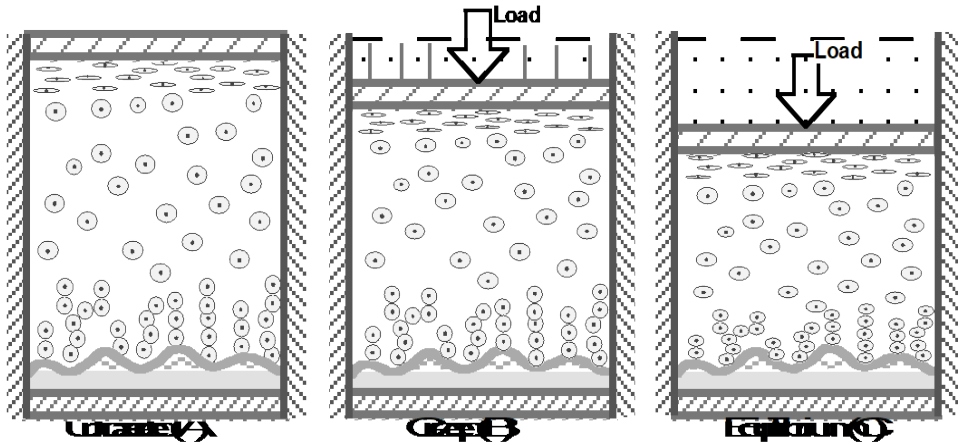
Biomechanics of cartilage

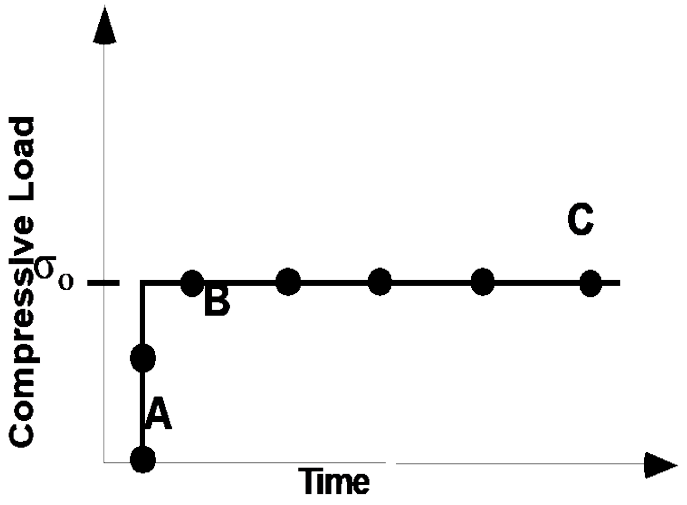
Confined compression test

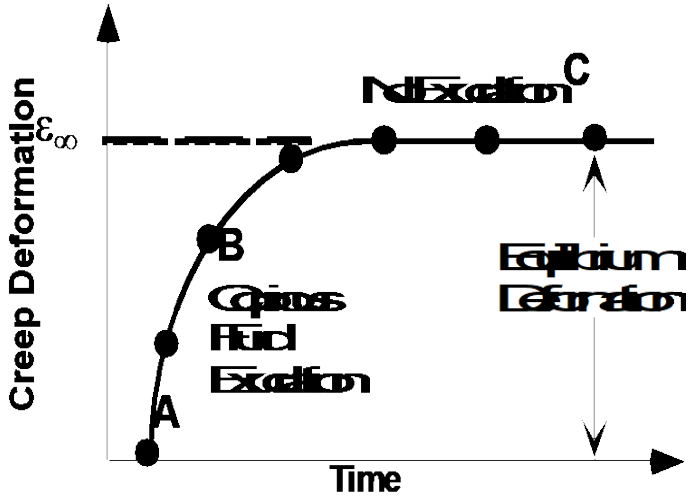


Biomechanics of cartilage

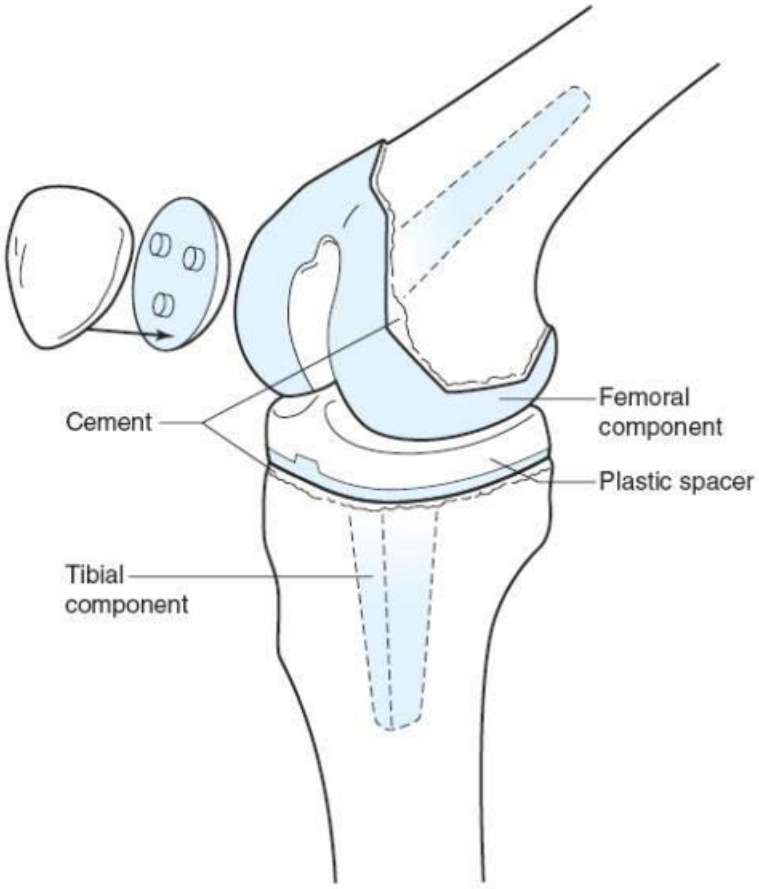
Confined compression test





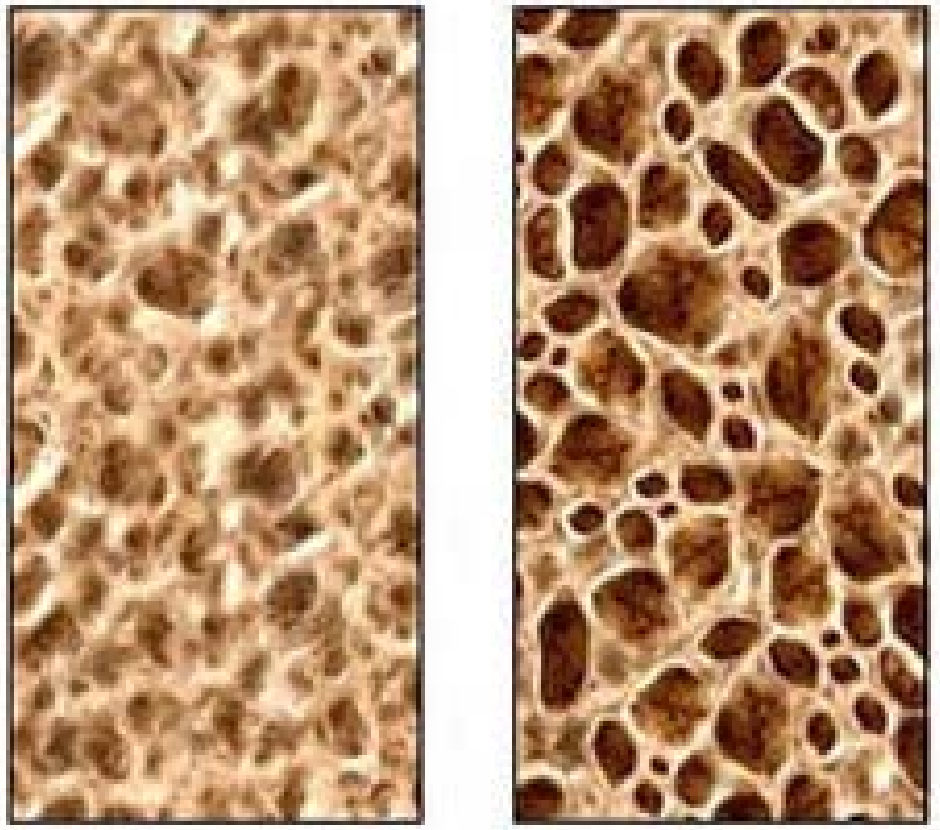


Biomechanics of cartilage

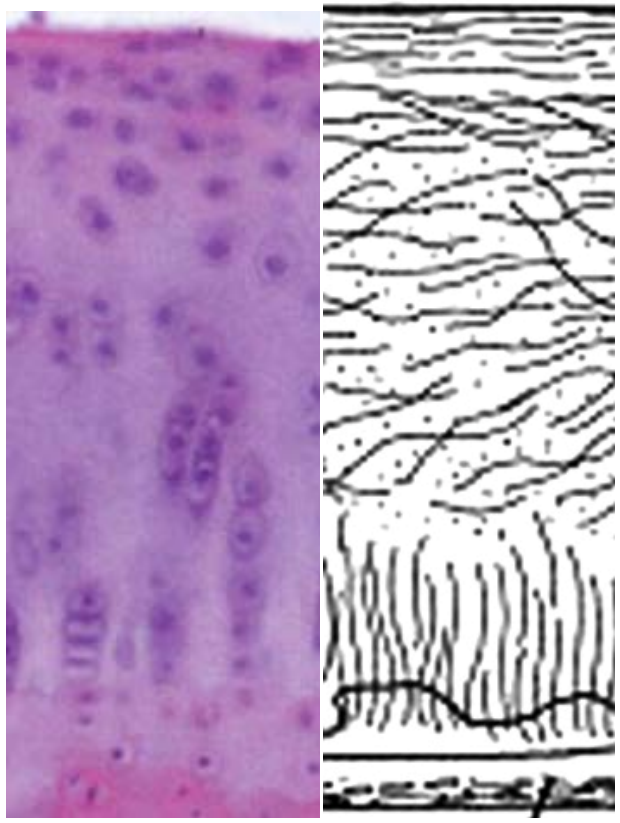


Review and rewind

Bone



Cartilage



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