

# Multiscale Models for Life Centre for Doctoral Training



## Some potential and typical project topics for 2023

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| Generating molecular replicas of tissues using nanoneedles for nondestructive spatial biology.                                                                                                                                                          |
| Combining fully synthetic hydrogels with human intestinal organoids to model fibrosis in Crohn's disease.                                                                                                                                               |
| Mechano-metabolic regulation of cochlear morphogenesis.                                                                                                                                                                                                 |
| Mechanisms of cell intercalation: how cells migrate on other cells.                                                                                                                                                                                     |
| Modelling cell fate decisions in the nervous system: combining experimental and computational approaches; and/or: Modelling human ear development in a dish: combining biology and bio-engineering approaches.                                          |
| Modelling and dissecting intestinal interactions in a dish using mini-guts.                                                                                                                                                                             |
| Understanding Axonal Biology in health and disease using multiomics analysis in a bioengineered on chip device.                                                                                                                                         |
| Spatial heterogeneity of endocrine organ stem cells during stress.                                                                                                                                                                                      |
| Spatial lipidomics of cancers using correlative label-free imaging.                                                                                                                                                                                     |
| Dissecting the molecular regulation of cell-cell interactions controlling tissue regeneration.                                                                                                                                                          |
| Environmental control of branching patterns: understanding the influence of tissue competition and the extracellular matrix on morphogenesis.                                                                                                           |
| Modelling muscle regeneration and aging with human iPSC-based myofiber constructs.                                                                                                                                                                      |
| Dissecting ECM assembly dynamics during tissue morphogenesis and homeostasis.                                                                                                                                                                           |
| Regulation of endodermal gene expression: from embryo to organoid.                                                                                                                                                                                      |
| Cell-cell interactions at spatial resolution during cancer immunotherapy.                                                                                                                                                                               |
| Exploring signalling circuits controlling neural crest migration using modelling and experimental high-resolution imaging approaches in vivo and ex vivo.                                                                                               |
| Anatomical variations in dermis development; The impact of dermal extracellular matrix organisation/composition on tissue functionality; The re-enactment of developmental programmes during tissue repair.                                             |
| Muscle tissue engineering to model muscle tissue formation, homeostasis and disease.                                                                                                                                                                    |
| Studying cell fate decisions at the 'omics' level using iPSC-derived pancreas progenitor organoids.                                                                                                                                                     |
| Dissecting functional cross-talks in the pancreas microenvironment during development.                                                                                                                                                                  |
| 1) Investigating dynamic changes in chromatin architecture during genome wide reprogramming. 2) Functional analysis of genes escaping X inactivation in the brain. 3) Functional analysis of genes escaping X inactivation in the hepatobiliary system. |
| Cell biology of glia-to-neuron reprogramming: from nuclear mechanics to migration.                                                                                                                                                                      |
| From food to physiology: single cell analysis of neuroendocrine networks that link dietary restriction to ageing.                                                                                                                                       |
| Single neuron transcriptomics of sensory gene networks that link diet to ageing.                                                                                                                                                                        |
| Building a better in vitro model of the local peripheral nerve environment.                                                                                                                                                                             |
| Understanding dynamic behaviour and functions of axonal RNA granules in developing and degenerating neurons.                                                                                                                                            |
| Modulating protein-RNA complexes to counteract neurodegeneration through homeostasis of disorder-prone proteins.                                                                                                                                        |
| Exploring the dynamics of neuritic adhesion complexes in vivo during arborization growth.                                                                                                                                                               |
| Developmental trajectories for neuronal subtype specification; Neuron-specific function in emerging cortical circuits.                                                                                                                                  |
| Cell fate decisions in a stem cell population - the neural crest.                                                                                                                                                                                       |
| Designing tissue specific MRI contrast agents for enhanced cancer screening; A 'Click' in time saves two - a new platform for theragnostics using supramolecular chemistry to create large libraries for targeted radiation delivery.                   |
| coupled multiscale simulations with in vitro and in vivo experiments to understand vascular defects in radial dysplasia.                                                                                                                                |
| Building functional membranes for artificial cells.                                                                                                                                                                                                     |