Master Biologie Moléculaire et Cellulaire 'BMC',
Université Paris Cité - *UFR Sciences du Vivant*

Parcours : **Biologie et Développement Cellulaires 'BDC'**
https://master2bdc.ijm.fr/
Fiche de Projet de Stage de M2, 2025-2026

Unité INSERM ou CNRS ou Université : Laboratoire d'Optique et de Biosciences CNRS UMR7645 - INSERM U696 **Intitulé Equipe :** Cell migration and morphogenesis in the early embryo **ED d'appartenance :** ED IP Paris	**Responsable de l'Equipe :** Nicolas David **Responsable du Stage :** Sophie Escot **Contacts** Adresse : Route de Saclay 91120 Palaiseau Email : sophie.escot@polytechnique.edu Tel :0169335041

Cell migration dynamics during zebrafish embryonic development

Context: Cell migration is a fundamental biological process involved in key physiological events such as embryonic development, wound healing, and immune response. It also plays a major role in pathological conditions like cancer metastasis, where cells acquire abnormal migratory properties. As a cell moves, it extends its plasma membrane forward at the leading edge. Actin polymerisation under the membrane generates the driving force allowing the membrane to move forward. To ensure optimal migration, precise regulation of actin dynamics is essential and controls key parameters such as speed, directionality, and persistence.
Our team uses the zebrafish embryo to study how molecular signals control cell migration, with the aim of understanding the cellular behaviours that shape the developing embryo. The zebrafish is a powerful model system that can combine simple genetic and functional approaches with high-resolution imaging, enabling precise analysis of cell dynamics at both tissue-wide and single-cell levels.

Project Overview: This project will use established experimental approaches, including functional perturbation, cell transplantation, and high-resolution live imaging, to investigate the molecular mechanisms regulating cell migration during early development. The student will participate in the functional characterisation of candidate genes identified from transcriptomic datasets. These genes are predicted to regulate key aspects of cell migration, such as cytoskeletal organisation, adhesion, and mechanosensing.
The internship will involve establishing gene expression patterns of selected candidates and initiating their functional analysis through gain- or loss-of-function experiments (mRNA injection, morpholinos, CRISPR/Cas13d knockdown). Cell migration parameters such as speed, persistence, and protrusion dynamics will be quantified using transgenic zebrafish lines expressing fluorescent markers in migrating cells. Advanced imaging techniques, such as confocal, two-photon, and light-sheet microscopy, will be used to visualise and analyse cell behaviour in real time.

Technical Methodology: Embryology (micro-injection, cell transplantation), high-resolution and fast imaging (confocal, two-photons, light sheet), quantitative analysis of cell migration.
Environment: The internship will take place in the Advanced Microscopy pole of the Lab for Optics and Biosciences at Ecole Polytechnique (LOB). This structure brings together experts in microscopy and biology, providing a great environment for multidisciplinary interactions.

Publications de l'équipe relatives au projet de stage (max 5)

- Serres M*, Shaughnessy R*, **Escot S***, Hammich H, Cuvelier F, Salles A, Rocancourt M, Verdon Q, Gaffuri AL, Sourigues Y, Malherbe G, Velikovsky L, Chardon F, Sassoon N, Tinevez JY, Callebaut I, Formstecher E, Houdusse A, David NB, Pylypenko O, Echard A. * Co-1st Author. MiniBAR/GARRE1 is a dual Rac and Rab effector required for ciliogenesis. Dev Cell. 2023 Nov 20;58(22):2477-2494.e8. https://doi.org/10.1016/j.devcel.2023.09.010.
- Escot S, Hassanein Y, Elouin A, Torres-Paz J, Mellottee L, Ignace A, David NB. Nance-Horan-syndrome-like 1b controls mesodermal cell migration by regulating protrusion and actin dynamics during zebrafish gastrulation. Commun Biol. 2025 Feb 28;8(1):328. https://doi.org/10.1038/s42003-025-07689-6.
- Boutillon, A., Escot, S., Elouin, A., Jahn, D., González-Tirado, S., Starruß, J., Brusch, L., David, N.B. Guidance by followers ensures long-range coordination of cell migration through α-catenin mechanoperception. Dev. Cell 57, 1529-1544.e5. https://doi.org/10.1016/j.devcel.2022.05.001.
- Boutillon, A., Escot, S., and David, N.B.. Deep and Spatially Controlled Volume Ablations using a Two-Photon Microscope in the Zebrafish Gastrula. J. Vis. Exp. https://doi.org/10.3791/62815.