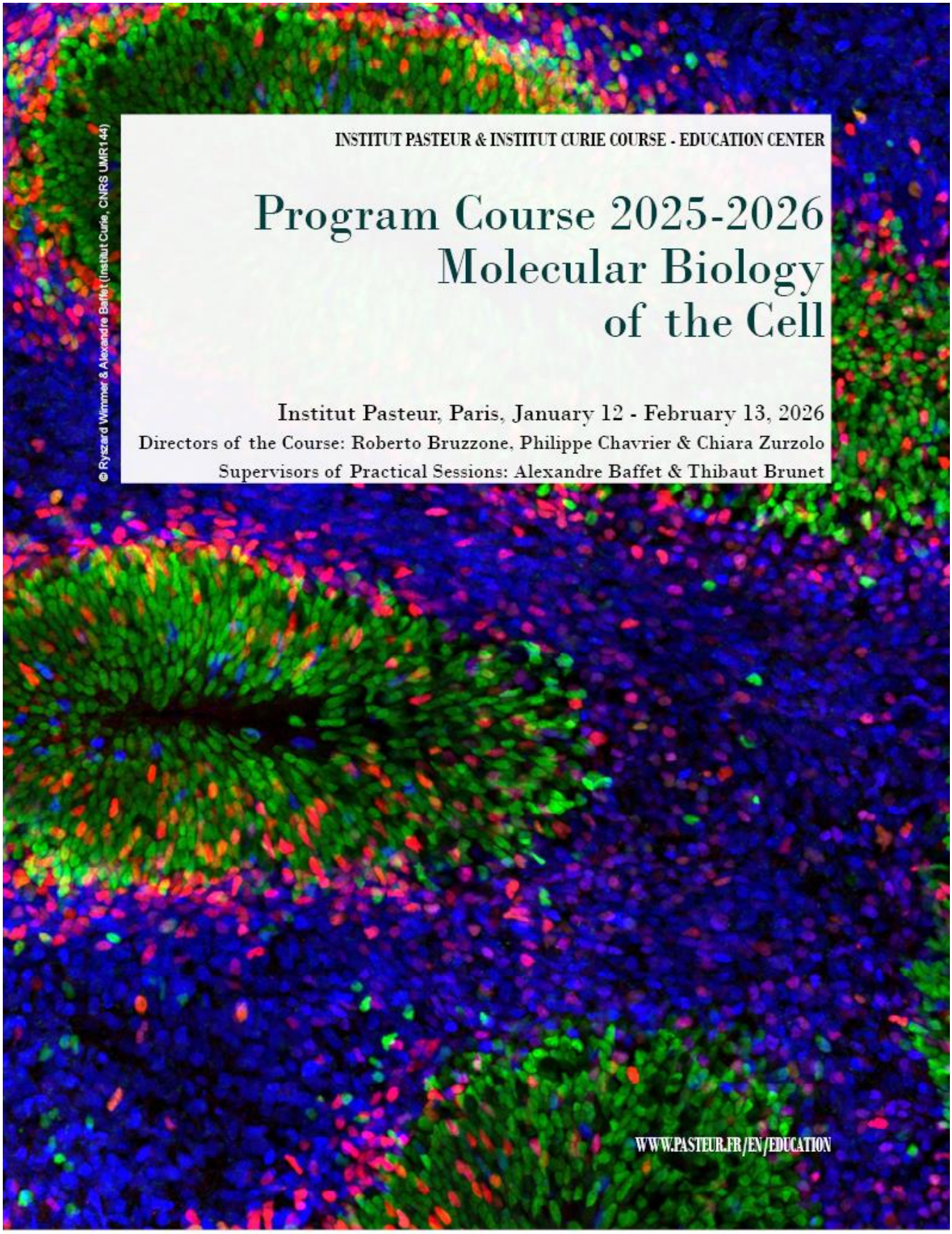

INSTITUT PASTEUR & INSTITUT CURIE COURSE - EDUCATION CENTER

Program Course 2025-2026 Molecular Biology of the Cell

Institut Pasteur, Paris, January 12 - February 13, 2026

Directors of the Course: Roberto Bruzzone, Philippe Chavrier & Chiara Zurzolo

Supervisors of Practical Sessions: Alexandre Baffet & Thibaut Brunet

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MOLECULAR BIOLOGY OF THE CELL

2025-2026

January 12 - February 13(*), 2026

Directors of the Course

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MOLECULAR BIOLOGY OF THE CELL 2025-2026

Description of the course

The Molecular Biology of the Cell course is an intensive laboratory and lecture course of five weeks focusing on cutting-edge aspects of cell biology. It is composed of lectures given by internationally renowned scientists, and of one practical session organized together with teams from the Institut Curie and the Institut Pasteur. The main topics of the course extend across the cell biology of infection, cancer, signaling, epigenetics and intracellular trafficking, emphasizing new experimental approaches. The availability of the core Imaging Platform at Institut Pasteur will introduce students to advanced techniques for the dynamic visualization of cells in health and disease.

Participants are selected from Master 2 students at the University Paris Cité, Sorbonne University and Paris Saclay. The course is intended to be a platform of excellence in which students can meet and closely interact with an international group of top-level scientists to discuss, exchange ideas and establish valuable contacts in the perspective of establishing a network of young cell biologists at an early stage in their careers. Students will be able to understand the importance of basic research and of a broad interdisciplinary approach to improve human health. We also expect to provide orientations and mentoring to help course alumni in their future career.

The first week of the course will address general aspects of cell biology in relationship to the two central modules.

The module in week 2 "DUAL NUCLEAR TRANSLOCATION MODES IN HUMAN NEURAL STEM CELLS" will present an overview of nuclear translocation mechanisms in various cell types and illustrate how induced pluripotent stem cells (iPSCs)-based organoids can be used to address these mechanisms in human cell types. The accompanying practicum will address the kinetics and molecular characteristics of nuclear translocation events occurring in bRG cells, a neural stem cell type rare in mice by highly abundant in humans. Using a combination of human cerebral organoid-derived in vitro cultures, functional perturbations, live imaging and image analysis, students will identify the key factors controlling bRG cell translocation, a process required for these cells to colonize the human fetal neocortex.

The module in week 3 "MULTICELLULAR DEVELOPMENT AND MORPHOGENESIS IN THE CLOSEST LIVING RELATIVES OF ANIMALS" will enter the field of evolutionary cell biology. Lectures will cover the evolutionary origin of eukaryotic cells and of multicellularity, both in eukaryotes in general and in animals in particular. In the practicum, you will investigate and quantify multicellular development in the closest microbial relatives of animals: the choanoflagellates, planktonic micro-eukaryotes that can alternate between a unicellular lifestyle and a multicellular form reminiscent of early animal embryos. Participants will (1) determine the mechanisms of colony formation (clonal versus aggregative); (2) test a hypothesized mechanism of size regulation by comparing colonies of different sizes (different species and mutant strains). To do so, students will stain and quantify the volume of extracellular matrix secreted.

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Practical I

DUAL NUCLEAR TRANSLOCATION MODES IN HUMAN NEURAL STEM CELLS

In Humans, the strong size increase of the neocortex is largely supported by an expanded neural stem cell population, the basal radial glial cells (bRG cells). These cells are extremely rare in small brain species such as mice but highly abundant in Hominids, and in particular in Humans, where they support the vast production of neuronal and glial cells. bRG cells are highly elongated, extending a cytoplasmic process up to the basal surface of the neocortex, millimetres away from their cell body. They progressively colonize the developing neocortex through a translocation of their soma into the basal process. Two modes of translocation exist within these cells, occurring at different stages of the cell cycle, at different speeds and amplitude, and controlled by entirely different cytoskeletal elements. The purpose of this practicum will be to identify these two phases of bRG cell translocation and their molecular characteristics. To do so, the students will have access to a powerful model system, in vitro cultures of human bRG cells, generated from human cortical organoids. The lab has indeed shown that both modes of translocation are conserved in these dissociated 2D cultures, enabling them to perform functional perturbations in a simplified system.

Students will learn how to generate these cultures from cortical organoids, replate them, and perform 24-hour live imaging to monitor their translocation behaviour. They will use various perturbations to interrogate the molecular mechanisms of human bRG cell translocation modes and analyze their live imaging data using tracking softwares. Finally, in vivo live imaging movies of these same conditions will be analysed by the students in order to speculate on how tissue microenvironment and crowding may affect the mechanics of these movements.

Practical II

MULTICELLULAR DEVELOPMENT IN THE CLOSEST LIVING RELATIVES OF ANIMALS

The unicellular-to-multicellular transition was a crucial step of animal origins, but its cellular mechanisms remain mysterious. In recent years, insights have come from the study of choanoflagellates: aquatic micro-eukaryotes that are the closest living relatives of animals. Choanoflagellates are characterized by a polarized cell architecture reminiscent of animal epithelial cells, with an apical flagellum and microvilli, and a basal secreted extracellular matrix. Genomics has revealed that choanoflagellates possess multiple genes encoding animal 'developmental genes' long thought to be unique to animals (cadherins, collagens, laminins, *c-myc*…) Moreover, certain choanoflagellates are capable of multicellular development into colonies that are reminiscent of early animal embryos.

Thanks to the recent development of genetic tools and to improved imaging techniques, the choanoflagellate *Salpingoeca rosetta* has emerged as a tractable model for modern cell biology. The practicum aims at testing recent hypotheses from the literature regarding the development and size control in this choanoflagellate. When it detects specific bacterial signals, *S. rosetta* forms spherical rosette colonies reminiscent of a morula-stage animal embryo. Rosettes are assumed to form strictly clonally, *i.e.* by serial cell division without siter-cell separation. Aggregation of separate cells is not thought to contribute to rosette development or growth. Once they reach a certain size, rosettes tend to undergo fission or to extrude cells. This growth/fission/extrusion balance is thought to regulate the size of colonies in the face of ongoing cell proliferation. Cells are connected to each other within colonies by a self-secreted basal extracellular matrix (or ECM). The size at which colonies undergo fission or extrusion is thought to be determined by a mechanical instability, whose parameters are set by the quantity of ECM: the more ECM per cell is secreted, the larger the rosette can grow. In this practicum, students will (i) challenge the assumption of clonality by combining strains expressing distinct fluorophores and test for exchange of cells between rosettes; (ii) test the ECM-driven mechanism for size regulation by quantifying ECM in rosettes of different sizes – produced by different mutant strains of *S. rosetta* or by other, related species of choanoflagellates. This will involve fluorescent staining, confocal imaging, and image analysis.

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Thursday, January 08

11:30 - 12:15	Pre-start meeting	**Education Center**

WEEK 1 — JANUARY 12 - 16, 2026

Monday, January 12

09:00 - 10:00	Welcome & Presentation of the Education Center	**Education Center** (Institut Pasteur, Paris, France)
	Introduction & Presentation of the course	**Roberto BRUZZONE** (Istituto Pasteur Italia, Roma, Italy) **Philippe CHAVRIER** (Institut Curie, Paris, France) **Chiara ZURZOLO** (Institut Pasteur, Paris, France)
10:00 - 11:30	**Presentation of the students (*5 min max, 2 slides each, background + project*)**	
12:00 - 13:00	**BCI departmental seminar (Auditorium François Jacob)** **Endoplasmic Reticulum Protein Homeostasis: From Quality Control to Signalling**	**Pedro CARVALHO** (University of Oxford, UK)
14:30 - 16:30	ER quality control and organelle biogenesis	**Pedro CARVALHO** (University of Oxford, UK)
17:00	Galette des rois / Epiphany Cake	

Tuesday, January 13

9:30 - 12:00	Cell division	**Helder MAIATO** (University of Porto, Portugal)
14:00 - 16:30	Cytokinesis and membrane scission	**Arnaud ECHARD** (Institut Pasteur, Paris, France)

Wednesday, January 14

9:30 - 12:00	Mechanics of human embryo compaction	**Jean-Leon MAITRE** (Institut Curie, Paris, France)
14:00 - 16:30	Glycoswitches to tune endocytosis and retrograde trafficking	**Ludger JOHANNES** (Institut Curie, Paris, France)
17:00 - 18:00	**Distribution of the articles for the final examination** *Written projects will be submitted to the Course Committee by Tuesday, February 10th, 2026* *Oral examination will be on Friday, February 13th, 2026*	

Thursday, January 15

9:30 - 12:00	Asymmetric cell division	**Lara KRUGER** (Institut Curie, Paris, France)
14:00 - 16:30	Mitochondria and Chloroplasts: Evolution of Bioenergetics	**Benjamin ENGEL** (University of Basel, Switzerland)

Friday, January 16

9:30 - 12:00	Mitotic spindle and checkpoints	**Andrea MUSACCHIO** (Max Planck Institute, Germany)
12:10 - 12:15	**PHOTO**	
13:45 - 14:00	**SURVEY**	
14:00 - 15:00	Presentation of Practicum I	**Alexandre BAFFET** (Institut Curie, Paris, France)
15:00 - 16:00	Presentation of Practicum II	**Thibaut BRUNET** (Institut Pasteur, Paris, France)

MOLECULAR BIOLOGY OF THE CELL 2025-2026

WEEK 2 — JANUARY 19 - 23, 2026

PRACTICAL I: DUAL NUCLEAR TRANSLOCATION MODES IN HUMAN NEURAL STEM CELLS
Alexandre BAFFET, Jean-Baptiste BRAULT & Pauline LESTIENNE (Institut Curie, Paris, France)

Monday, January 19

9:00 - 11:00	From Stem Cells to Circuits: Developmental Neuroanatomy with Organoids and Assembloids	**Simon SCHAFER** (Technical University of Munich, Germany)
12:00 - 13:00	**BCI departmental seminar (Auditorium François Jacob) Organoids as Decoders of the Logic and Function Of Neuro-Immune Circuits**	**Simon SCHAFER** (Technical University of Munich, Germany)
14:00 - 18:00	**Practical I**: General introduction Experiment session 1 : Replating of Neural stem cell cultures	**Alexandre BAFFET** **Jean-Baptiste BRAULT** **Pauline LESTIENNE**

Tuesday, January 20

10:00 - 12:30	Mammalian neurogenesis	**Alexandre BAFFET** (Institut Curie, Paris, France)
14:00 - 18:00	**Practical I**: Dissociation of cortical organoids for neural stem cell culture	**Alexandre BAFFET** **Jean-Baptiste BRAULT** **Pauline LESTIENNE**

Wednesday, January 21

10:00 - 12:30	Consequences of large deformations of the cell nucleus during immune cell migration and tumor growth	**Matthieu PIEL** (Institut Curie, Paris, France)
14:00 - 18:00	**Practical I**: Immunofluorescence and live imaging + start Movie 1 (organoid-derived NSCs - 2D + DRUGS) – PHASE CONTRAST + Fluo (EVOS M7000?)	**Alexandre BAFFET** **Jean-Baptiste BRAULT** **Pauline LESTIENNE**

Thursday, January 22

10:00 - 12:30	Microtubule dynamics	**L.C. Lukas Kapitein** (Utrecht University, Netherlands)
14:00 - 18:00	**Practical I**: IMAGING IF NSC (widefield microscopes Pasteur Teaching + start Movie 2 (organoid derived NSCs - 2D + DYES) PHASE CONTRAST + Fluo (EVOS M7000?)	**Alexandre BAFFET** **Jean-Baptiste BRAULT** **Pauline LESTIENNE**

Friday, January 23

10:00 - 12:30	Axonal transport and human pathologies	**Giampietro SCHIAVO** (University College London, UK)
13:45 - 14:00	**SURVEY**	
14:00 - 18:00	**Practical I**: Image analysis	**Alexandre BAFFET** **Jean-Baptiste BRAULT** **Pauline LESTIENNE**

WEEK 3 — JANUARY 26 - 30, 2026

PRACTICAL II: MULTICELLULAR DEVELOPMENT IN THE CLOSEST LIVING RELATIVES OF ANIMALS

Thibaut BRUNET, Mylan ANSEL, Uzuki HORO, Maite FREIRE & Nuria ROS

Monday, January 26

9:00 - 11:00	The origin of animal multicellularity	**Thibaut BRUNET** (Institut Pasteur, Paris, France)
12:00 - 13:00	**BCI departmental seminar (Auditorium François Jacob)** **Exploring the origin of multicellularity in real time: What we've learned from 10,000 generations of laboratory evolution**	**William RATCLIFF** (Georgia Institute of Technology, USA)
14:00 - 17:00	**Practical II**: General introduction	**Thibaut BRUNET** **Mylan ANSEL** **Uzuki HORO** **Maite FREIRE** **Nuria ROS**

Tuesday, January 27

10:00 - 12:30	Experimental evolution of multicellularity	**William RATCLIFF** (Georgia Institute of Technology, USA)
14:00 - 18:00	**Practical II**	**Thibaut BRUNET** **Mylan ANSEL** **Uzuki HORO** **Maite FREIRE** **Nuria ROS**

Wednesday, January 28

10:00 - 12:30	Single cell omics	**Musa MHLANGA** (Radboud Institute for Molecular Life Sciences, Nijmegen, Netherlands)
13:00 - 17:30	**Practical II**	**Thibaut BRUNET** **Mylan ANSEL** **Uzuki HORO** **Maite FREIRE** **Nuria ROS**

Thursday, January 29

10:00 - 12:30	Biophysics of protist behaviour	**Kirsty WAN** (University of Exeter, UK)
13:30 - 18:00	**Practical II**: Image analysis	**Thibaut BRUNET** **Mylan ANSEL** **Uzuki HORO** **Maite FREIRE** **Nuria ROS**

Friday, January 30

10:00 - 12:30	Single cell lipid biology	**Giovanni D'Angelo** (Ecole Polytechnique Fédérale de Lausanne, Switzerland)
13:45 - 14:00	**SURVEY**	
14:00 - 17:30	**Practical II**: Image analysis and preparation of presentation	**Thibaut BRUNET** **Mylan ANSEL** **Uzuki HORO** **Maite FREIRE** **Nuria ROS**

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WEEK 4 — FEBRUARY 2 - 6, 2026

Monday, February 2

9:00 - 11:00	Control of cell adaptation in cancer and immunity	**Raphael RODRIGUEZ** (Institut Curie, Paris, France)
12:00 - 13:00	**BCI departmental seminar (Auditorium François Jacob)** **Chemical control of cell adaptation**	**Raphael RODRIGUEZ** (Institut Curie, Paris, France)
14:00 - 18:00	**Practical II:** Students' presentations	**Thibaut BRUNET** **Mylan ANSEL** **Uzuki HORO** **Maite FREIRE** **Nuria ROS**

Tuesday, February 3

10:00 - 12:30	Epigenetic and gene regulatory functions of small RNAs	**Germano CECERE** (Institut Pasteur, Paris, France)
14:00 - 18:00	**Practical I**: Students' presentations	**Alexandre BAFFET** **Jean-Baptiste BRAULT** **Pauline LESTIENNE**

Wednesday, February 4

10:00 - 12:30	Stem cells	**Shahragim TAJBAKHSH** (Institut Pasteur, Paris, France)
14:00 - 16:00	Archaeal structure and the origins of eukaryotes	**Buzz BAUM** (MRC Laboratory of Molecular Biology, UK)

Thursday, February 5

10:00 - 12:30	Caveolae mechano-signaling in cellular functions	**Christophe LAMAZE** (Institut Curie, Paris, France)
14:00 - 18:00	**Preparation of Examination**	

Friday, February 6

10:00 - 12:30	Applications of AI in life sciences	**Etienne GUEVEL** (Sorbonne University, Paris, France)
13:00 - 15:00	**Farewell party**	
15:00 - 16:00	**Oral examination for non-Master students**	

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WEEK 5 FEBRUARY 09 - 13, 2026

FINAL EXAMINATION ON SITE

Monday & Tuesday, February 09 - 10

Project preparation.
The written project has to be submitted to the Course Committee by Tuesday, February 10, 2026 by 20:00.

Friday, February 13

9:30 - 17:00 **Oral examination on site**

MOLECULAR BIOLOGY OF THE CELL 2025-2026

DETAILED DESCRIPTION OF THE EXAMINATION

Oral examination on Friday February 13, 2026 (mark on a 1-20 scale, coefficient 1):

Critical analysis of a scientific article and presentation of an imaginary 3-year research project as follow-up of the results of the article.
Presentation: 13 minutes; questions: 7 minutes; total duration: 20 minutes

Organization of the oral presentation:

- The presentation is open to the public
- Slides (Powerpoint or other supported formats)

The scientific articles will be given to students during the first week of the course. Each student will write a project intended to be a follow-up of the article received and submit a 4/5-page document to the members of the jury no later than Tuesday 10th February 2026 at 20:00. This document should include:

- Summary of the article (max 1 page)
- Aims and description of the project (max 3 pages including figures if appropriate)
- References (max 1 page), using the style of a cell biology journal (e.g., JCB, JCS, MBC, Cell, NCB….)

DESCRIPTION DETAILLEE DE L'EXAMEN

Examen oral vendredi 13 février 2026 (note sur 20, coefficient 1) :

Présentation critique d'un article et discussion d'un projet fictif sur 3 ans découlant de ces résultats.
Présentation : 13 minutes ; questions du jury : 7 minutes ; durée totale : 20 minutes.

Organisation de la présentation orale :

- Exposé public de chaque étudiant devant le jury
- Diapositives (logiciel Powerpoint ou autre format compatible)

Les articles scientifiques seront donnés aux étudiants pendant la première semaine de cours. Le projet fictif est présenté dans un document de 4/5 pages à remettre au jury au plus tard le mardi 10 février 2026 à 20h00, comprenant :

- Résumé de l'article (max 1 page)
- Objectifs et description du projet (max 3 pages, figures incluses)
- Bibliographie (max 1 page) selon le style d'un journal type JCB, JCS, MBC, Cell, NCB…