Master 2 Reproduction et Développement
Stage de recherche 2025-2026

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Intitulé de l 'équipe d'accueil : Divisions méiotiques de l'ovocyte – Oocyte meiosis Group (OMG)

Site internet de l'unité : https://www.ibps.sorbonne-universite.fr/fr/Recherche/umr-developpement-adaptation-et-vieillissement/divisions-meiotiques-de-lovocyte

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Résumé du thème de recherche de l'équipe d'accueil (une dizaine de lignes maximum) :
Cells proliferation is a fundamental process for development, growth and maintenance of living organisms. Despite the scientific interest in studying this process over many years, the understanding of the mechanisms driving cell division remains elusive. Entry into M-phase is driven by the activation of the kinase Cdk1, which phosphorylates hundreds of proteins to coordinate cell division. Our team investigates the mechanisms controlling Cdk1 activation during meiotic divisions using the Xenopus oocyte as a model system. In this model, oocytes are arrested in prophase of the first meiotic division, and hormonal stimulation by progesterone induces a rapid drop in cAMP levels and PKA activity, allowing the cell to re-enter the cell cycle. We aim to identify the molecular effectors that link PKA inactivation to Cdk1 activation. Building on this work, we are now extending our research to early embryonic divisions—another transcriptionally silent context—to better understand how PKA regulates the early cell cycle.

Titre du projet de stage : Role of PKA and its effectors in the control of the timing and progression of early embryonic divisions.

Projet de stage : (une vingtaine de lignes maximum)

Despite decades of research, the mechanisms governing the G2-M transition remain poorly understood. Our lab has extensively used the Xenopus oocyte model to identify molecular actors that regulate the choice of the cell to enter and execute the cell division. Interestingly the first embryo divisions are also a great model to study this process. As the meiotic divisions, the cleavage occurs in the absence of transcription and rely entirely on maternally stored RNAs and proteins. These divisions also occur in highly synchronous and organized manner. Our lab has extensively studied the role of PKA in maintaining G2-arrest in oocytes and identified several effectors that mediate its action on meiotic cell cycle progression. Previous studies have reported dynamic fluctuations in cAMP levels during early embryonic cleavages, suggesting a potential regulatory role for PKA in these mitotic divisions. However, the function of PKA and its substrates during early embryogenesis remains largely unexplored.

The objective of this M2 internship is to investigate the role of PKA and its effectors in controlling the timing and progression of early embryonic divisions. Using the *Xenopus laevis* embryo—a powerful model due to its large size and ease of manipulation—we will manipulate the activity of PKA or of its effector microinjecting mRNAs or proteins into one blastomere at the two-cell stage, using the sibling blastomere as an internal control. In the first aim, we will modulate PKA activity through injection of a PKA inhibitor (loss-of-function), or overexpression PKAc or the phosphodiesterase inhibitor IBMX (gain of function), and monitor the impact on the number of cells and timing of divisions. In the second aim, we will investigate the role of PKA substrates, including Arpp19, Cdc25, and unpublished

effectors identified in our lab, using phosphomimic and non-phosphorylable mutants to dissect their functional importance. Understanding how PKA and its downstream effectors influence these early divisions will provide new insights into kinase-based control of cell cycle transitions in early development.

Techniques mises en œuvre par le stagiaire :

During the internship, the student will acquire a diverse set of skills and techniques. These include: (1) molecular biology techniques: cloning and site-specific mutagenesis using Gibson assembly and overlap-extension PCR and in vitro transcription of mRNAs; (2) biochemistry techniques: SDS-PAGE, western blotting, use of phospho-specific antibodies; (3) embryological techniques: Xenopus fertilization, embryo culture, and microinjection of blastomeres. Additionally, the student will actively participate in the lab's weekly meetings and receive training on oral and written presentation of scientific questions and the obtained results.

Publications du Responsable de stage au cours des 5 dernières années :

Mandal, M., Scerbo, P., Coghill, I., **Riou, J.-F**., Bochet, C. G., Ducos, B., Bensimon, D., Le Saux, T., Aujard, I. and Jullien, L. (2024). Caged Dexamethasone to Photo-control the Development of Embryos through Activation of the Glucocorticoid Receptor. Chemistry 30, e202400579.

Durant-Vesga, J., Suzuki, N., Ochi, H., Le Bouffant, R., Eschstruth, A., Ogino, H., Umbhauer, M. and **Riou, J.-F**. (2023). Retinoic acid control of pax8 during renal specification of Xenopus pronephros involves hox and meis3. Developmental Biology 493, 17–28.

Goea, L., Buisson, I., Bello, V., Eschstruth, A., Paces-Fessy, M., Le Bouffant, R., Chesneau, A., Cereghini, S., **Riou, J. F**. and Umbhauer, M. (2022). Hnf1b renal expression directed by a distal enhancer responsive to Pax8. Sci Rep 12, 19921.

Autres informations:

Etudiants actuellement en thèse ou en M2 dans l'équipe d'accueil. Pour chaque étudiant indiquez le nom du responsable de thèse, l'année du début de la thèse et l'Ecole Doctorale de rattachement

1. Martina Santoni (Ph.D. student) - Responsables : Enrico Daldello and Catherine Jessus, started in 2022, ED515: Complexité du Vivant (Sorbonne Université).

2. Asil Abualwafa (M2 student) - Responsables : Enrico Daldello. Molecular and Cellular Biology (BMC), Sorbonne Université.

Etudiants ayant préparé ou soutenu leur thèse ou leur M2 dans l'équipe d'accueil au cours des six dernières années. Pour chaque étudiant indiquez le nom du responsable de l'étudiant, l'année du début de la thèse et de fin de la thèse, l'Ecole Doctorale de rattachement et le devenir de l'étudiant.

1. Ph.D student – Ferdinand Meneau. Responsables : Marika Miot and Catherine Jessus, 2019-2023. ED515: Complexité du vivant (Sorbonne Université). Post-doctorat at University of Edinburgh (UK).

2. M2-student - Nabil Sekhsoukh. Responsable : Enrico Maria Daldello, stage M2 2021-2022. M2 Biochimie et Biologie Moléculaire, Sorbonne Université. CDD d'ingénieur France.

Cette proposition de stage s'adresse-t-elle spécifiquement à un étudiant scientifique, médecin ou vétérinaire ou bien est-il ouvert à tous les profils ?

étudiant scientifique

Ce sujet peut-il donner lieu à une thèse ?

Yes