<u>Funded PhD (3y) or post-doc (2y) position to be filled now</u>

***Physical modeling of mammalian embryo cavitation*:**

from lumenogenesis to the formation of a blastocyst

<u>Laboratory:</u>
Center for Interdisciplinary Research in Biology - CNRS UMR 7241 / INSERM U1050.
Collège de France - 11, place Marcelin Berthelot, 75005 Paris

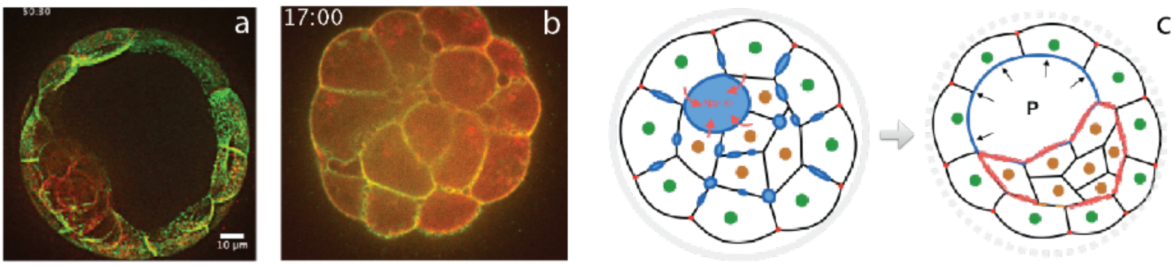
<u>Team:</u> *Multiscale Physics of Morphogenesis* www.virtual-embryo.com

<u>PhD thesis director</u>: Hervé Turlier herve.turlier@college-de-france.fr
Phone: +33.1.44.27.14.10

The mammalian preimplantation embryo is shaped via a series of cell divisions and cell rearrangements (1-3), leading to the blastocyst, a stereotypical structure composed of an epithelial monolayer surrounding an inner mass of cells and a fluid-filled cavity (Fig. 1a). The formation of the blastocoel cavity remains widely uncharacterized from both biological and physics perspectives. In tight collaboration with the experimental embryology group of JL Maître in Institut Curie, we are investigating this morphogenetic process combining physical modeling, embryo imaging and genetic/mechanical perturbations. Our current view is that the cavity forms by nucleation, growth and merging of a multitude of lumens at all cell-cell interfaces (Figs. 2b-c). This morphogenetic process combines osmotic fluid pumping with luminal fluid exchange, driven by differences of hydrostatic pressures between lumens. We ambition to understand how the interplay between surface tension, cell-cell adhesion and osmotic effects controls the formation and the localization of the cavity.

This funded project aims at modeling physically the process of cavitation in mammalian embryos at various length/time scales. Subprojects include the stochastic process of lumen nucleation, the dynamics of fluid exchange in networks of lumens, the interplay between tension, adhesion and osmotic pumping in driving the growth and directing the localization of the cavity in the embryo, and realistic numerical simulations of the process combining all relevant aforementioned effects. The project will benefit from abundant preliminary experimental data, significant initial theoretical/numerical work, and a unique combined experience in mammalian embryo morphogenesis (1-3). The project has a strong potential for several publications in high impact interdisciplinary and physics journals.

The candidate should have a strong training in soft-matter physics, or condensed-matter physics or theoretical physics, and should demonstrate very good analytical and excellent programming skills (Python and preferably also C++). The candidate will interact closely with biologists and will work in a highly interdisciplinary/international environment, requiring good communication skills and a real interest for biological systems. She/he will be expected to participate actively to the scientific life of the laboratory and to show a large degree of autonomy. She/he will have a powerful computer & access to the lab computing servers.



1. Turlier H. et al., Furrow Constriction in Animal Cell Cytokinesis. *Biophysical Journal* **106** (2014).
2. Maître, J-L. et al. Pulsatile cell-autonomous contractility drives compaction in the mouse embryo. *Nature Cell Biology* **17** (2015)
3. Maître, J-L, Turlier H. et al. Asymmetric division of contractile domains couples cell position and specification. *Nature* **536** (2016)

<u>Location</u>: Located in the heart of the Latin Quarter in Paris, Collège de France is one of the oldest Research University in France, with internationally renowned Professors and research laboratories. The Center for Interdisciplinary Research in Biology (CIRB) is a young & interdisciplinary CNRS/INSERM structure regrouping 21 teams focused on biological problems from various perspectives: cell & developmental biology, neuroscience, mathematical and physical biology.