

# Molecular Communications for Cardiac Bio-Implants in Human Intra-Body Nanonetworks

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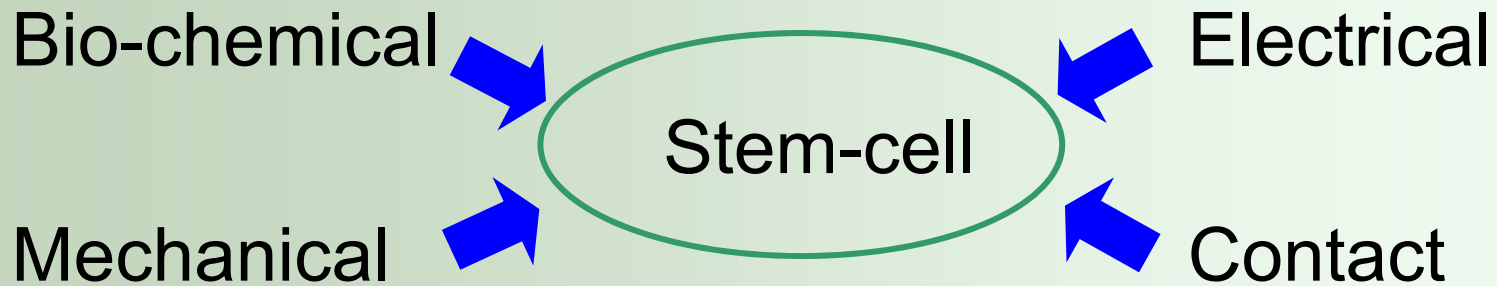


## Outline

- Focus
- Cardiac regenerative tissue engineering
- Nanonetwork elements identification
- Potential applications

## Focus

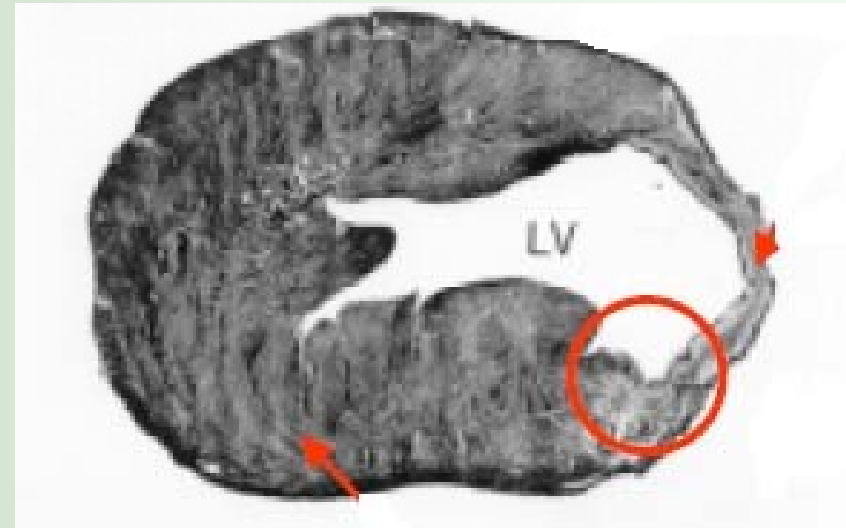
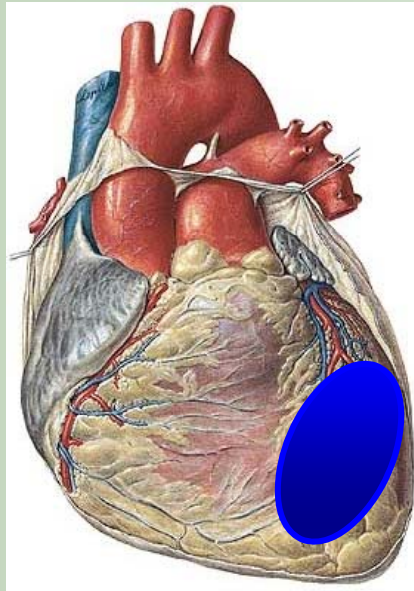
### Cardiac regenerative strategies



- Plenty of known and unknown factors
- MNN as a tool to model / modify the effect of factors in stem-cell growing and differentiation

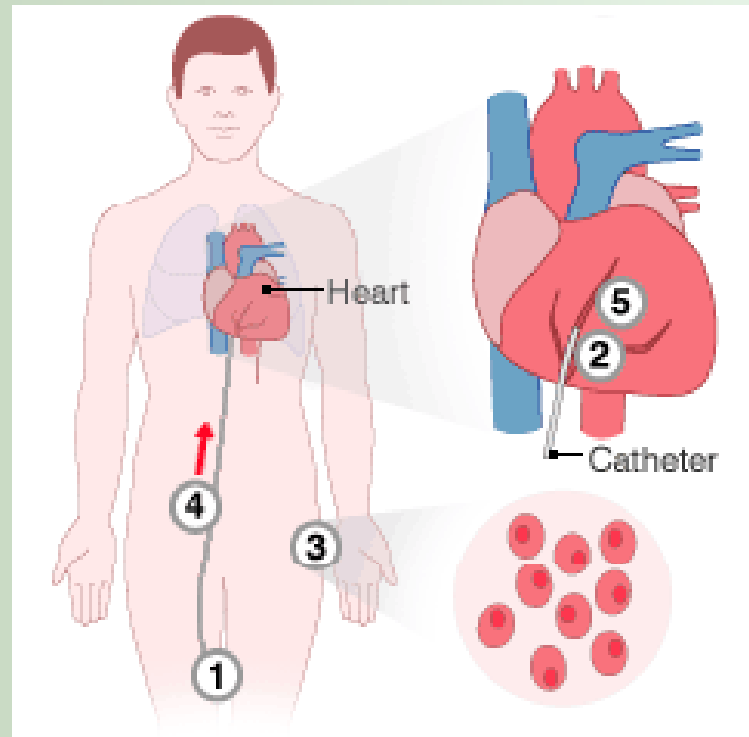
# Cardiac regenerative tissue engineering

- Heart failure in developed countries
- Ischemic heart failure → transplantation
- Small self-regeneration capability



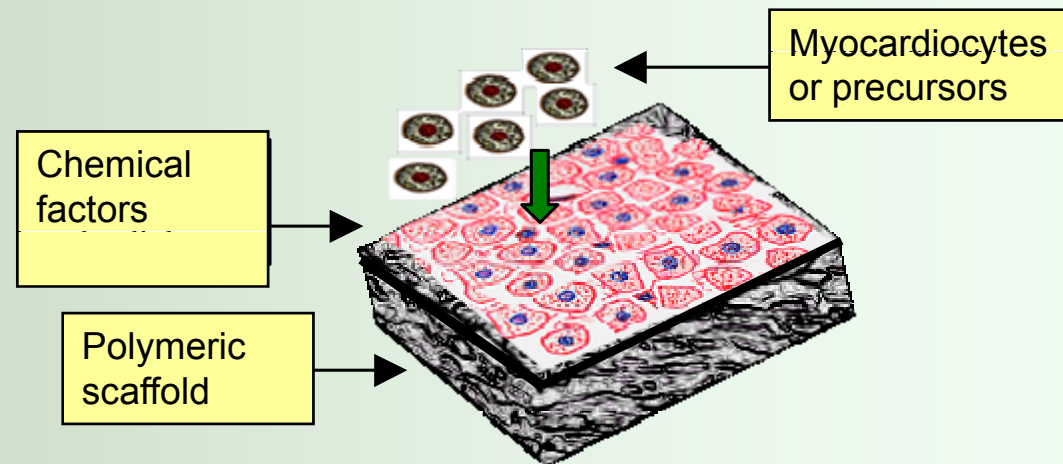
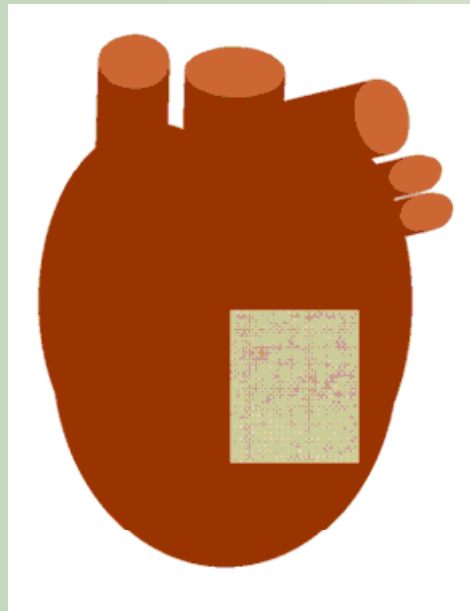
# Cardiac regenerative tissue engineering

- Regenerative approaches
  - Cell injection



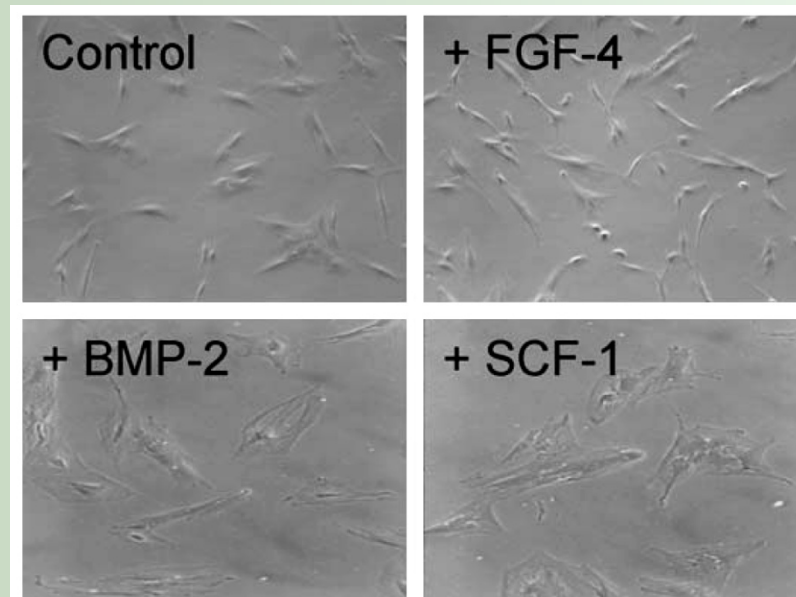
# Cardiac regenerative tissue engineering

- Regenerative approaches
  - Cell patch / bioactive implant



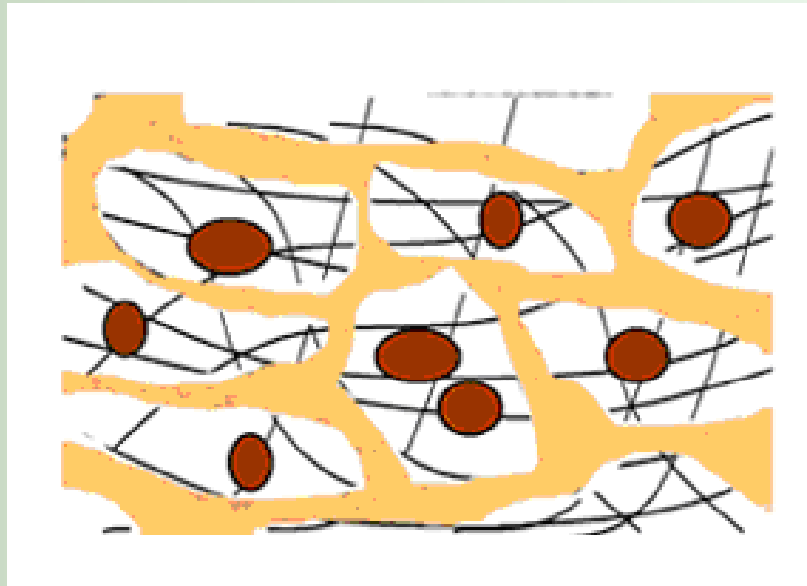
# Cardiac regenerative tissue engineering

- Factors: Chemical
  - Development of specific culture milieu
  - Use of various cytokines / growth factors /synthetic chemicals



# Cardiac regenerative tissue engineering

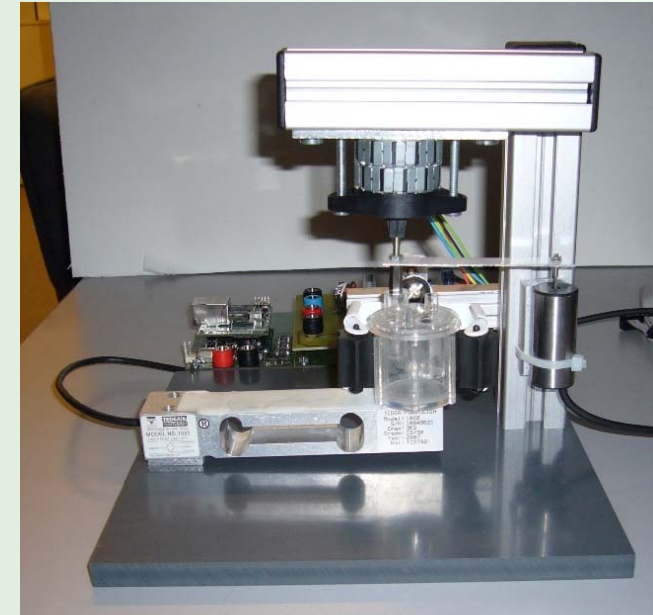
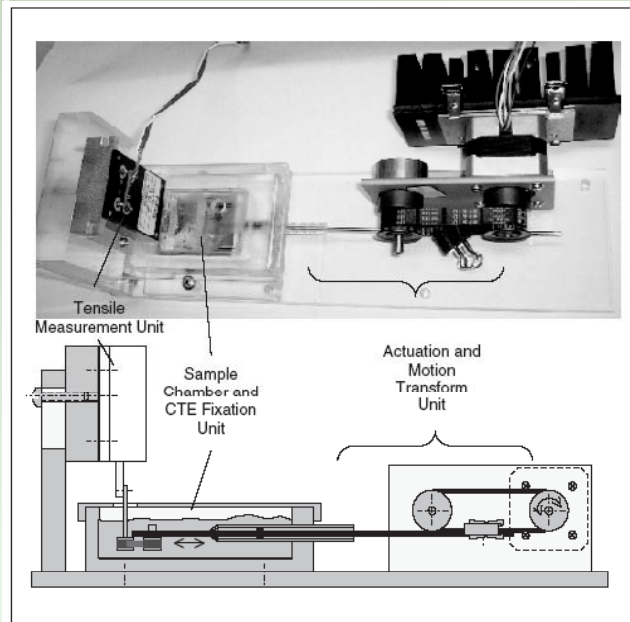
- Factors: Contact interface with the extracellular matrix





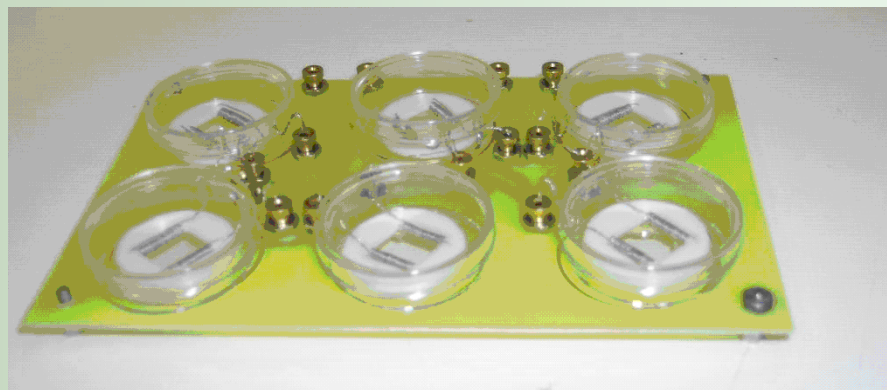
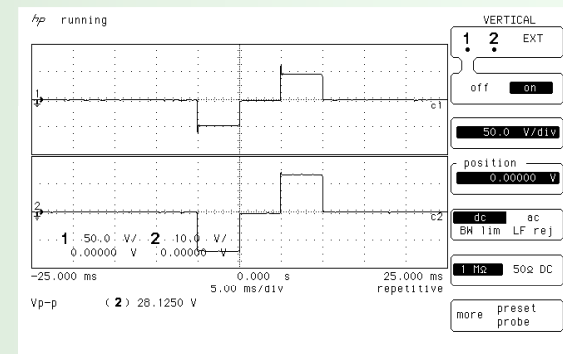
# Cardiac regenerative tissue engineering

- Factors: Mechanical stimulation



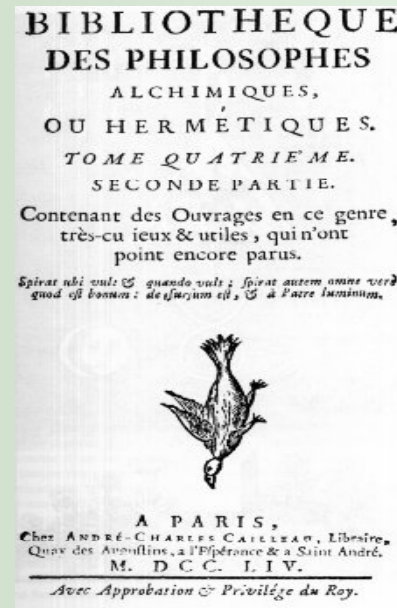
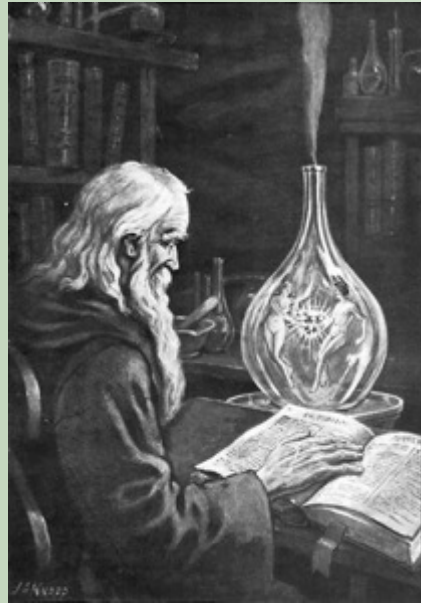
# Cardiac regenerative tissue engineering

- Factors: Electrical stimulation



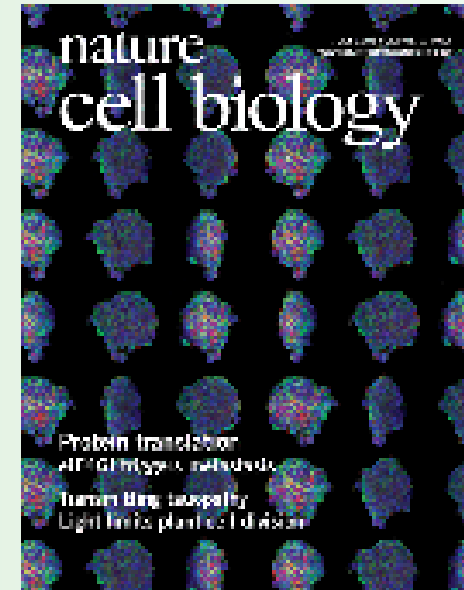
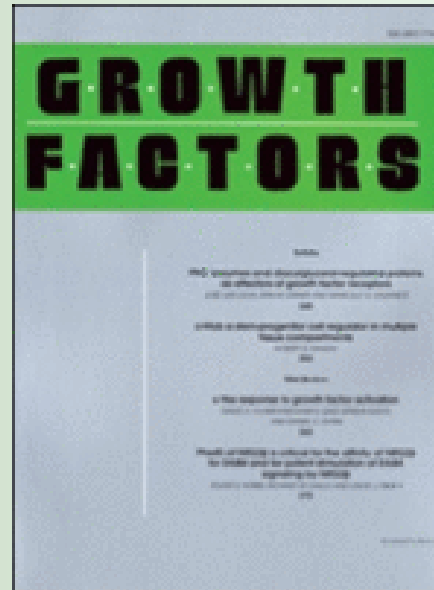
# Cardiac regenerative tissue engineering

- Multiple factor incidence



# Cardiac regenerative tissue engineering

- Multiple factor incidence





# Nanonetwork elements identification

- Cellular / molecular Nanonetworks role?

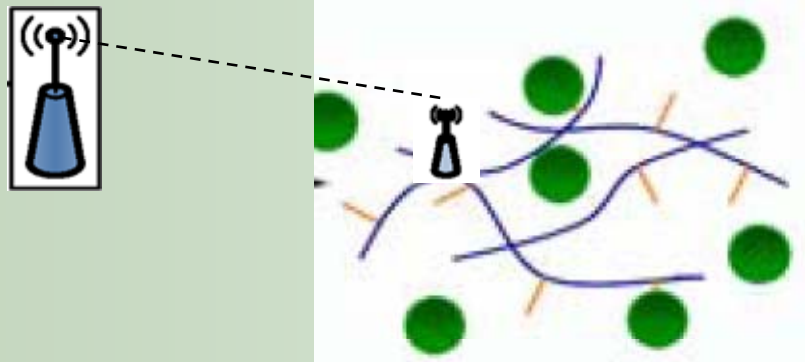


# Nanonetwork elements identification

- Messages
  - Chemical, mechanical, electrical factors
  - Amplitude / time parameters
  - Valid codes
  - Interferences
- Channel
  - Propagation speed
  - Noise, crosstalk, interferences
  - Specific myocyte features: gap-junctions

## Potential applications

- MNN as a tool to model the effect of factors in stem-cell growing and differentiation
  - To understand the mechanisms
  - To speed-up the application-driven research
- MNN as a tool to drive / control the engineered tissue evolution in-vivo and in-situ.



## Potential applications

- Labeled or Label-free cell growing and differentiation monitoring

