Erasmus+

Institut Pasteur, 2026-2027

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INSTITUT Pasteur

Education

DEPARTMENT

Projects 2026-2027
MD-PhD program

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Institut Pasteur, 2026-2027

RESEARCH CENTER

Legal name: **Institut Pasteur**
Address: **25-28 rue du Dr. Roux, 75724 Cedex 15, PARIS**
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Brief description of your Institution

The Institut Pasteur is a private non-profit foundation that contributes to the prevention and treatment of diseases through research, education, and public health activities. Its campus in Paris hosts more than 3000 individuals, 153 research units, organized in 13 departments.
Research: priority is given to fight infectious diseases, as well as to study the impact of climate change on health, the origin of pathologies (cancer, genetic, neurodegenerative, and allergic diseases) and to explore health and diseases at extremities of life (Pasteur 2030 Strategic Plan).
Education: every year 600 young scientists from all over the world follow high-level courses in various fields related to research in microbiology, immunology, cellular biology, epidemiology, genetics, and disease control. Over 850 trainees from 77 different countries come to perfect their skills or conduct their Master or Doctoral trainings in the Institute's laboratories.

Description of the work program(s)

See projects on following pages

N° of placements available for work programs:

The laboratories at the Institut Pasteur have proposed 9 projects for Erasmus internships for medical students as a part of the MD-PhD program, reflecting the Institut Pasteur's engagement in the European University Alliance for Global Health (EUGLOH).
Students may also contact other laboratories at Pasteur to apply for an internship, even if the laboratories have not presented a project (https://research.pasteur.fr/en/team-heads).

FACILITIES

- **Accommodation**: a limited number of rooms for rent are reserved for Pasteur at the student residence "Cité Universitaire".
- **Canteen**: partially subsidized canteen is available on the Pasteur Campus.
- **Reimbursement of the public transportation pass (monthly/yearly):** the Institut Pasteur reimburses your Navigo pass at 75%.
- **Additional salary:** additional salary of approximately 650 euros/month (for internships longer than 60 days) is paid by the host lab (4.50 euros/hour, 7 hours/day).

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Institut Pasteur, 2026-2027

Title of the work program 1

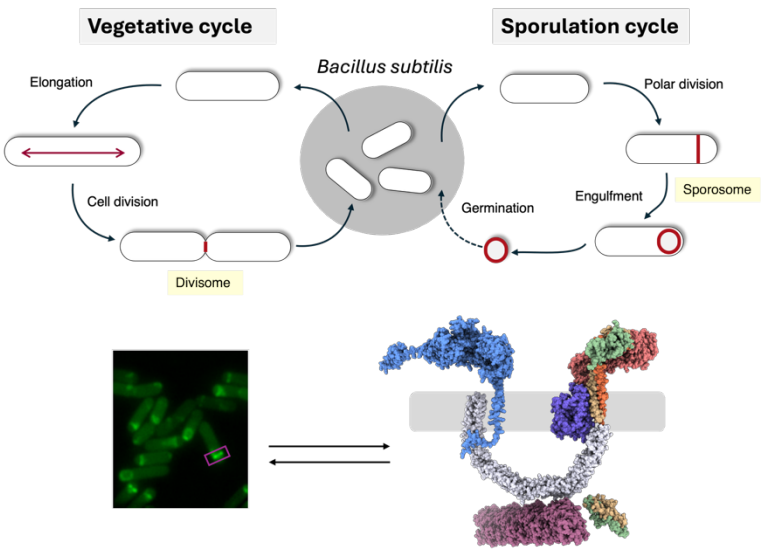
Genetic and structural characterisation of the sporosome in *Bacillus subtilis*.

Description of the work program

Bacteria deploy an arsenal of molecular strategies to survive unfavourable conditions such as nutrient starvation, oxidative stress and exposure to toxic molecules. One of the most extreme of these survival strategies is **sporulation**, in which the cell follows a genetically programmed differentiation pathway that produces a dormant spore able to withstand extreme conditions such as desiccation, UV radiation or even antibiotic exposure for hundreds of years. Understanding the molecular principles behind this process is the central question of the project.

Sporulation is widespread among members of the Firmicutes, a group that includes i**mportant human pathogens** such as *Bacillus anthracis* and *Clostridioides difficile*. When nutrients are available, bacterial cells divide by binary fission (the vegetative cycle), a highly coordinated process in which the cell divides at midcell to produce two identical daughter cells. Cell division is carried out by a macromolecular complex known as **the divisome**, which spans the cytoplasm, membrane and cell wall to drive constriction. Remarkably, the same machinery also carries out the first steps of sporulation, dividing the cell close to one pole when conditions become unfavourable; in this context, it is referred to as the **polar divisome**. Although the core machinery that constricts the cell is shared between the vegetative and sporulation cycles, key differences exist, which is why we have renamed the polar divisome **the sporosome**. The sporosome is a specialised divisome that forms two unequally sized compartments, each following a different genetic fate. The main goal of the project is to understand the differences in assembly, structure and regulation between the divisome and the sporosome.

To answer these questions, the lab uses an integrative approach that combines *in vitro* biochemical characterisation and structure determination by crystallography and cryo-electron microscopy with *in vivo* cell imaging and genetic engineering. The project will use ***Bacillus subtilis* as a model organism,** for which we have an extensive genetic toolkit, including CRISPR/Cas9, and engineered strains for native protein purification.



The discoveries made in this project will not only advance our understanding of the fundamental process of cell differentiation in bacteria but will also likely identify new **potential drug targets,** specifically targeting sporulating cells, with a direct impact on biomedical research.

Figure 1. Overview of the project. **(top)** Cell cycle of *B. subtilis* **(bottom)** Simplified view of the methodological approach

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Tutor/supervisor

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☒ I authorise the IP Erasmus+ team to publish the project proposal on the pasteur.fr website

Selected publications or patents of the Research Group offering the work program

1. Sogues A, Martinez M, Gaday Q, et al. Essential dynamic interdependence of FtsZ and SepF for Z-ring and septum formation in Corynebacterium glutamicum. Nat Commun. 2020;11(1):1641. Published 2020 Apr 2. doi:10.1038/s41467-020-15490-8
2. Sleutel M, Sogues A, Remaut H. Auto-crosslinking sporesilk fibers promote endospore and Cry toxin clustering. Nat Commun. 2026;17(1):3809. Published 2026 Mar 11. doi:10.1038/s41467-026-70495-z
3. Martinez M, Petit J, Leyva A, et al. Eukaryotic-like gephyrin and cognate membrane receptor coordinate corynebacterial cell division and polar elongation. Nat Microbiol. 2023;8(10):1896-1910. doi:10.1038/s41564-023-01473-0
4. Carloni G, Gaday Q, Megrian D, et al. Mechanistic insights into SteAB regulation of cell wall hydrolase RipA in Mycobacterium tuberculosis. mBio. 2026;17(3):e0370025. doi:10.1128/mbio.03700-25

Scientific or technical background required for work program

We are looking for a **curious and motivated student** with an interest in microbiology and/or structural biology. The candidate should have a theoretical background in either molecular biology, biochemistry or microbiology. Previous laboratory experience would be beneficial, but is not required. This project offers an excellent opportunity to acquire a broad range of molecular, genetic and structural techniques while contributing to answering fundamental questions with real biomedical implications.

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Title of the work program 2

Role of substrate rigidity and mechanotransduction in cancer cell plasticity

Description of the work program

Glioblastoma (GBM) is a primary brain tumor and a paradigmatic poor-prognosis cancer, in which cellular plasticity drive diffuse invasion, adaptive resistance to radio-chemotherapy, and near-inevitable relapse. Microenvironmental cues, including hypoxia, perivascular niches, immune and glial cells, and the extracellular matrix (ECM) are key instructors of GBM identity, proliferation, migration, and survival. Because glial cells are exquisitely mechanosensitive, substrate rigidity can reprogram cytoskeletal architecture and mechanics, thereby influencing adhesion, migration, invasion, and proliferation. Thereby, the ECM stiffness influences GBM phenotypes like durotaxis and proliferation. The brain's mechanical landscape changes markedly with aging and disease. Tissue characterization indicates global softening and regional stiffening during aging and neurodegenerative diseases, driven by gliosis, extracellular matrix (ECM) remodeling, and increased crosslinking. GBMs further disrupts this milieu: tumor borders often stiffened via extracellular matrix deposition and remodelling. However, the full extent and the consequence of local tissue stiffness and GBM progression remain unclear.

We propose that ECM rigidity drives GBM plasticity and therapy resistance via mechanotransduction. Understanding how GBM cells interpret and respond to rigidity is critical for explaining why GBM is highly invasive in the soft brain and for identifying mechanobiology-informed therapeutic strategies. We hypothesize substrate rigidity rewires cytoskeletal composition and organization in GBM cells, creating distinct mechano-phenotypes that govern adhesion dynamics, motility programs, and cell proliferation and survival control. We predict GBM displays broadened stiffness tolerance and enhanced mechanoadaptation compared to normal astrocytes, mediated by specific cytoskeletal and mechanotransduction nodes.

The objectives of the project will be:

1- Quantify how substrate rigidity alters GBM cell functional behaviors (adhesion, migration/invasion, proliferation) and resistance to treatment (irradiation and temozolomide treatment). Patient-derived glioblastoma cells will be used in 2D and 3D hydrogels with tunable rigidities (0.5 kPa (healthy brain) to 10 kPa (tumor core/fibrotic areas)).

2- Identify major mechanotransduction pathways involved in rigidity-dependent GBM cell behavior by targeting mechanosensitive cytoskeletal regulators and pathways (e.g., Western Blot/qPCR of YAP/TAZ, Rho/ROCK, FAK) using genetic or pharmacologic tools. The expression of major mechanosensitive markers will be correlated with patient survival data (using public databases like TCGA) or immunohistochemistry on human tissue sections.

3- This approach will be coupled with transcriptomic/proteomic profiling to map rigidity-dependent networks for potential future PhD project.

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These tools and methods are all commonly used in the lab.

Tutor/supervisor

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☒ I authorise the IP Erasmus+ team to publish the project proposal on the pasteur.fr website

Selected publications or patents of the Research Group offering the work program

- van Bodegraven E.J., Infante E., Peglion F., Pereira D., Kesenci Y., Roca V., Perfettini I., Terriac E., Geay J., Soto L., Sluijs J., Rietveld R., Seetharaman E., Boëda B., Olivo-Marin J.C., Asnacios A., Boquet-Pujadas A., Manneville J.B., Etienne-Manneville S. *Cytoplasmic intermediate filaments promote glioblastoma cell invasion by controlling nuclear deformations and mechanosensitive expression of MMP14.* **Cell Rep.** 2025 Nov 14;44(11):116553. doi: 10.1016/j.celrep.2025.116553. PMID: 41241939

Preprints:

- Infante Elvira, Terriac Emmanuel, Gelin Matthieu, Siegfried Hugo, Pereira David, Roca Vanessa, Varet Hugo, Khalilian Sara, Rietveld Reinier, Asnacios Atef, van Bodegraven Emma J, Etienne-Manneville Sandrine. *Intratumoral Heterogeneity of Vimentin Modulates Nuclear Mechanotransduction, DNA Damage Response and Cancer Cell Survival. BioRXiv* 2025. https://doi.org/10.1101/2025.06.27.661506 (in press in EMBO Rep)

- Clara Gomez-Cruz, Matthieu Gelin, Lucas Pradeau-Phelut, Arrate Munoz-Barrutia, Sandrine Etienne-Manneville, Daniel Garcia-Gonzalez. *Transient cytoskeletal anisotropy encodes short-term mechanical memory. BioRXiv* 2026. https://www.biorxiv.org/cgi/content/short/2026.03.09.710573v1 (in press in Adv Mat.)

Scientific or technical background required for work program

This project is designed for medical students aspiring to bridge the gap between clinical practice and translational research. Candidates should possess a strong foundation in human pathophysiology, particularly regarding neuro-oncology and mechanisms of therapy resistance. While prior laboratory proficiency in mammalian cell culture and molecular techniques is advantageous, the primary focus is on cultivating a clinician-scientist mindset. You will gain unique expertise in modeling the tumor microenvironment, allowing you to investigate how physical tissue properties influence treatment failure, a critical perspective for future innovations in personalized medicine.

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Title of the work program 3

Unlocking Functional Origins of Muscle Resilience in Muscular Dystrophies

Description of the work program

Not all muscles in the body are equivalent. Extraocular muscles (EOMs), which control eye movement, are distinct from all other muscles due to their unique resistance to neuromuscular diseases and their remarkable evolutionary conservation across vertebrates. The coexistence of both vulnerable and resilient muscles within the same organism provides compelling in vivo evidence that sustained regenerative capacity is possible, even in severe conditions such as Duchenne muscular dystrophy. However, the mechanisms underlying EOM resilience remain largely unknown, making EOMs a powerful model for uncovering muscle-specific protective processes.

This project aims to address the following key questions: Why are EOM myofibers more robust? What mechanisms drive EOM regeneration? Can we harness EOM myofiber properties to strengthen vulnerable limb and trunk muscles?

Our single-nucleus multiomics data have revealed that spared muscles are built upon unique gene regulatory networks triggering distinctive contractile programs compared to other cranial and limb muscles. Preliminary analysis already identified a transcription factor that when mutated induces dystrophic features in EOMs. In this project, we aim to implement functional analysis of these regulators in the dystrophic context in vivo and determine determine whether enforcing these programs in limb muscles is sufficient to mitigate dystrophic pathology.

Tutor/supervisor

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Profile on ORCID (if applicable):	0000-0003-3244-3378

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Selected publications or patents of the Research Group offering the work program

1. Impaired stem cell migration and divisions in Duchenne muscular dystrophy revealed by live imaging. Sarde L, Letort G, Varet H, Laville V, Fernandes J, Tajbakhsh S, Evano B. Nat Commun. 2026 Jan 28;17(1):1769. doi: 10.1038/s41467-026-68474-5.

2. Co-option of neck muscles supported the vertebrate water-to-land transition. Heude E, Dutel H, Sanchez-Garrido F, Prummel KD, Lalonde R, Lam F, Mosimann C, Herrel A, Tajbakhsh S. Nat Commun. 2024 Dec 4;15(1):10564. doi: 10.1038/s41467-024-54724-x.

3. Extraocular muscle stem cells exhibit distinct cellular properties associated with non-muscle molecular signatures. Girolamo DD, Benavente-Diaz M, Murolo M, Grimaldi A, Lopes PT, Evano B, Kuriki M, Gioftsidi S, Laville V, Tinevez JY, Letort G, Mella S, Tajbakhsh S*, Comai G*. Development. 2024 Feb 15;151(4):dev202144. doi: 10.1242/dev.202144. Epub 2024 Feb 21.

4. Interplay between Pitx2 and Pax7 temporally governs specification of extraocular muscle stem cells. Kuriki M, Korb A, Comai G*, Tajbakhsh S*. PLoS Genet. 2024 Jun 14;20(6):e1010935. doi: 10.1371/journal.pgen.1010935.

5 . Local retinoic acid signaling directs emergence of the extraocular muscle functional unit. Comai GE, Tesařová M, Dupé V, Rhinn M, Vallecillo-García P, da Silva F, Feret B, Exelby K, Dollé P, Carlsson L, Pryce B, Spitz F, Stricker S, Zikmund T, Kaiser J, Briscoe J, Schedl A, Ghyselinck NB, Schweitzer R, Tajbakhsh S. PLoS Biol. 2020 Nov 17;18(11):e3000902. doi: 10.1371/journal.pbio.3000902.

6. Transcriptome and epigenome diversity and plasticity of muscle stem cells following transplantation. B. Evano, D. Gill, I. Hernando-Herraez, G. Comai, T. M. Stubbs, P.-H. Commere, W. Reik, S. Tajbakhsh. Plos Genet 16, e1009022 (2020).

7. Reciprocal signalling by Notch-Collagen V-CALCR retains muscle stem cells in their niche. Baghdadi MB, Castel D, Machado L, Fukada SI, Birk DE, Relaix F, Tajbakhsh S, Mourikis P. Nature. 2018 May;557(7707):714-718. doi: 10.1038/s41586-018-0144-9. Epub 2018 May 23.

Scientific or technical background required for work program

We are looking for highly motivated and creative « Medicine-Sciences » students. This internship is particularly suited for medical students with an interest in Neuromuscular disorders, Ophthalmology and vision sciences.
The student will become familiar with a number of techniques routinely used in the lab including: mouse handling, histology, AAV-mediated gene expression, confocal microscopy and image processing. Prior expertise in mouse genetics, image analysis and coding would be highly appreciated. The candidate should feel comfortable working in English, be able to critically discuss experimental results and be updated on the related literature. Students will be fully integrated in the scientific life of the lab and department (seminars, lab retreat, training).
The internship should last between 6-12 months.

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Title of the work program 4

Decoding the craniofacial proprioceptive circuit

Description of the work program

Understanding the complexity of the human body requires detailed molecular and cellular investigation into how distinct organs communicate to achieve integrated function. The nervous, muscular, and skeletal systems work in concert to produce coordinated locomotion. But how do these systems develop and communicate at the molecular level? And why do some muscles - like those controlling eye movements or speech - defy the rules?

Most muscles rely on proprioception (the body's "sixth sense" of position and movement) to function properly. Yet, some craniofacial muscles perform incredibly precise tasks (like tracking objects or singing) without the usual sensory structures. Even more fascinating, these muscles are spared in diseases like muscular dystrophy and ALS, suggesting they have unique protective mechanisms.

Our lab recently discovered that craniofacial muscles develop under different genetic programs than limb muscles, giving them special properties. We now ask: How do these muscles sense themselves? What developmental logic allows them to bypass the classical proprioceptive circuit?

In this project we will develop two major angles:

1. Multiscale Circuit Mapping. Using viral lineage tracing, section and whole-mount 3D immunostaining, light-sheet/confocal microscopy and computational segmentation in the mouse, the student will reconstruct the architecture of sensory nerve terminals within EOMs and laryngeal muscles.
2. Comparative & Evolutionary Perspectives. To highlight universal principles, we will extend the analysis to the syringeal muscles of zebra finch and to EOMs across vertebrates. In parallel, the student will investigate available high-resolution 3D human head datasets (through a collaboration) to test whether the craniofacial proprioceptive logic is conserved in humans.

Tutor/supervisor

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Lab webpage	https://research.pasteur.fr/en/team/stem-cells-and-development/
Profile on ORCID (if applicable):	0000-0003-3244-3378

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Selected publications or patents of the Research Group offering the work program

1. Impaired stem cell migration and divisions in Duchenne muscular dystrophy revealed by live imaging. Sarde L, Letort G, Varet H, Laville V, Fernandes J, Tajbakhsh S, Evano B. Nat Commun. 2026 Jan 28;17(1):1769. doi: 10.1038/s41467-026-68474-5.

2. A Global, and Orbital, View of Extraocular Muscles. G. E. Comai, S. Tajbakhsh. Encyclopedia of the Eye (2nd edition) (2024)pp. 322–346.

3. Co-option of neck muscles supported the vertebrate water-to-land transition. Heude E, Dutel H, Sanchez-Garrido F, Prummel KD, Lalonde R, Lam F, Mosimann C, Herrel A, Tajbakhsh S. Nat Commun. 2024 Dec 4;15(1):10564. doi: 10.1038/s41467-024-54724-x.

4. Extraocular muscle stem cells exhibit distinct cellular properties associated with non-muscle molecular signatures. Girolamo DD, Benavente-Diaz M, Murolo M, Grimaldi A, Lopes PT, Evano B, Kuriki M, Gioftsidi S, Laville V, Tinevez JY, Letort G, Mella S, Tajbakhsh S*, Comai G*. Development. 2024 Feb 15;151(4):dev202144. doi: 10.1242/dev.202144. Epub 2024 Feb 21.

5. Interplay between Pitx2 and Pax7 temporally governs specification of extraocular muscle stem cells. Kuriki M, Korb A, Comai G*, Tajbakhsh S*. PLoS Genet. 2024 Jun 14;20(6):e1010935. doi: 10.1371/journal.pgen.1010935.

6. Local retinoic acid signaling directs emergence of the extraocular muscle functional unit. Comai GE, Tesařová M, Dupé V, Rhinn M, Vallecillo-García P, da Silva F, Feret B, Exelby K, Dollé P, Carlsson L, Pryce B, Spitz F, Stricker S, Zikmund T, Kaiser J, Briscoe J, Schedl A, Ghyselinck NB, Schweitzer R, Tajbakhsh S. PLoS Biol. 2020 Nov 17;18(11):e3000902. doi: 10.1371/journal.pbio.3000902.

7. Transcriptome and epigenome diversity and plasticity of muscle stem cells following transplantation. B. Evano, D. Gill, I. Hernando-Herraez, G. Comai, T. M. Stubbs, P.-H. Commere, W. Reik, S. Tajbakhsh. Plos Genet 16, e1009022 (2020).

Scientific or technical background required for work program

We are looking for a rigorous and intellectually curious M2 student from either fundamental biology (developmental biology, neuroscience, genetics) or the Medicine-Sciences programs with an interest in Neuroanatomy, Neuromuscular and Evolutionary biology. The student will become familiar with a number of techniques routinely used in the lab including: histology, confocal microscopy and image processing. Prior exposure to neurobiology/developmental biology and expertise in image analysis, coding and bioinformatics would be highly appreciated. The candidate should feel comfortable working in English, be able to critically discuss experimental results and be updated on the related literature. Students will be fully integrated in the scientific life of the lab and department (seminars, lab retreat, training).
The internship should last between 6-12 months.

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Institut Pasteur, 2026-2027

Title of the work program 5

Applied Epidemiology and Outbreak Preparedness Research – Outbreak Investigation Task Force (OITF), Institut Pasteur

Description of the work program

The Emerging Diseases Epidemiology Unit at Institut Pasteur (Paris) focuses on the study of emerging pathogens. The unit has been involved in the investigation of numerous recent epidemics, including SARS, H1N1 influenza, MERS, Zika, Ebola, pneumonic plague, COVID-19 and mpox. It is headed by Prof. Arnaud Fontanet, who also directs the Pasteur Pandemic Preparedness Initiative (P3I), which coordinates the Institute's pandemic preparedness and response activities.

Within this unit, the Outbreak Investigation Task Force (OITF) develops and supports applied epidemiological research during and between epidemics, aiming to rapidly generate evidence for public health decision-making while building methods, tools and capacities to strengthen preparedness for, and investigation of, future epidemics. The OITF is a multidisciplinary rapid-response team bringing together experts in early outbreak research, field epidemiology, anthropology, diagnostics, genomic surveillance and mathematical modelling.

We are looking for a mid-experienced scientific or medical PhD with a background and genuine interest in global health and infectious diseases to join the OITF for a period of 6 months to 1 year. The successful candidate will work primarily on one of the projects below, selected at the start of the placement according to the state of ongoing activities, operational needs, and the candidate's own interests and availability, with the possibility to contribute on a more occasional basis to other epidemic preparedness or response activities.

Project 1 – Epidemiological research during an outbreak (TAMBUA-BDBV project): Participation in a sero-epidemiological study conducted following the ongoing outbreak of Bundibugyo ebolavirus disease in the Democratic Republic of the Congo. This study aims to better document past or unrecognised infections, community and occupational exposures, and the characteristics of healthcare workers – in collaboration with the INRB, IRD and ITM. Depending on timing, tasks may include finalising study tools and the analysis plan, data preparation and quality control, descriptive and analytical work, epidemiological interpretation, feedback to partners, and contribution to a scientific report and/or article.

Project 2 – Sentinel Sero-surveillance in a climate and health context in Madagascar: Contribution to the development, implementation, or analysis of serological data for multiple pathogens coming from sentinel surveillance sites in Madagascar – in collaboration with the Institute Pasteur of Madagascar. The project aims to reinforce existing systems and build local capacity, providing climate and health indicators to inform public health decision-making and protect vulnerable populations.

Project 3 – Epidemic preparedness and simulation exercise (SimEx): Contribution to the preparation, delivery and evaluation of a global pandemic simulation exercise organised with the Pasteur Network in Brazil in March 2027. Activities may include reviewing existing exercises, building the scenario and facilitating the exercise on site. The candidate may also contribute to the after-action review and recommendations to strengthen preparedness and response capacities across the Pasteur Network.

Project 4 – EPOPT: protocols for early outbreak investigation: Contribution to the Early Phase Outbreak Protocol Templates (EPOPT) project, developed by the OITF with Institut Pasteur de Bangui and other Pasteur Network partners. This project aims to build a library of standardised, modular and rapidly adaptable epidemiological protocols for the early phases of an outbreak. Following a launch workshop planned for October 2026, tasks may include reviewing and mapping existing protocols, identifying gaps and adaptation needs, drafting and harmonising generic protocols, CRFs, core

variables and analysis plans, considering options for expedited ethical review and rapid implementation, and preparing the piloting of certain tools during a future outbreak.

By the end of the placement, the candidate will have strengthened their ability to translate a real-world outbreak challenge into a rigorous, operational public health question. Skills developed may include: structured literature review; study design and implementation in an outbreak context; development of protocols, analysis plans and data-collection tools; ethical, regulatory, logistical and operational considerations specific to research conducted during a health emergency; data management, cleaning and quality control; descriptive and, depending on the project, multivariate or infectious-disease-specific statistical analysis; interpreting results in their epidemiological and operational context; the principles of epidemiological surveillance and field epidemiology; the architecture of global health governance; multidisciplinary and international teamwork; and communicating results through presentations, public health notes, reports or scientific articles.

The candidate will be part of the OITF team, supervised primarily by Michael Casera (OITF Coordinator) and Natalie Fischer (Deputy Coordinator), with regular supervision meetings to define priorities, track progress on the main project, and support methodological and analytical choices. Depending on the project selected, co-supervision may also be provided by a researcher, biostatistician, anthropologist, biologist or other expert from Institut Pasteur or the Pasteur Network. The candidate will also be welcome to take part in the scientific meetings of the Emerging Diseases Epidemiology Unit, relevant OITF and P3I activities, and seminars, conferences and courses organised by Institut Pasteur and its partners.

Tutor/supervisor

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☒ I authorise the IP Erasmus+ team to publish the project proposal on the pasteur.fr website

Selected publications or patents of the Research Group offering the work program

Geoffroy A, Jeang D, Baidjoe A et al. Research priorities for characterising Bundibugyo virus. The Lancet, 2026; 408211

Jeang D, Randrianasolo L et al. Integrated Sentinel Serosurveillance in Madagascar: A Model for Routine Multi-Pathogen Monitoring. Journal of Global Health, 2026 – in review.

Villa J et al. Field investigation suggests an earlier, wider Bundibugyo virus disease epidemic in Mongbwalu, Democratic Republic of the Congo. The Lancet, 2026 – submitted.

Harimanana AN, N'Takpé JB et al. Preliminary findings from a prospective household mpox transmission study in Antananarivo, Madagascar, 2026. State-of-the-Art Mpox Symposium, Kampala, Uganda, 2026 – abstract for oral presentation.

Scientific or technical background required for work program

A completed or ongoing PhD (or equivalent, e.g. MD-PhD) in epidemiology, public health, infectious disease research or a related field, with demonstrated interest in global health and outbreak response. Prior exposure to field epidemiology, outbreak investigation, or infectious disease surveillance is an asset. Solid grounding in epidemiological methods and biostatistics, with practical experience using a statistical software environment (e.g. R) for data management and analysis is an asset. Ability to work independently as well as within a multidisciplinary, international team, including under the time constraints typical of an outbreak response. Strong scientific writing skills and fluency in English; working knowledge of French is an advantage given the Institute's environment. Availability for a placement of 6 months to 1 year, with some flexibility on start date.

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Title of the work program 6

Mechanisms of the influence of intestinal dysbiosis induced by a Western diet on the brain response to nicotine in mice

Description of the work program

Tobacco smoking is responsible for more than seven million deaths each year. While major genetic advances have improved our understanding of vulnerability to nicotine addiction, the contribution of environmental factors remains insufficiently explored. Among these factors, the gut microbiota has emerged as a central component of the gut–brain axis, a bidirectional communication system increasingly implicated in various neuropsychiatric disorders. However, its role in the neural mechanisms underlying reward and addiction remains to be elucidated.

The rewarding effects of drugs initially rely on activation of the mesolimbic system, composed of dopaminergic neurons projecting from the ventral tegmental area (VTA) to the nucleus accumbens (NAc). Our team was the first to demonstrate that gut microbiota depletion potentiates nicotine-induced activation of the VTA and alters its motivational properties in mice. In addition, preliminary data suggest that a Western diet, rich in fat and sugar and low in fiber, may also modify the sensitivity of the mesolimbic system to nicotine, in association with profound alterations of the gut microbiota, notably including short-chain fatty acid (SCFA)-producing bacteria.

SCFAs, the main metabolites derived from dietary fiber fermentation, are key mediators of gut–brain communication. They regulate gut hormone secretion, can cross the blood–brain barrier, and act as epigenetic regulators through inhibition of histone deacetylases. They also contribute to immune homeostasis by limiting inflammation. Recent findings from our laboratory indicate that modulation of SCFA levels may influence VTA activation under dysbiotic conditions, suggesting their involvement in regulating the brain's response to nicotine.

Among the mechanisms considered, modulation of gut hormones appears central. Preliminary observations suggest that a Western diet may alter the balance of circulating forms of ghrelin. Ghrelin, an orexigenic hormone, activates its receptor GHS-R1A, which is expressed in several reward-related regions including the VTA and NAc, and stimulates dopamine release. In contrast, other hormones regulated by SCFAs (GLP-1, leptin, insulin, PYY) exert anorexigenic effects and tend to reduce reward sensitivity. Disruption of this hormonal balance could therefore contribute to the heightened nicotine sensitivity observed under dysbiotic conditions.

The aim of this project is to better establish the link between SCFAs, gut hormonal signaling, and the brain response to nicotine under Western diet–induced dysbiosis, by assessing multiple levels in mouse models: neuronal activation, neurotransmission, and nicotine-related motivational behaviors..

This project builds on the laboratory's previous work and hopes to move closer to a translational perspective aimed at better understanding how environmental factors such as diet and the microbiota contribute to individual vulnerability to nicotine addiction.

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Selected publications or patents of the Research Group offering the work program

de Chaumont F*, Icick R*, Gorwood P, Granon S, Forget B, Bouarab C, Mattioni J, Bourgeron T, Maskos U, Ramoz N, Besson M$. The influence of CHRNA5 and D398N missense variation on social and emotional behaviors in rodents and humans. Trans Psychiatry. 2025;15(1):507. PMID: 41309559.

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Scientific or technical background required for work program

The candidate should have a strong background in neuroscience and, preferably, a good knowledge of neuropsychiatric disorders and their neurobiological correlates, particularly the circuits and mechanisms involved in addiction. Knowledge of immunology would be an important asset. Ideally, the candidate will have previous training in rodent handling, behavioral testing, and brain tissue preparation and analysis (e.g., dissection, sectioning, immunohistochemical labeling, etc.).

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Title of the work program 7

Application of a Lymphoid Organ-on-chip to the evaluation of candidate antiviral vaccines

Description of the work program

Predicting the immunogenicity of candidate vaccines in humans remains a challenge. To address this issue, we have developed a lymphoid organ-on-chip (LO chip) model based on a microfluidic chip seeded with human peripheral blood mononuclear cells (PBMC) at high density within a 3D matrix. Perfusion of the SARS-CoV-2 Spike mimicked a vaccine boost, by inducing a massive amplification of memory B cells and Spike-specific antibody secretion. (R. Jeger-Madiot et al., J Exp Med 2024).

The student will aim at comparing the immune responses induced in the LO chip by candidate antiviral vaccines based on different platforms, including classic mRNA-liponanoparticles (LNPs), self-amplifying mRNA LNPs, and mRNA-LNPs encoding self-assembling virus-like particles. The kinetics of antigen expression, the innate responses induced in antigen presenting cells, and the differentiation of specific B and T cells will be evaluated by spectral flow cytometry, while CD4+ T cell / B cell interactions will be probed by confocal microscopy. This project should help develop a human-relevant 3D model for evaluating a broad variety of vaccination and immunotherapeutic strategies.

Tutor/supervisor

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Selected publications or patents of the Research Group offering the work program

- Jeger-Madiot R*, Planas D, Staropoli I, ..., Gobaa S, and Chakrabarti LA*. (2024) Modeling memory B cell responses in a Lymphoid Organ-Chip to evaluate mRNA vaccine boosting. **Journal of Experimental Medicine** 221(10):e20240289.

- Claireaux M., Robinot R., ..., Lambotte O., and Chakrabarti L.A.* (2022) Low CCR5 expression protects HIV-specific CD4+ T cells of elite controllers from viral entry. **Nature Communications** 13:521

Scientific or technical background required for work program

Students are expected to have a background in Immunology.

Students should be familiar with procedures to perform cell culture under sterile conditions. An expertise with primary human T cell culture and/ or spectral flow cytometry would be an asset.

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Title of the work program 8

How systemic disease imposes a distinct quiescent state on tissue-resident stem cells

Description of the work program

Background. Adult stem cells reside in a reversible quiescent (G0) state that is actively maintained and that preserves their capacity to respond to injury. Our laboratory has identified a distinct quiescent state, which we term G_{Path}, induced in skeletal muscle stem cells (MuSCs), mesenchymal progenitors (Fibro-Adipogenic Progenitors, FAPs) and neural stem cells by pathologies arising at a distance from those tissues. The two systemic diseases we are studying are the respiratory influenza virus infection, and a non-metastatic subcutaneous tumour model of cancer cachexia in mice. G_{Path} is paradoxical. Cells downregulate multiple canonical regulators of quiescence, any one of which would normally be expected to promote quiescence exit, yet they do not enter the cell cycle during homeostasis. Instead they are smaller, metabolically depressed (reduced mitochondrial mass and membrane potential, lower oxygen consumption and ATP production), show broad downregulation of extracellular matrix programmes together with an immune-associated signature, and display altered chromatin accessibility. In MuSCs, timed EdU incorporation, Cyclin D1 and Ki67 kinetics, phospho-Rb accumulation and live imaging place the dominant delay before S-phase entry. Functionally, muscle regeneration after injury is delayed and qualitatively impaired. Circulating cytokines including TNFα reproduce part of the phenotype; providing soluble activin receptor type IIB (sActRIIb-Fc) rescues it partially.

Several questions remain open: **is G_{Path} reversible once the primary pathology resolves; which signalling nodes enforce the delay in proliferative commitment; and how much of the state is imposed directly by circulating factors?**

As part of this project, trainee will work with a senior researcher to establish a recovery time course in influenza-infected mice, analysing MuSCs and FAPs at the peak of pathology and at successive recovery time points after viral clearance. Readouts: cell number and size by flow cytometry, mitochondrial mass and membrane potential, a quiescence gene panel by qRT-PCR, and proliferative competence by EdU incorporation. Downstread signaling will be examined in the influenza model and phospho-SMAD2/3 in both models. The trainee will isolate MuSCs from pathological and control mice, plate them under growth-permissive conditions with or without pharmacological inhibitions and quantify Cyclin D1, Ki67, EdU positivity at defined intervals after plating, complemented by time-lapse videomicroscopy of time-to-first-division. The trainee will also use our existing transcriptomic and chromatin-accessibility datasets to define core gene sets promoting stem cell deregulation, and will use it to score the experimental conditions generated during the placement. No prior programming experience is required; guided introduction to R is provided.

Tutor/supervisor

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Selected publications or patents of the Research Group offering the work program

1. Gayraud-Morel B., Di Girolamo D., et al., Tajbakhsh S. Systemic pathologies induce a distinct quiescent state in tissue-resident stem cells. *Cell Stem Cell, in revision*.

2. Di Girolamo D., et al., Tajbakhsh S. Extraocular muscle stem cells exhibit distinct cellular properties associated with non-muscle molecular signatures. *Development* 151, dev202144 (2024). doi:10.1242/dev.202144
3. Di Girolamo D., Tajbakhsh S. Pathological features of tissues and cell populations during cancer cachexia. *Cell Regeneration* 11, 15 (2022). doi:10.1186/s13619-022-00108-9
4. Evano B., Tajbakhsh S. Skeletal muscle stem cells in comfort and stress. *npj Regenerative Medicine* 3, 24 (2018). doi:10.1038/s41536-018-0062-3
5. Latil M., et al., Tajbakhsh S. Skeletal muscle stem cells adopt a dormant cell state post mortem and retain regenerative capacity. *Nature Communications* 3, 903 (2012). doi:10.1038/ncomms1890
6. Rocheteau P., Gayraud-Morel B., Siegl-Cachedenier I., Blasco M.A., Tajbakhsh S. A subpopulation of adult skeletal muscle stem cells retains all template DNA strands after cell division. *Cell* 148, 112–125 (2012). PMID: 22265406

Scientific or technical background required for work program

Training in cell biology, developmental biology, physiology, immunology or a related biomedical discipline. Prior hands-on experience with mammalian cell culture, immunostaining and light microscopy is expected; experience with flow cytometry, mouse experimentation or molecular biology (qRT-PCR, western blot) is an advantage. Candidates must highly motivated and willing to invest, work with laboratory mice. We look for rigour, autonomy in record-keeping, and a genuine interest in stem cell biology and tissue regeneration. Basic statistics is expected; familiarity with Fiji/ImageJ and any experience with R is welcome. Working language is English.

Techniques acquired. Mouse disease models, in vivo experimentation under approved ethics protocols; tissue dissection, enzymatic digestion; FACS isolation; primary cell culture at physiological oxygen; EdU proliferation assays; immunofluorescence and confocal microscopy; time-lapse videomicroscopy; flow-cytometry-based metabolic assays and qRT-PCR and western blotting; cryosectioning, histology; quantitative image analysis; statistics and data presentation (Prism, R).

Environment and expected outcome. The Stem Cells & Development Unit comprises around fifteen people (senior scientists, postdocs, PhD students, engineers) and works in English. The trainee will have day-to-day supervision from a senior scientist in the unit, direct access to Institut Pasteur core facilities (cytometry, imaging, animal facility, bioinformatics), and will present at weekly lab meetings and journal clubs.

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Title of the work program 9

Microbiota and sex dependent programming of T cell immunity

Description of the work program

Sex differences are a fundamental feature of our immune responses, but the mechanisms through which they are established and maintained are still incompletely understood and generally understudied. Puberty is a major physiological transition for the immune system, and the gut microbiota is an important regulator of T-cell activation and differentiation. However, **how hormonal and microbial signals interact to shape sex-specific T-cell immunity** is still largely unknown.

Our project investigates this question using **mouse models**. We have identified a marked sex bias in liver T-cell immunity that appears after puberty and is strongly influenced by microbial signals. This system provides an opportunity to **investigate how sex hormones, developmental timing and the environment interact to shape sex-biased T-cell states**.

The Erasmus student will contribute to this ongoing work by characterising the emergence of sex biased T-cell phenotypes and their relationship with the gut microbiota. Depending on the duration and progress of the project, the work will include **spectral flow-cytometric analyses** of immune cells, in vivo T cell transfers, confocal imaging, faecal sampling for **microbiota profiling**, controlled microbiota-transfer experiments, **meta-genomics** and **single cell RNA sequencing**. The student will receive training in mouse immunology, flow cytometry, experimental design, data analysis and scientific communication. This internship will be embedded in a project funded by the Branco Weiss Fellowship Society in Science and will be supervised on a day-to-day basis by Dr Valentina Venzin

Tutor/supervisor

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Selected publications or patents of the Research Group offering the work program

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- Naik, S., Bouladoux, N., … Belkaid, Y. (2012). Compartmentalized control of skin immunity by resident commensals. *Science*, *337*(6098), 1115–1119.
- Venzin, V., … Iannacone, M. (2025). CD4+ T cells license Kupffer cells to reverse CD8+ T cell dysfunction induced by hepatocellular priming. *Nature immunology*, *26*(8), 1352–1366

Scientific or technical background required for work program

Applicants should have completed undergraduate-level coursework in biology, immunology and microbiology. Interest in host-microbiota interactions and T-cell immunobiology and a good command

of English are required. Prior laboratory experience (mouse handling/immunology) is desirable but not essential; training in mouse work and flow cytometry will be provided.