

# Role of mechanical stimuli in bone remodeling in microgravity

ASI–Roma 15.03.2023

*Tullio Genova*

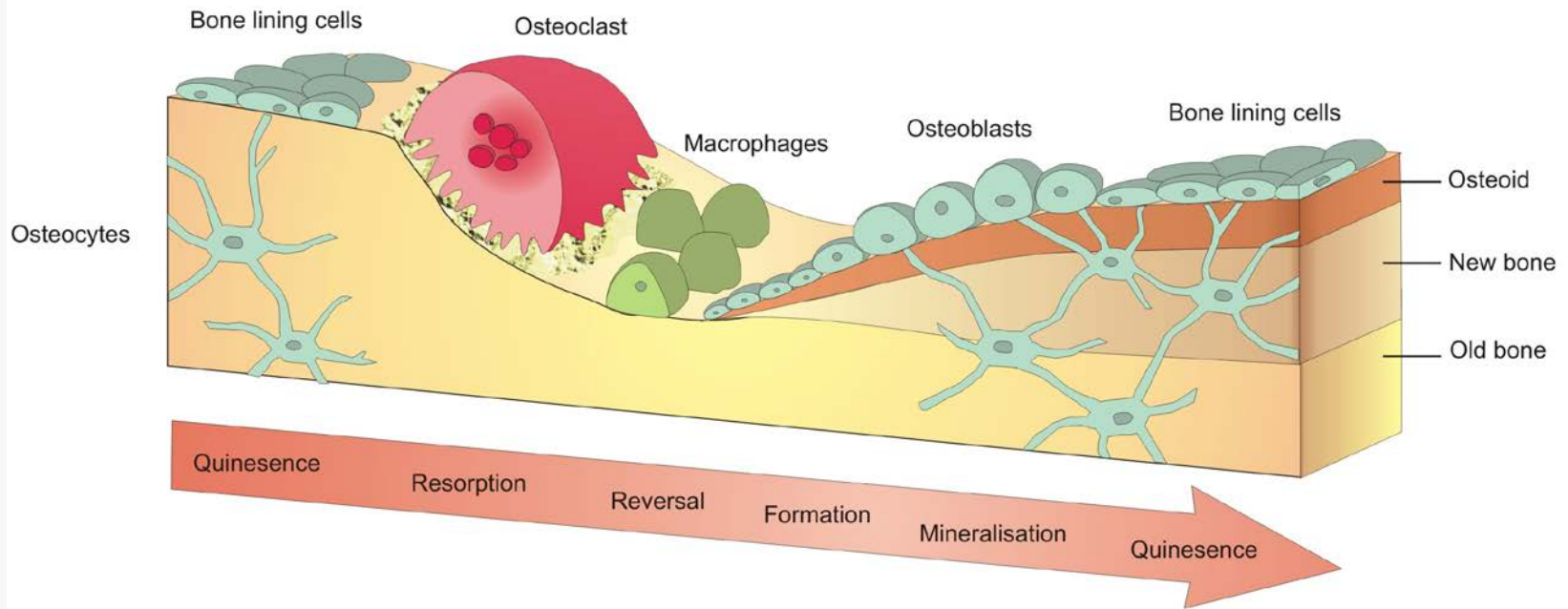


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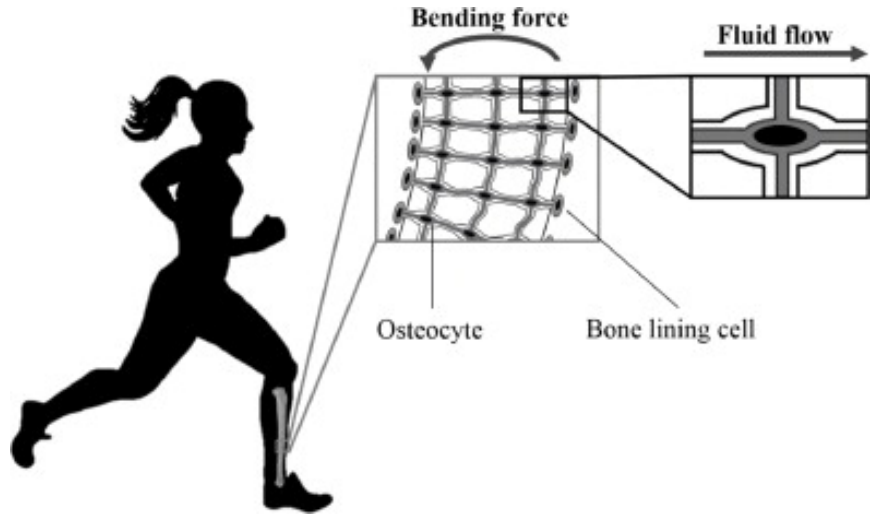
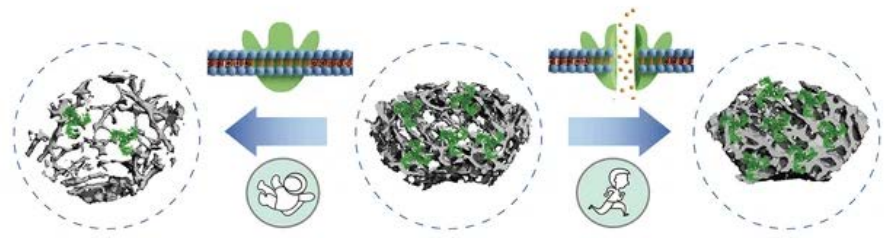


# Bone Remodeling

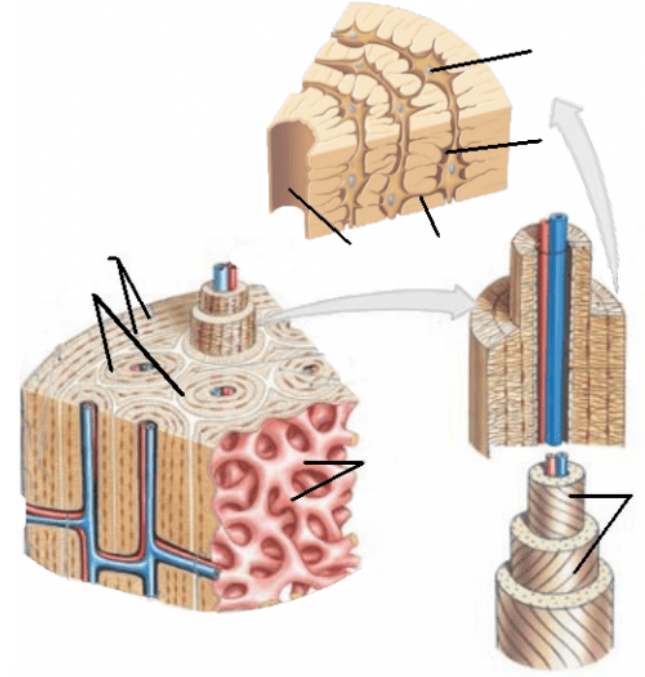
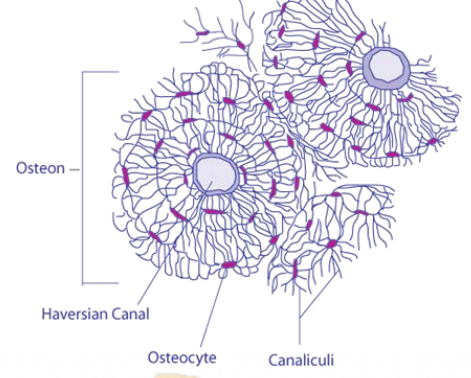
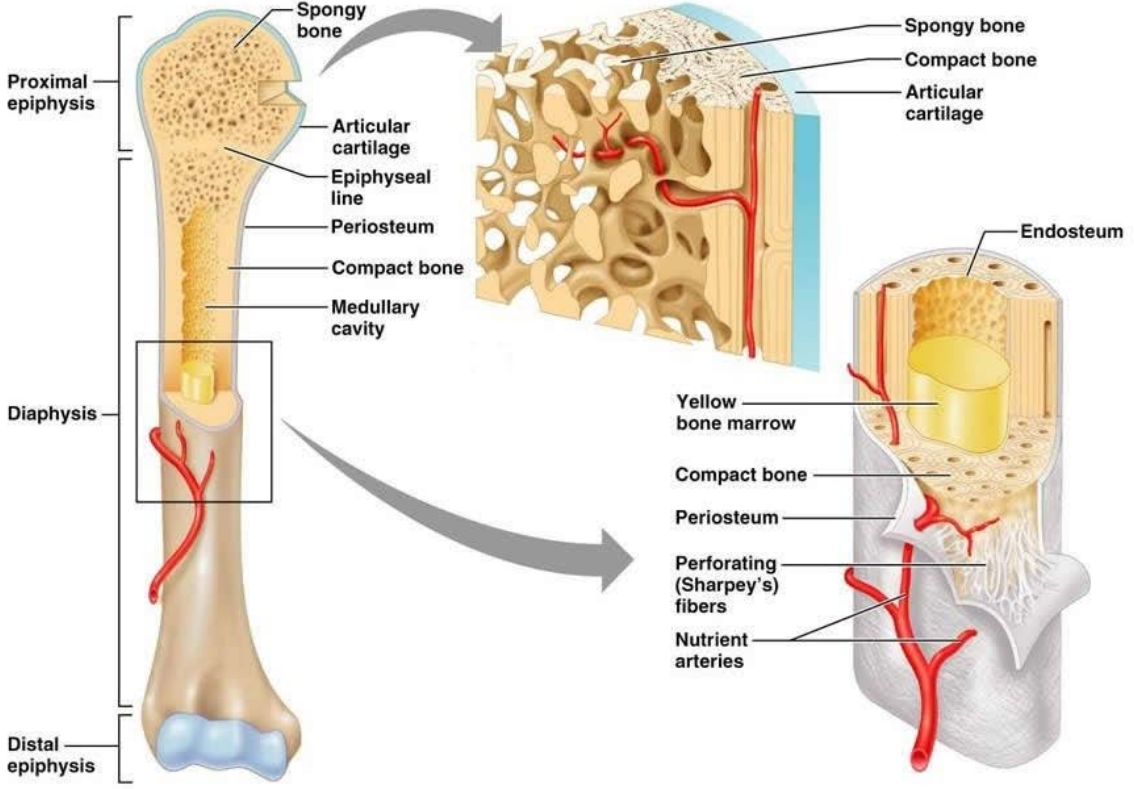
Bone tissue is subjected to continuous remodeling



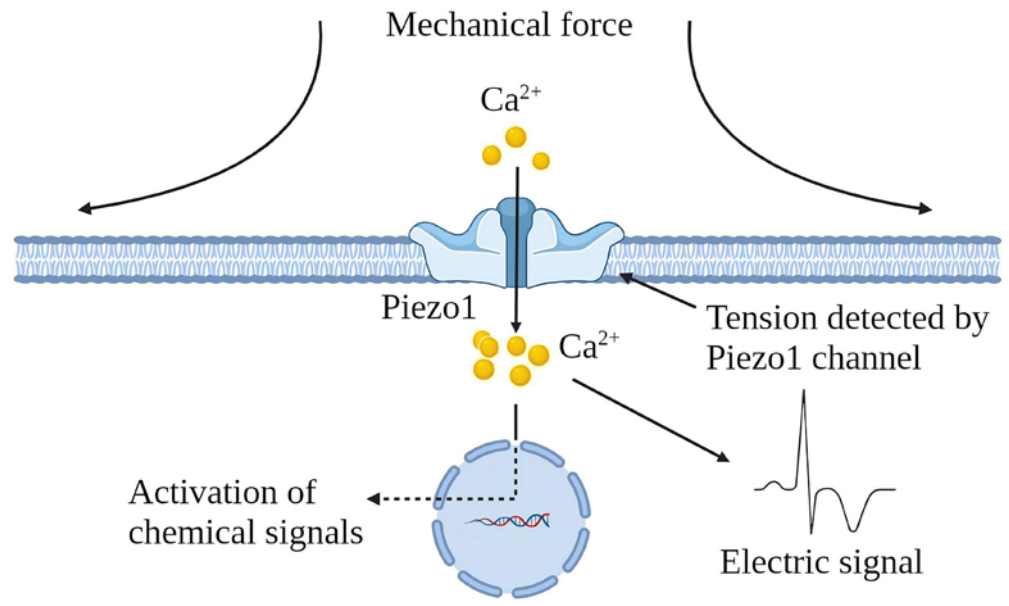
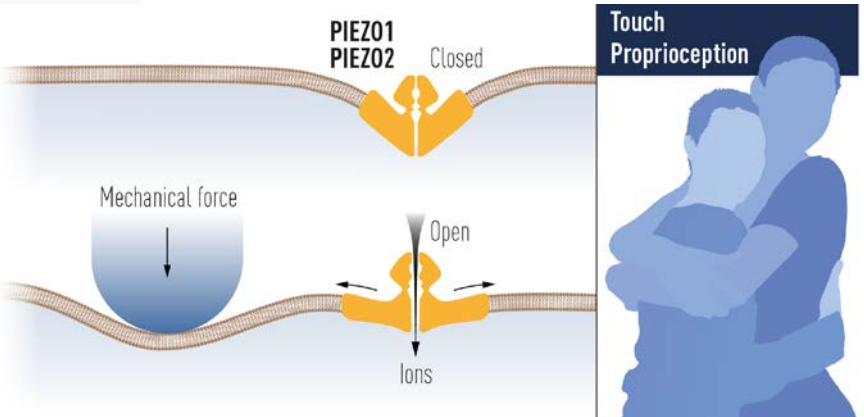
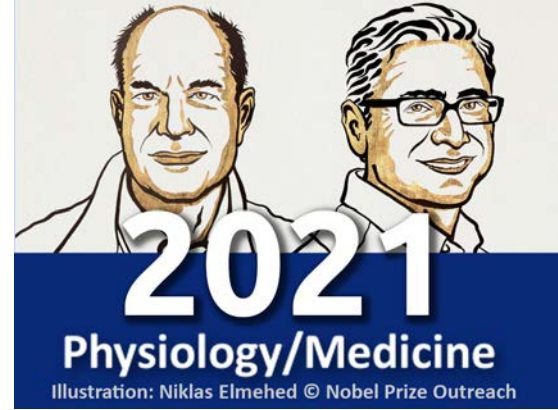
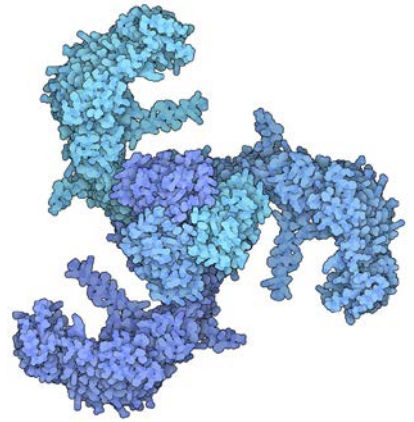
# Mechanical stimuli and bones



# Bone Structure



# Mechanical stimuli perception





# Our Lab...

## Endothelial Cells Promote Osteogenesis by Establishing a Functional and Metabolic Coupling With Human Mesenchymal Stem Cells

Sara Petrillo<sup>1</sup>, Tullio Genova<sup>1,2\*</sup>, Gioia Joanna Kopecka<sup>1</sup>, Fiorella Altruda<sup>1</sup>, Federico Mussano<sup>1†</sup> and Luca Munaron<sup>1†</sup>

<sup>1</sup> Molecular Biotechnology Center (MBC), Depart Turin, Italy, <sup>2</sup> Department of Life Sciences and Cy Sciences, C.I.R. Dental School, University of Turin

## The Crosstalk Between Osteodifferentiating Stem Cells and Endothelial Cells Promotes Angiogenesis and Bone Formation

Tullio Genova<sup>1,2\*</sup>, Sara Petrillo<sup>1†</sup>, Elisa Emanuela Tolosano<sup>1</sup>, Fiorella Altruda<sup>1</sup>, Luca Munaron<sup>1†</sup>

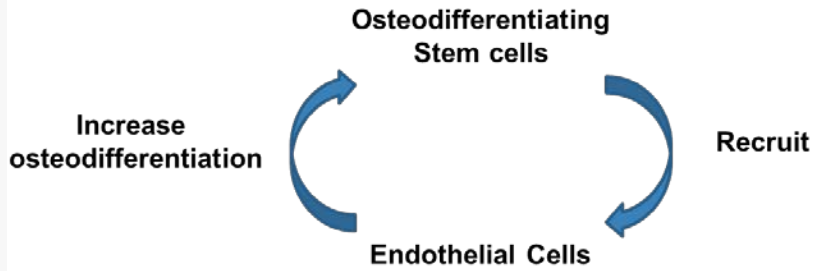
Hard Tissues and Materials

<sup>1</sup> Department of Life Sciences and Systems Biology

Overcoming physical constraints in bone engineering: 'the importance of being vascularized'

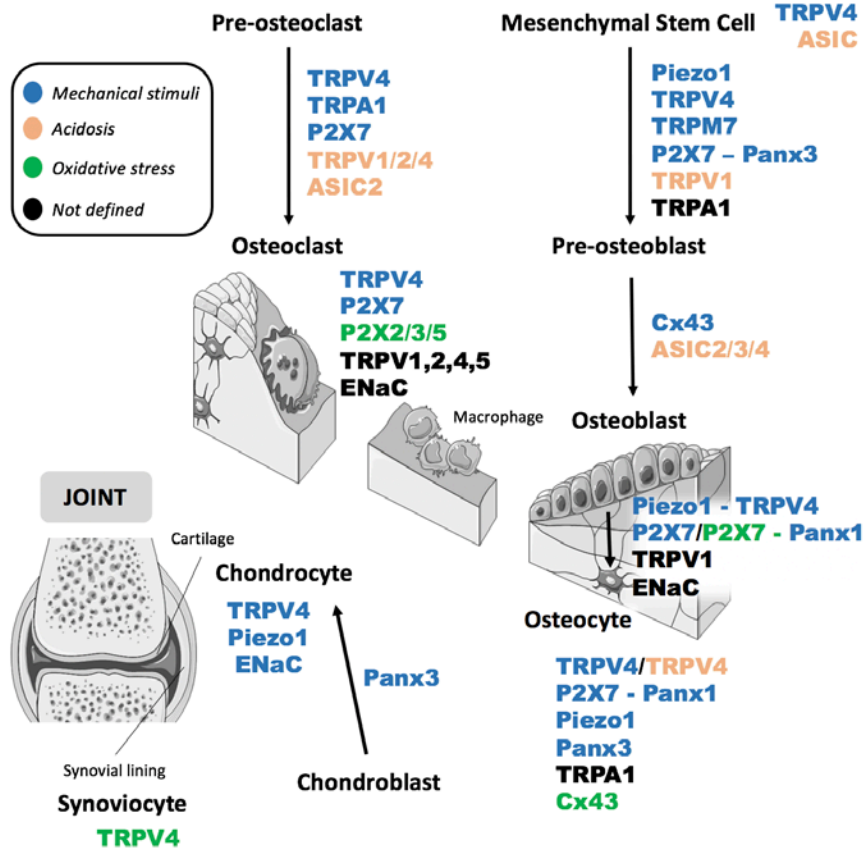
T Genova<sup>1,2</sup>, L Munaron<sup>1</sup>, S Carossa<sup>2</sup> and F Mussano<sup>2</sup>

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### BONE RESORPTION

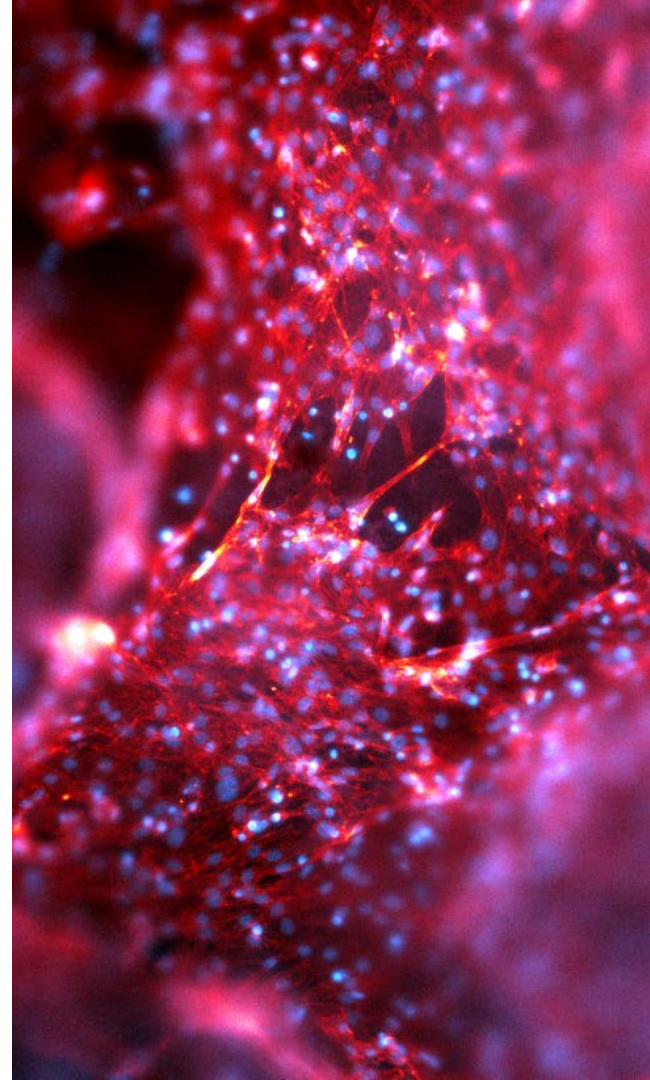
### BONE FORMATION



Perin et al. 2023

# Aim of the project

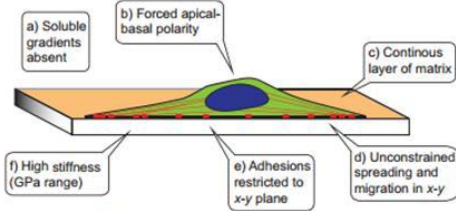
- ▶ Identify the sensors involved in bone differentiation
- ▶ Identify the molecular mechanism underlying this process
- ▶ Identify the role of blood vessels
- ▶ Validate the model in dynamic 3D cell cultures



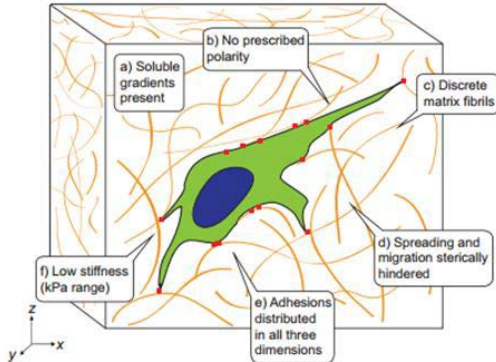
# Advanced cell models

To be physiologically relevant and predictive, *in vitro* models should replicate most of the stimuli acting on cells in the human body.

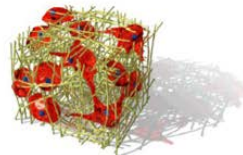
Collagen-coated glass (2D)



Collagen gel (3D)



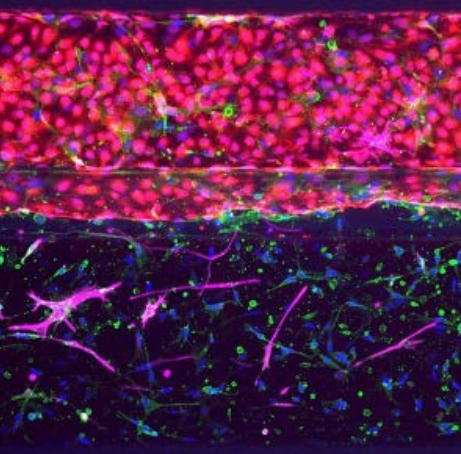
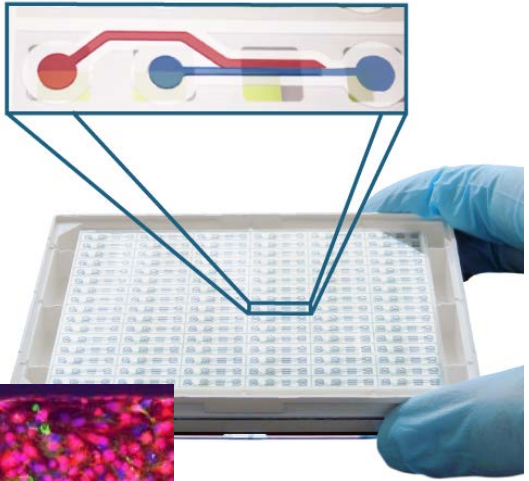
	3D	2D
Shape	Ellipsoids with dimensions of 10-30 $\mu\text{m}$	Flat with typical thickness of 3 $\mu\text{m}$
Environment	~ 100 % of cell surface exposed to other cells or matrix	~ 50 % of cell surface exposed to fluid ~ 50 % exposed to the flat culture surface Very small % exposed to other cells
Behaviour	Differences in: Differentiation, Drug Metabolism, Gene and Protein expression, General Cell Function, In Vivo Relevance, Morphology, Proliferation, Response to Stimuli and Viability	



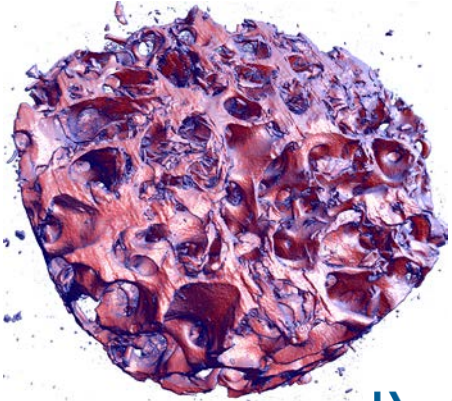
**Real life happens in 3D.  
So should your cell culture!**



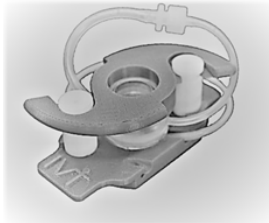
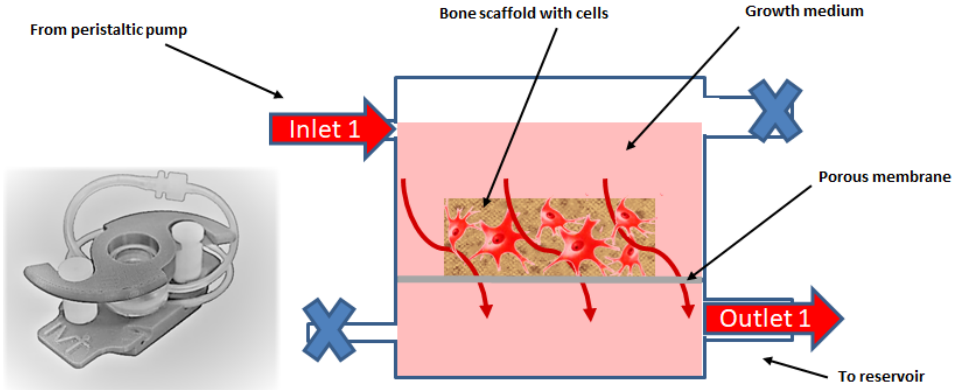
# Bioreactors/ Organ on chip/ 3D Bioprinting



**MIMETAS**  
the organ-on-a-chip company



**IVT** In-vitro technologies  
**tech**





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