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, 2026-2027

Unité INSERM ou CNRS ou Université : UMR 8263 CNRS, U 1345 INSERM et Sorbonne Université **Intitulé Equipe :** Mechanics of neuronal development **ED d'appartenance :** 515 Complexité du Vivant **Responsable de l'Equipe :** Marie Breau	**Responsable du Stage :** Marion Baraban **Contacts** IBPS, Dev2A Adresse : 9 Quai Saint-Bernard, 75252 PARIS Cedex 05 Email : marion.baraban@sorbonne-universite.fr Tel : +331 44 27 20 84

Titre du projet : Deciphering the chemical and mechanical impact of the skin during the morphogenesis of a sensory organ

Résumé du Projet de Stage (en 300 mots maximum, mots clés en gras)
During organogenesis, the emergence of a functional organ requires a precise coordination between adjacent tissues that continuously exchange chemical and mechanical signals. How these reciprocal interactions shape organ architecture in vivo remains one of the major unanswered questions in developmental biology. Sensory organs provide a particularly powerful model to address this issue, as they must establish direct communication with the external environment through the formation of epithelial openings, orifices, whose morphogenetic mechanisms remain largely unknown. In the zebrafish olfactory organ, a small epithelial opening form above a neuronal rosette, allowing sensory neurons to become exposed to odorant molecules. Preliminary data reveal that, prior to opening, a specific subset of skin epithelial cells undergoes dramatic remodeling characterized by cytoskeletal reorganization, actomyosin accumulation, polarity changes, and local loss of cell-cell junctions. These observations suggest that local epithelial remodeling generates a mechanically and molecularly competent domain required for orifice formation.
The proposed Master 2 internship will focus specifically on the impact of remodelled skin cells on orifice formation. The objective is to understand how molecular and mechanical properties of epithelial cells drive local tissue remodeling and epithelial opening in vivo.
The first aim of the project will be to characterize the cytoskeletal and polarity changes occurring in remodelled skin cells. Using zebrafish transgenic lines, optogenetics, and high- resolution live imaging, the student will investigate the role of RhoGTPase signaling, actomyosin dynamics, microridge organization, and adhesion proteins during orifice formation. Functional perturbations will be achieved through tissue-specific expression of dominant- negative or constitutively active proteins to determine how epithelial mechanics and cytoskeletal organization regulate morphogenesis.
A second major objective will focus on how remodelled skin cells display altered mechanical properties that facilitate epithelial opening. To test this, we will combine laser ablation and nano-indentation to map tissue tension, viscoelasticity, and stiffness in vivo. In collaboration with physicists Isabelle Bonnet (Institut Curie) and Jonathan Fouchard (CNRS, IBPS Dev2A), we will analyse recoil dynamics, Young's modulus, and topological defects during orifice formation. Preliminary data reveal extensile +1/2 defects at the future opening site, suggesting a direct role for tissue mechanics in morphogenesis.
This project combines developmental biology, mechanobiology, advanced imaging, and physics to uncover fundamental principles governing tissue interactions during organ formation.

Publications de l'équipe relatives au projet de stage (max 5)
-Gordillo-Pi C, Cabrera M, Gilles J-F, Bardet P-L, Eschstruth A, Bonnet I, Breau M and Baraban M*, accepted in principle at Nature Communications, deposit as a bioRxiv preprint: https://doi.org/10.1101/2025.07.25.666761
-Baraban M*, Gordillo Pi C, Bonnet I, Gilles J-F, Lejeune C, Tep F, Cabrera M, Breau MA. Developmental Cell (2023) 58:1–15 https://doi.org/10.1016/j.devcel.2023.02.001
-Monnot P, Gangatharan G, Baraban M, Pottin K, Cabrera M, Bonnet I, Breau MA. EMBO report (2022) e52963. doi: 10.15252/embr.202152963 https://doi.org/10.15252/embr.202152963
-Baraban M, Retamal MA and Ortiz FC. Frontiers Cellular Neuroscience 13:475. https://doi.org/10.3389/fncel.2019.00475
-Baraban M* , Koudelka S and Lyons DA. Nature Neuroscience, 21(1), 19-23. https://doi.org/10.1038/s41593-017-0040-x