Internship subject

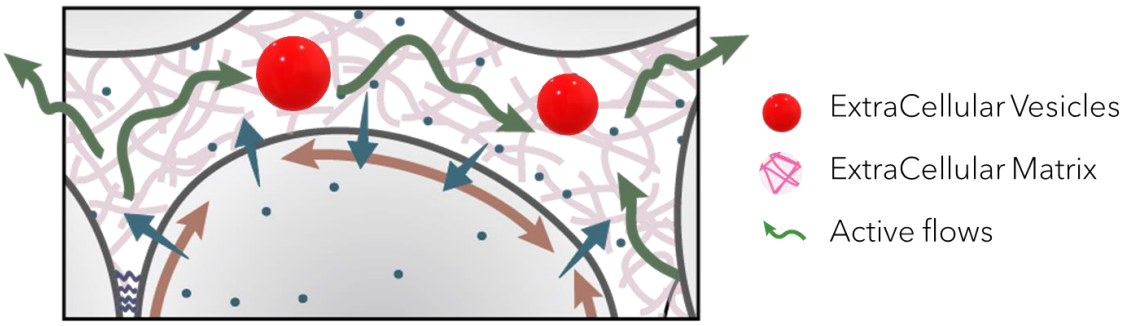
Active pumping of Extracellular Vesicles through Extracellular Matrix

Project description

In biological tissues, cell–cell communication often relies on the emission and reception of biochemical agents. These agents travel over considerable distances, especially when encapsulated within extracellular vesicles. Remarkably, these vesicles (typically around 100 nanometers in diameter) are able to traverse the fibrous extracellular matrix (ECM), even though its pore size is often much smaller (approximately 10 nanometers), and the vesicles themselves are almost non-deformable. We hypothesize that cellular contractility facilitates the transport of extracellular vesicles through the ECM. This may occur either by generating traction forces that deform the matrix structure or by inducing interstitial fluid flows that aid in vesicle movement.

The aim of this project is to design an in vitro experimental model that replicates the interactions between cells, the ECM, and interstitial fluid. The objective is to demonstrate that cell contractility actively drives the transport of extracellular vesicles via pulsatile deformation of the surrounding matrix.

The student will begin by developing a microfluidic device to track vesicle motion through a reconstituted ECM under externally applied flow. Subsequently, contractile cells will be incorporated into the system to test the hypothesis that active cellular forces enhance vesicle mobility through a dense matrix environment.



Related Publications by the team

Extracellular matrix in multicellular aggregates acts as a pressure sensor controlling cell proliferation and motility, M. Dolega et al., *Elife 10, e63258*

Cell-like pressure sensors reveal increase of mechanical stress towards the core of multicellular-spheroids under compression. M. Dolega et al. *Nature Communications 8 (2017) 14056*

Background and skills expected

This interdisciplinary project addresses a current biological question through the use of biophysical tools. It aims to test a theoretical prediction based on the physics of poroelastic composite materials, composed of deformable gels, contractile cells, and non-Newtonian interstitial fluids. Thus, the ideal student will have a background in either physics or biology and a strong interest in working at the interface between these two fields.

Supervisor : Giovanni CAPPELLO,
Laboratory : Laboratoire Interdisciplinaire de Physique
Team/Group : MOTIV / MicroTiss
Contacts - E-mail : Giovanni.Cappello@univ-grenoble-alpes.fr **Tel :** +33 (0)616208511

Web-page : https://liphy.univ-grenoble-alpes.fr/fr/recherche/equipes/microtiss