

BioFluid Mechanics
& BioHeat Transfer



Bio-
Engineering

Medical
Physics

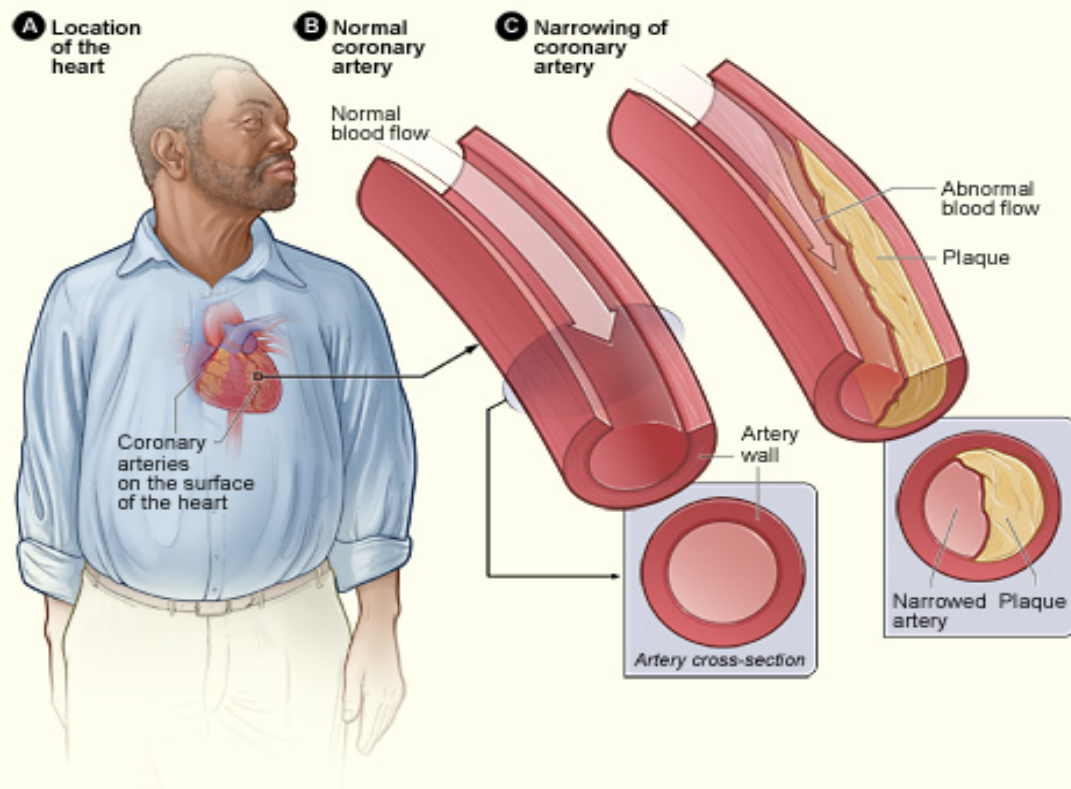
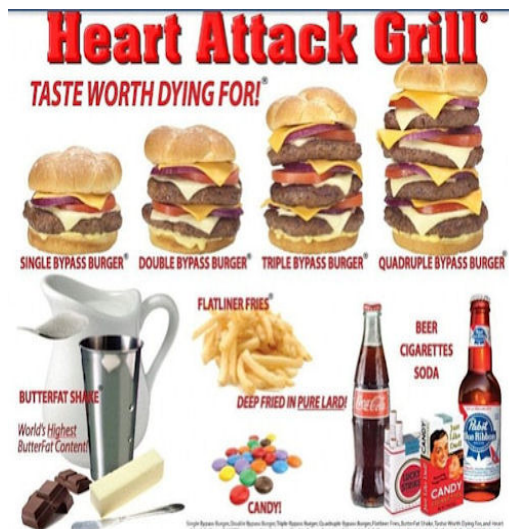


Biomechanics



BioFluid Mechanics and Atherosclerosis (αθηροσκλήρωση)

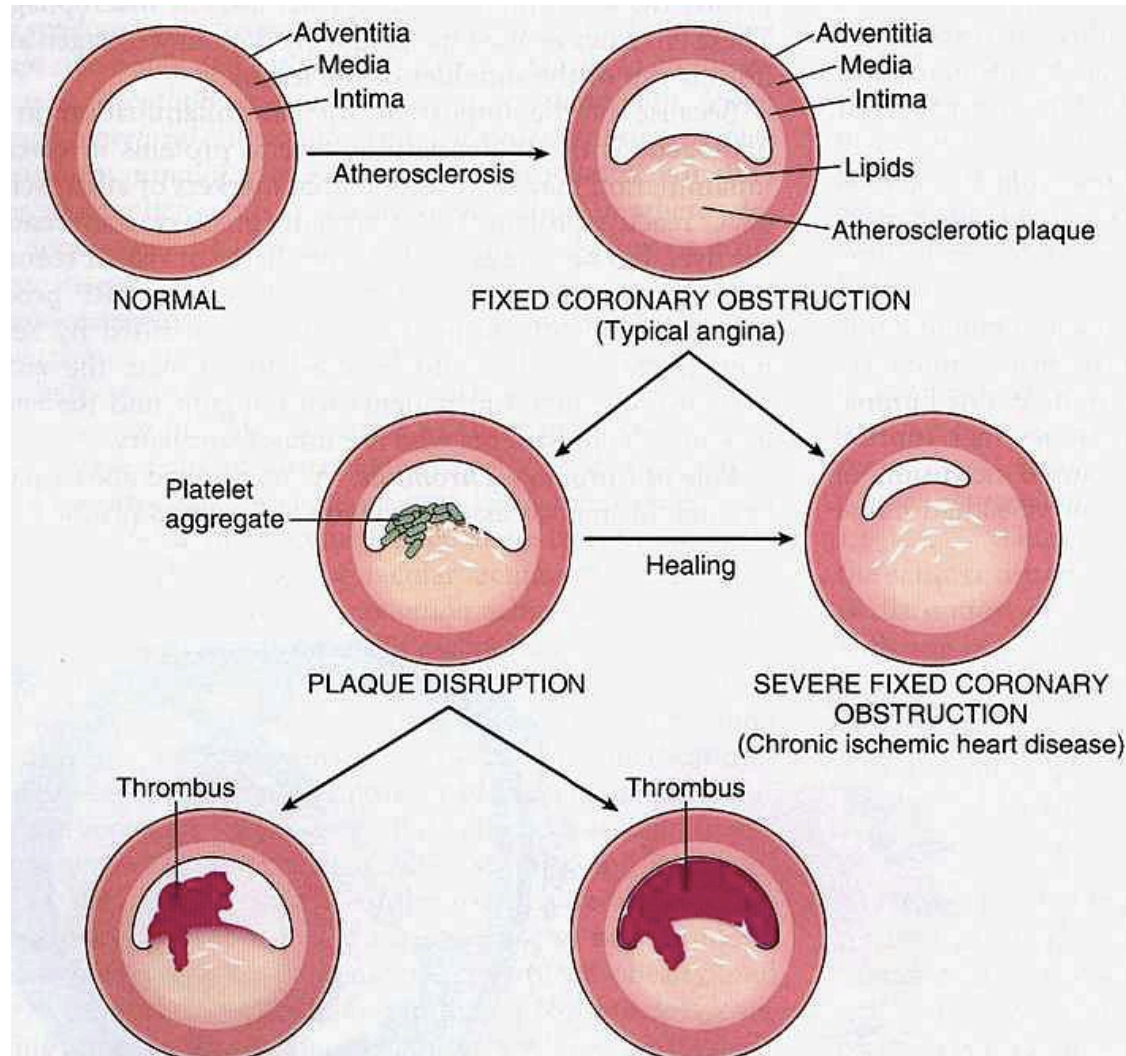
Atherosclerosis is a disease in which plaque builds up inside your arteries



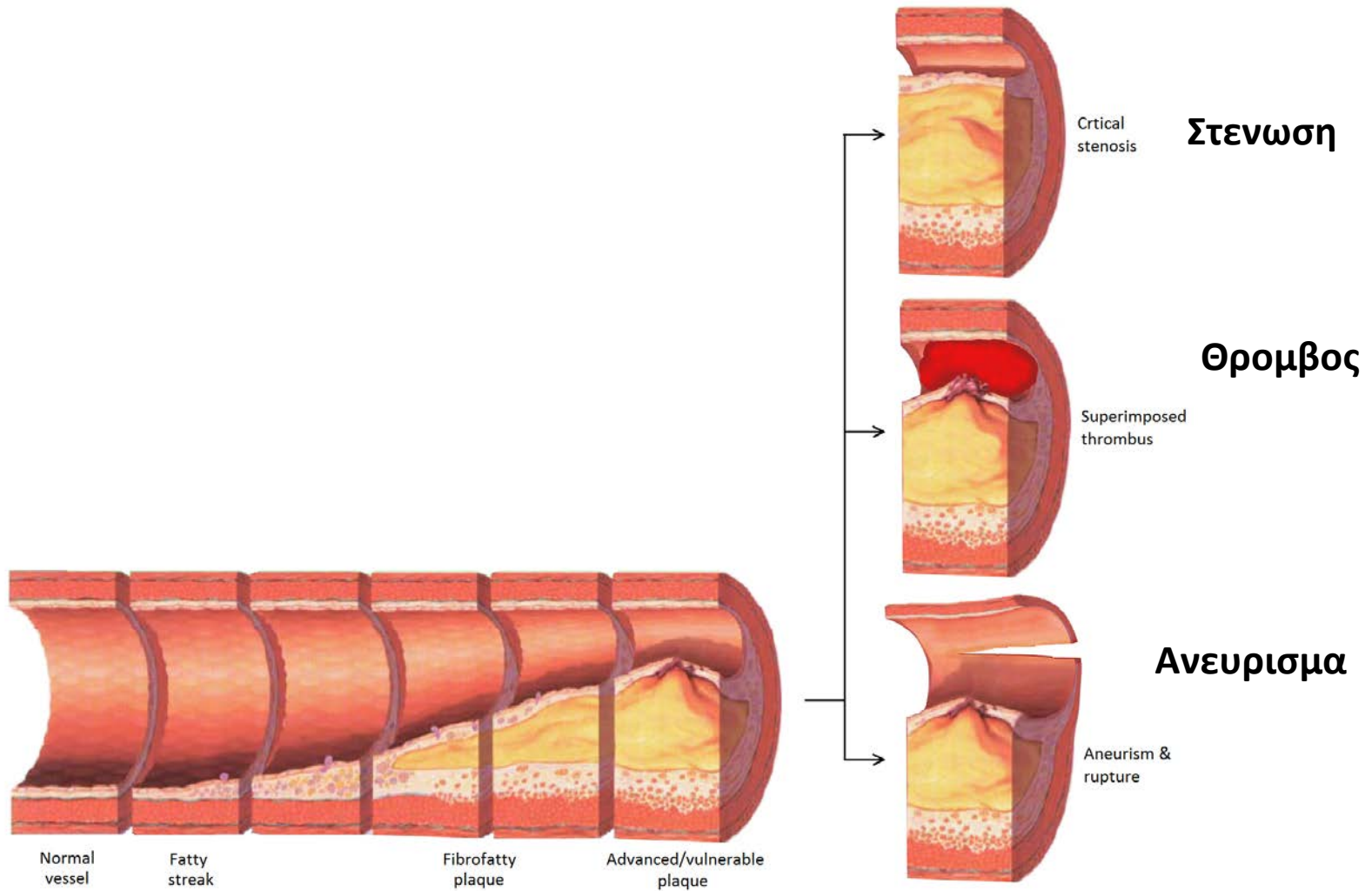
PLAQUE (αθηρωματική πλάκα):

- Degenerative material in the inner layer of artery walls.
- Consists of white blood cells, lipids (cholesterol and fatty acids), calcium and fibrous connective tissue.

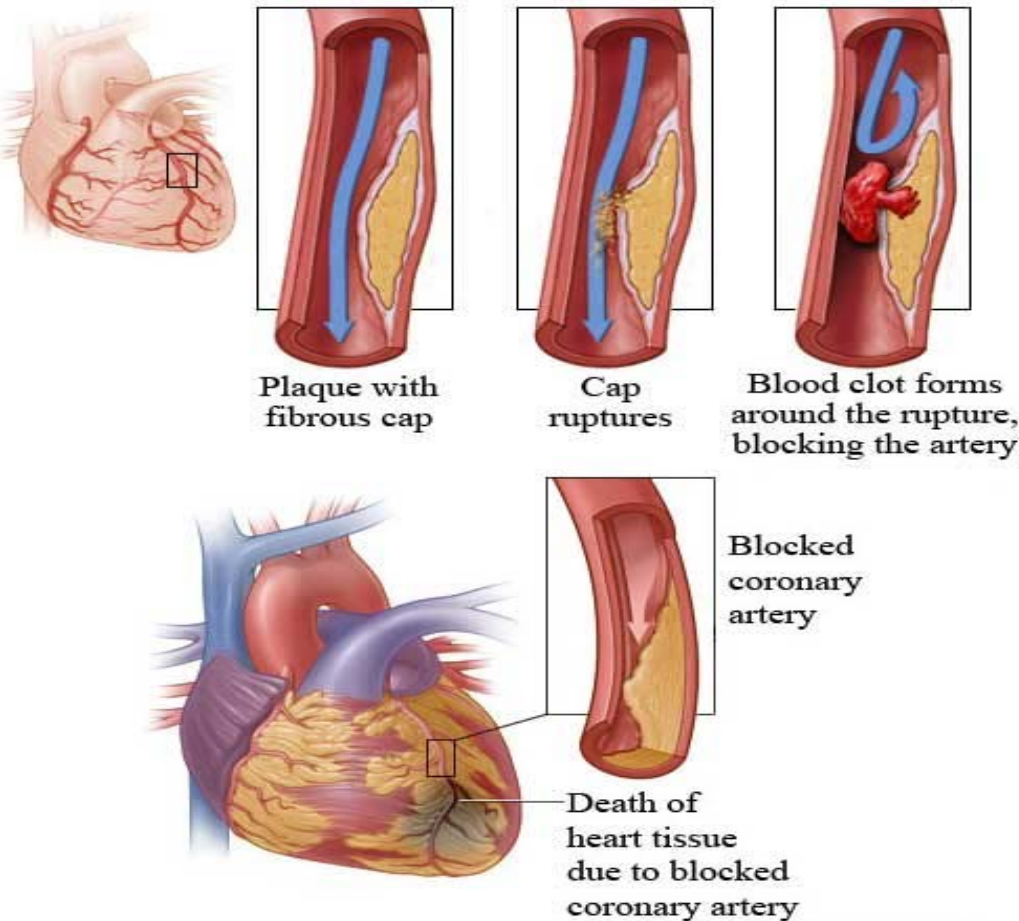
Cross Section of an Atherosclerotic Artery



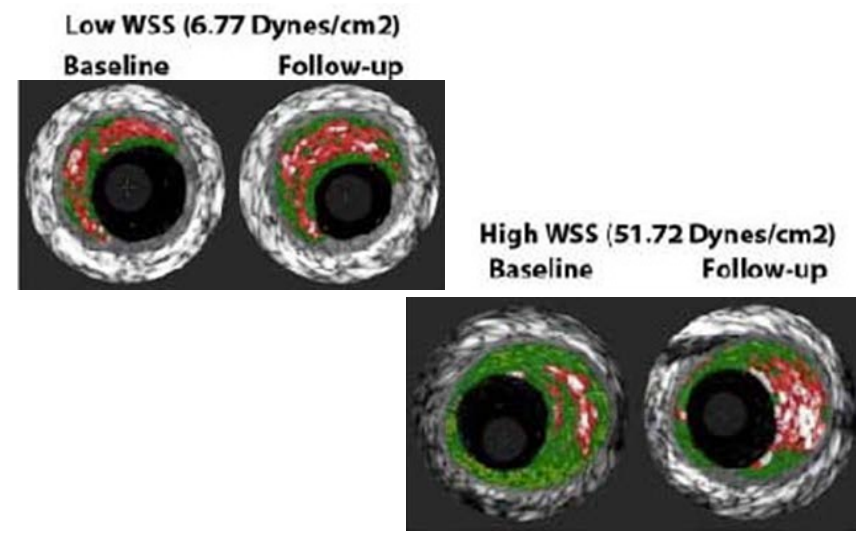
Εξελιξη Αθηρωματικης Πλακας



BioFluid Mechanics: Understanding Plaque Formation

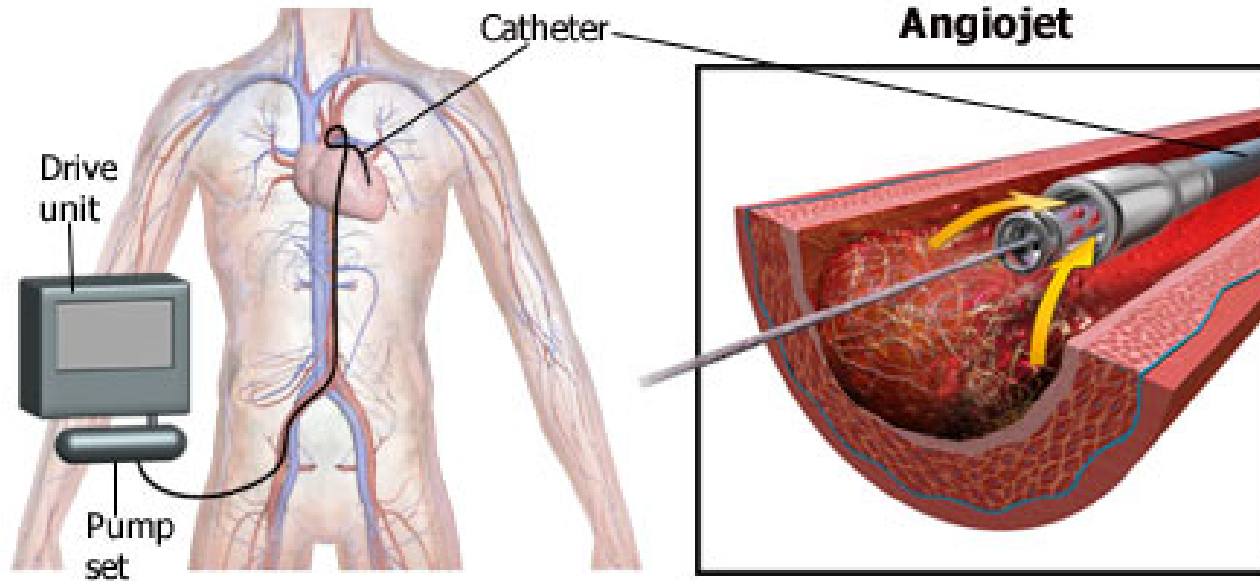


Plaque formation and Wall Shear Stress (WSS)



H. Samady, et al. Coronary artery wall shear stress is associated with progression and transformation of atherosclerotic plaque and arterial remodeling in patients with coronary artery disease. *Circulation* (2011 Jul 25)

Clot Removal using Angiojet Catheter



The catheter is inserted into an artery (usually the femoral artery) and guided to the blood clot.

Saline jets dissolve the clot by creating a vacuum within the artery. The clot is pulled apart and sucked out of the body via the catheter and into the pump set.

...Removing thrombus mainly from peripheral arteries and veins prior to balloon angioplasty or stent placement

AngioJet Thrombectomy in Action...

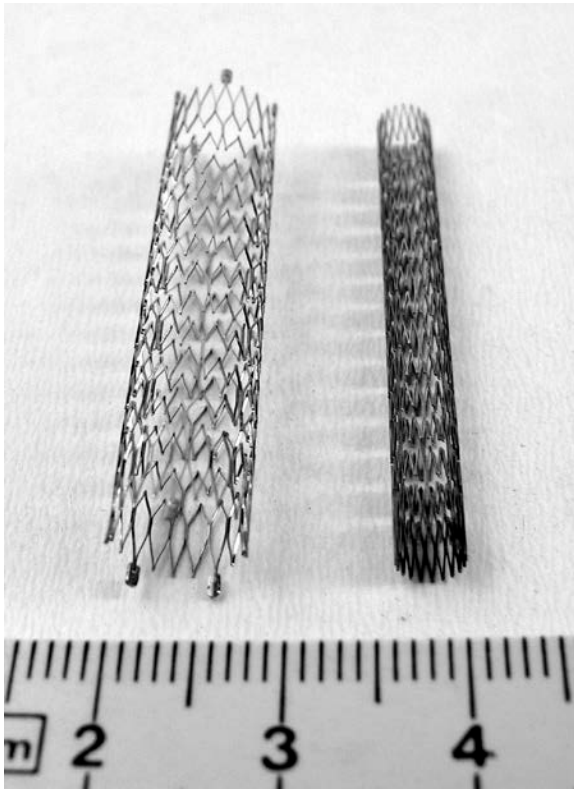
Watch the movie at:

<http://www.bostonscientific.com/en-US/products/thrombectomy-systems/angiojet-thrombectomy-system.html>

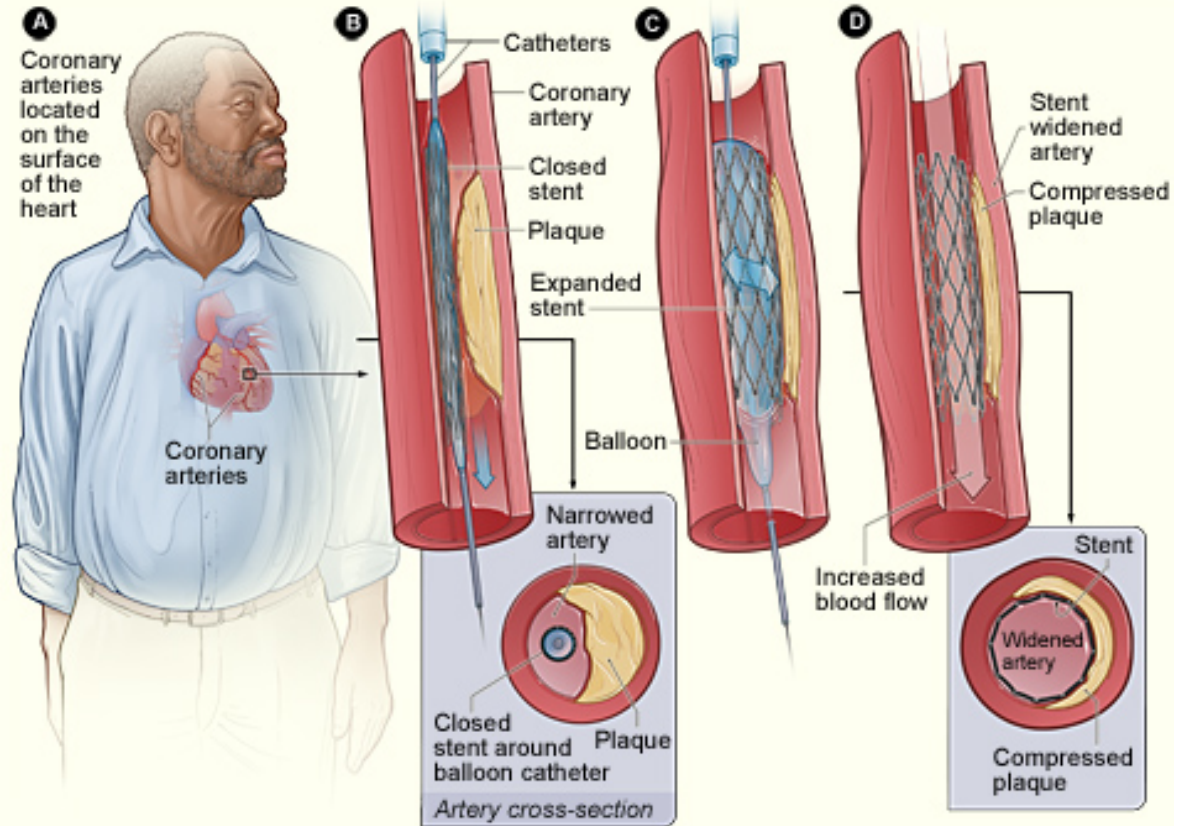


Treating Stenosis: The Stent

The Stent










The procedure: Angioplasty



<http://en.wikipedia.org/wiki/Stent>

<http://www.nhlbi.nih.gov/health/health-topics/topics/stents/placed>

Stents: Design & Materials

Stent type						
1st generation		2nd generation		3rd generation		
Cypher	Taxus	Xience	Endeavor	Promus		
						
Strut wall thickness 0.140mm	Strut wall thickness 0.097mm	Strut wall thickness 0.081mm	Strut wall thickness 0.081mm	Strut wall thickness 0.090mm	Strut wall thickness 0.081mm	Strut wall thickness 0.081mm
Stainless Steel		Cobalt Chromium		Platinum Chromium		

Specs:

Biocompatibility, minimize inflammation, slow down restenosis

Καλο θεμα για τη εργασια σας

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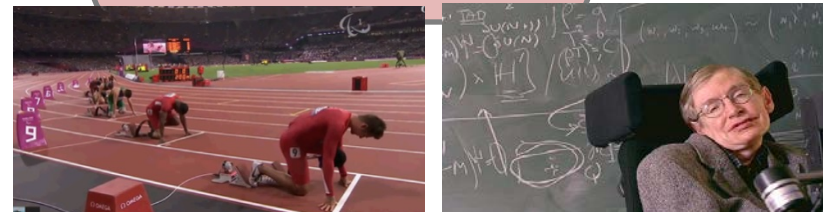


Medical
Physics



Bio-
Engineering

Biomechanics



Genetic
Engineering



Image shows three sets of tomatoes. The ordinary control tomatoes (extreme left) soften and shrivel up, while texture of gene-silenced tomatoes remains intact for up to 45 days.
Photo credit: Asis Datta, Subhja Chakraborty, National Institute of Plant Genome Research, New Delhi

Genetic engineering

Genetic engineering:

Direct manipulation of an organism's genes

Γενετική Μηχανική uses the techniques of molecular cloning and transformation to alter the structure of genes directly.

Examples:

- Improving *crop technology* (not a medical application)
- the manufacture of synthetic human insulin through the use of modified bacteria
- GFP expression for imaging

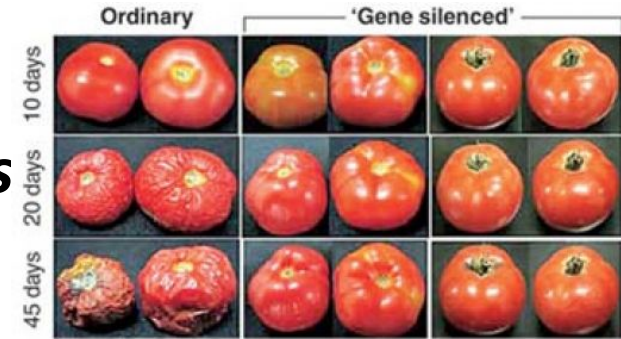


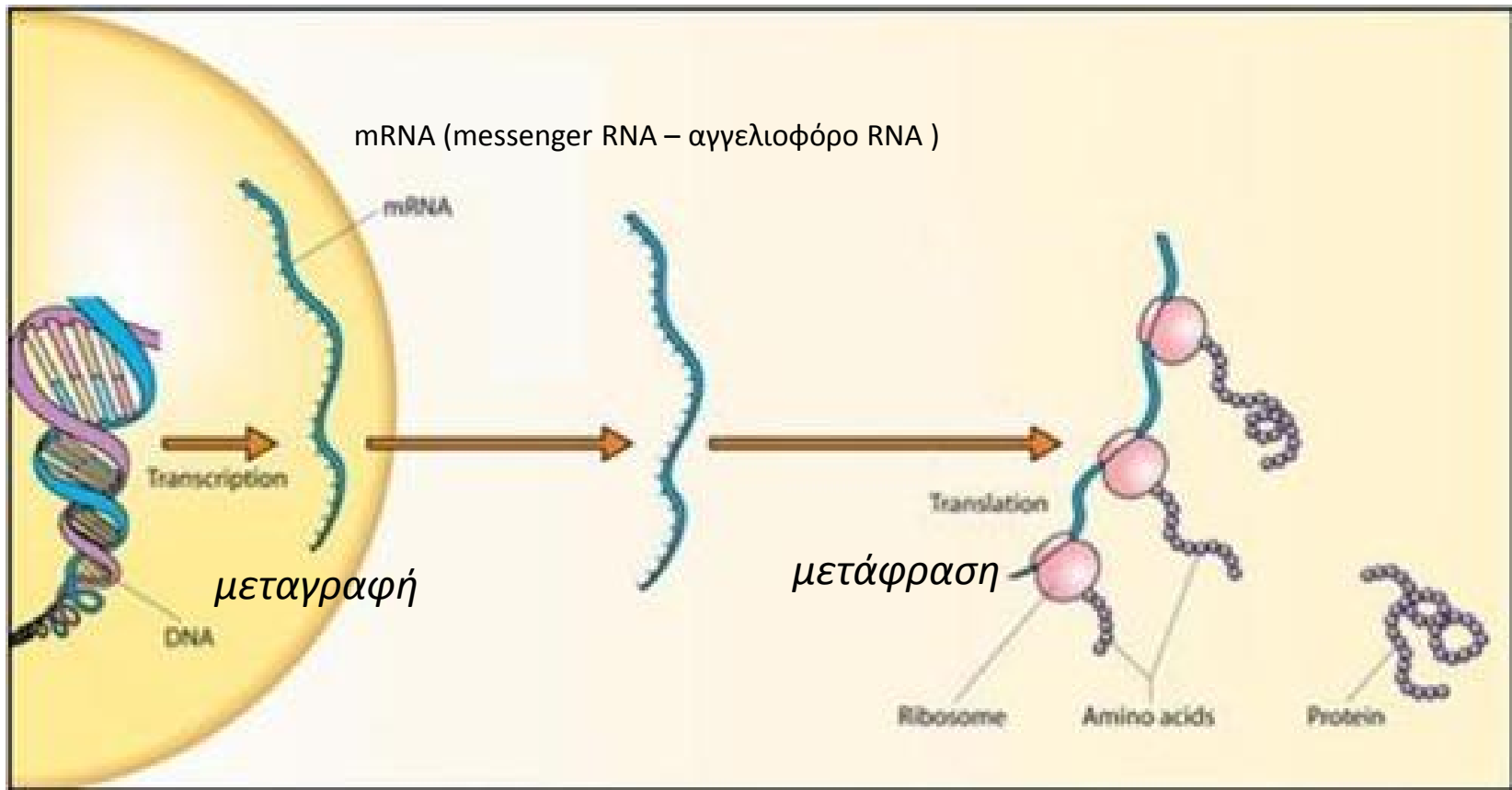
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How many Genes we have?

The Central Dogma of Molecular Biology

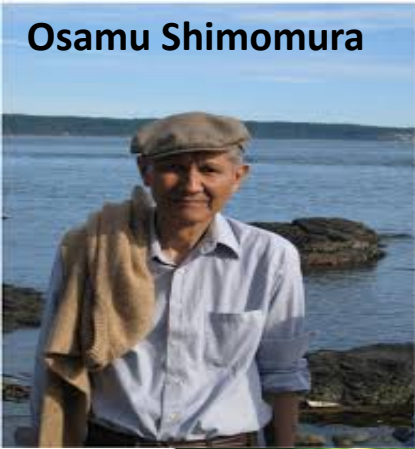


<http://captain-nitrogen.tumblr.com/post/2573349090/a-crash-course-in-biochemistry-from-atoms-to>

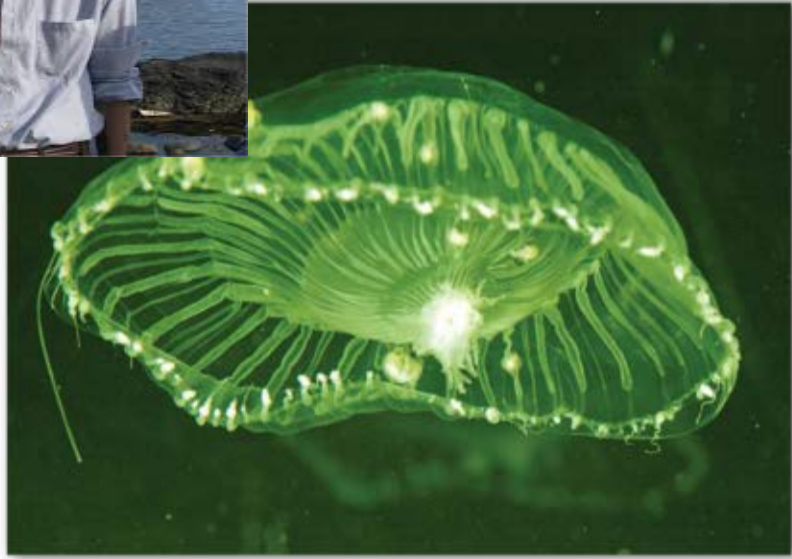


The result of a chemical reaction called **Bioluminescence** (βιοφωταύγεια), it occurs when a micro-organism in sea water is disturbed by oxygen

Read more: <http://www.dailymail.co.uk/sciencetech/article-2124432/Glow-flow-Natural-phenomenon-turns-sea-water-electric-neon-blue-washes-beach.html#ixzz3SgHv4HwN>

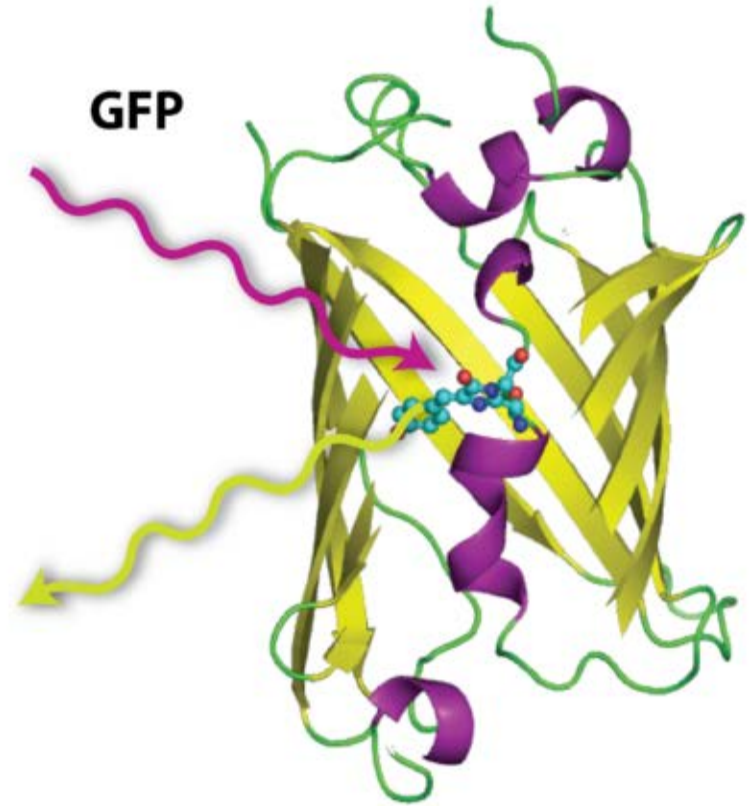


The GFP Protein



Aequorea victoria

GFP comes from the jellyfish (μεδουσα) *Aequorea Victoria*. It has the shape of a barrel. Inside the barrel there is the light-absorbing complex, which absorbs high-energy UV-light and emits green light.

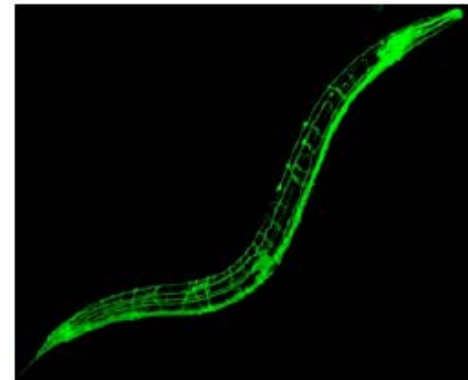
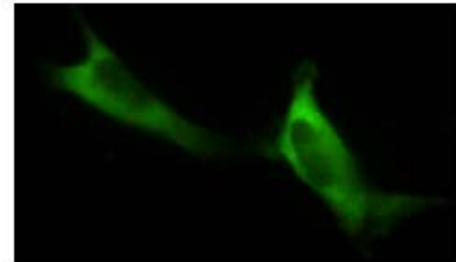
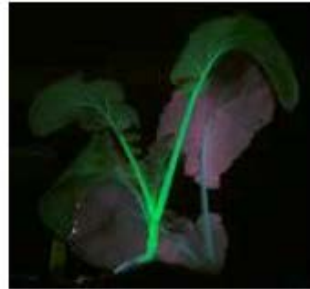
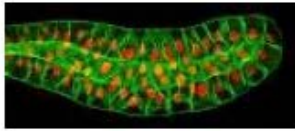


high energy

low energy

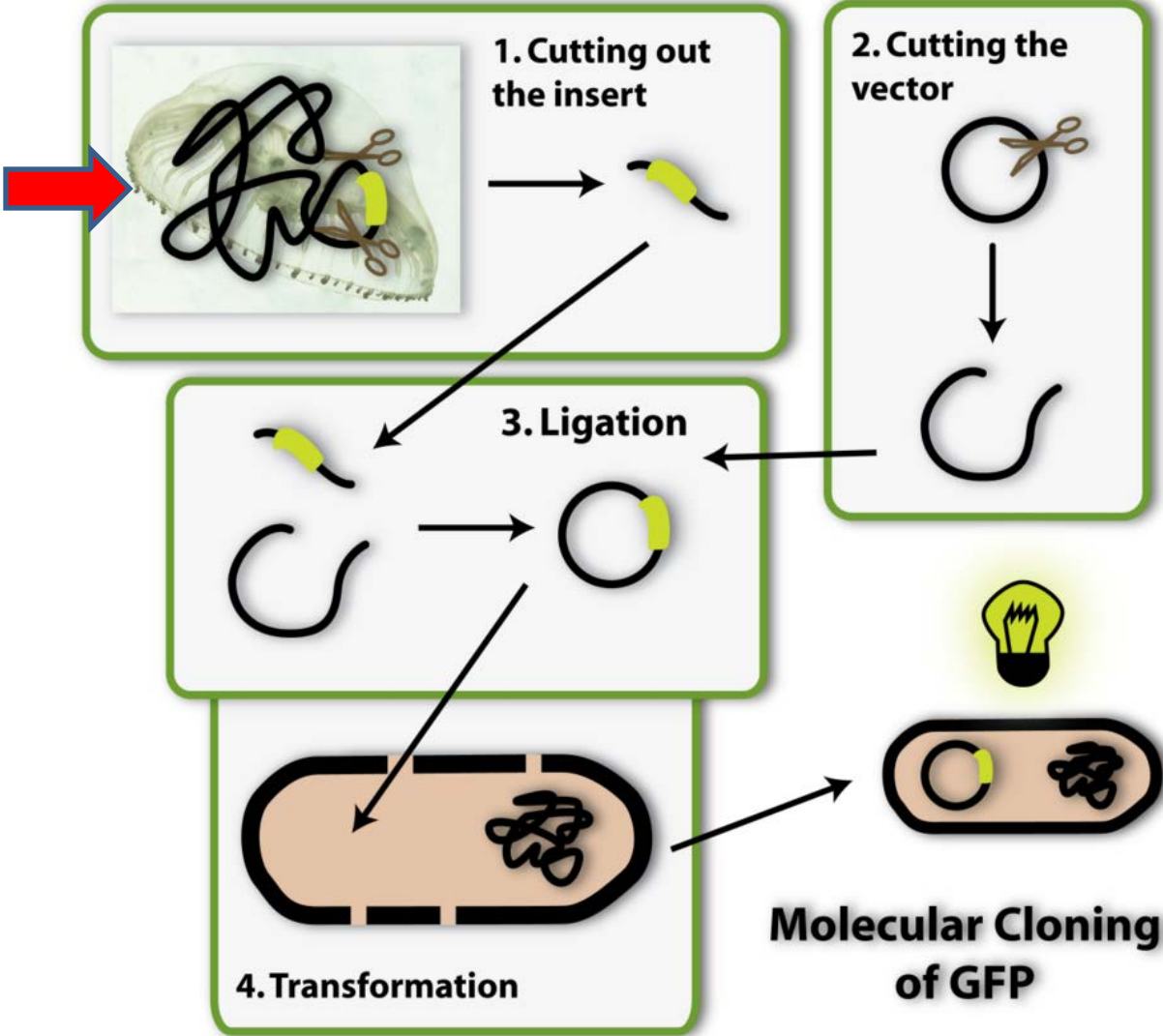


2008 Nobel Price in Chemistry - Martin Chalfie (Columbia University)



How is it done?

Green
Fluorescent
Protein (GFP) is
naturally
expressed in
jellyfish



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Medical Physics



Bio-Engineering

Biomechanics



Tissue Engineering



Genetic Engineering



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Tissue Engineering: Creating Human Tissue/Organs

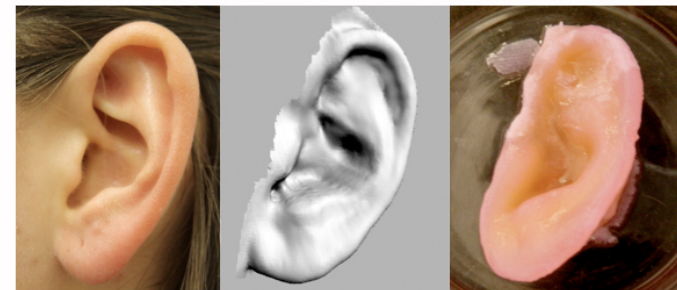
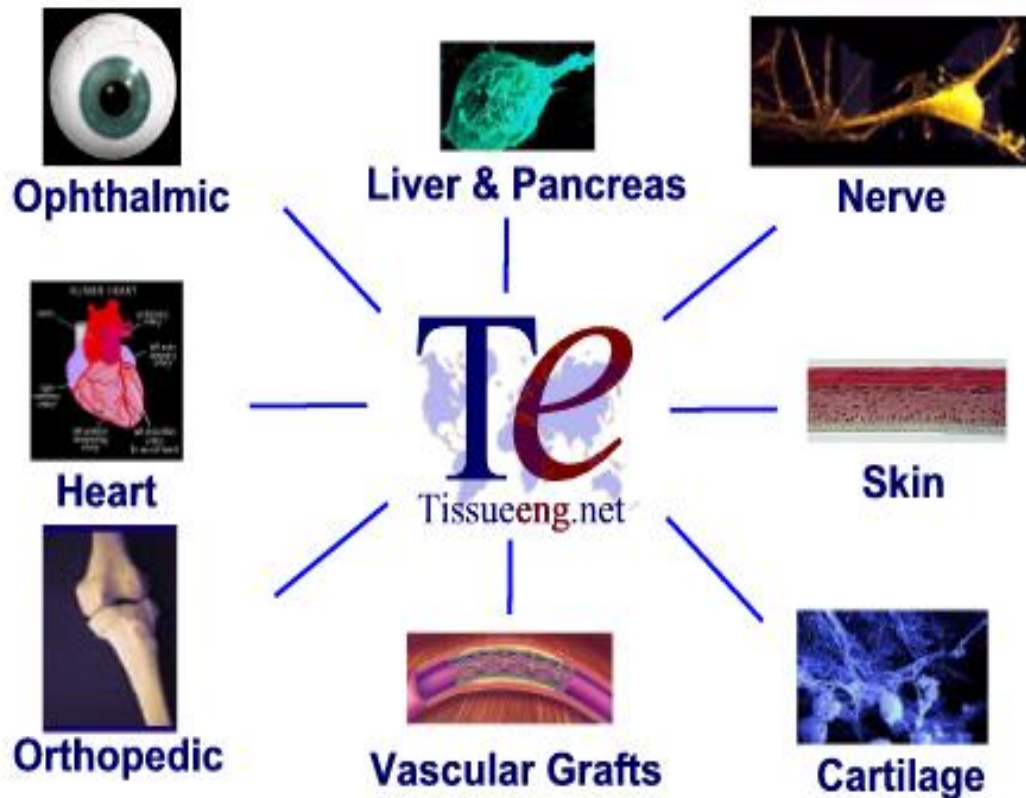
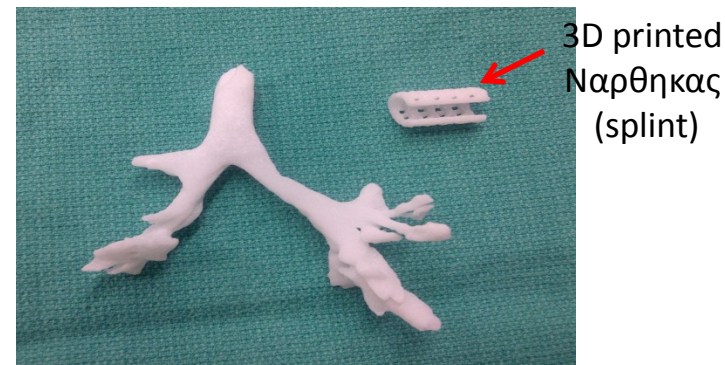


Figure: Image-based tissue engineering of human ear cartilage. Comparison of photograph (left), digitized image (middle), and tissue engineered ear cartilage after two weeks in culture.

<http://meeting.nesps.org/2011/47.cgi>



<http://ns.umich.edu/new/multimedia/videos/21742-national-magazine-honors-creators-of-life-saving-3d-printed-airway-splint>

<http://www.tissueeng.net/main.htm>

Tissue Engineering: How it is done

Basic principles of Tissue engineering

