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

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

Unité INSERM ou CNRS ou Université : U1050/UMR7241, CIRB, Collège de France **Intitulé Equipe :** Oocyte Mechanics and Morphogenesis **ED d'appartenance :** SdV-PSL - 657 **Responsable de l'Equipe :** Marie-Emilie Terret/Marie-Hélène Verlhac	**Responsable du Stage :** Marie-Emilie Terret/Lucie Barbier **Contacts** Adresse : CIRB, Collège de France, 11 place Marcelin Berthelot, 75005 Paris. Email : marie-emilie.terret@college-de-france.fr Tel : 01 44 27 16 92

Titre du projet : Regulation of oocyte membrane during its development

Meiosis produces oocytes and spermatozoa, sexual cells of reproduction. In women, it generates a lot of poor-quality oocytes, a trend that increases with age: 20% of oocytes are aneuploid before 35 years, 60% after. This leads to infertility and developmental diseases, such as trisomies. It is a public health problem in industrialized countries where the age of motherhood is increasing, reflecting the investment of women in their professional lives and leading to an increased use of assisted reproductive technologies. The developmental potential of mammalian oocytes correlates with their mechanical properties, that could serve as biomarkers of their quality[1]. In mouse and human, mechanical properties are tightly regulated during oocyte development[2-4]. Mechanical defects induce alterations in division geometry[2], chromosome alignment[5] and cytoplasmic landscape[6], all deleterious for embryo development after fertilization. Up to now, we have focused on the role of the actomyosin cortex in the regulation of oocyte mechanical properties, but not on its plasma membrane. However, plasma membrane is known to play a role in cell mechanics, and our preliminary results show that it undergoes rearrangement during oocyte development. Our project aims to **characterize these membrane changes, their consequences on cell mechanics, and their impact on oocyte development**. To study these aspects, we have developed innovative tools in **imaging and biophysical approaches**[1-6]. Using these tools, we will at short (master 2 project) and long (thesis project) term:

1 / Characterize the membrane changes during oocyte development by analyzing the localization in space and time of different lipid probes, and by performing lipidomics.

2 / Assess the consequences of these membrane changes on cell mechanics and on the organization of the cortex, by measuring membrane tension using AFM and probes, by applying osmotic shocks at different developmental stages to compare the response of the oocyte, and by playing with membrane composition (targeting enzymes of the lipid metabolism to the membrane) to assess the effect on cortex organization.

3 / Assess the consequences of these membrane changes on oocyte development by playing with membrane composition (see 2/) to assess the effect on meiotic divisions (timing, geometry, efficiency), on fertilization (gamete fusion) and on early embryonic development.

Our project is ambitious and innovative, requiring a unique interdisciplinary set of skills and collaborations already established. It aims to understand the impact of membrane regulation on oocyte fitness and therefore has a high potential for transfer to the society.

Team publications related to the proposed project:

1. Barbier L *et al*. *Sci Adv* 11(8) :eadr9869 (2025).
2. Chaigne A *et al*. *Nat Cell Biol* 15:958-66 (2013).
3. Chaigne A *et al. Nat Commun* 6, 6027 (2015).
4. Bulteau R *et al*. *Small* e2500221 (2025).
5. Bennabi I *et al*. *Nat Commun* 11(1):1649 (2020).
6. Nikalayevich E *et al*. *Dev Cell* 59(7):841-852 (2024).