Master in Biomedical Research

2024-2025

Advanced list of potential laboratories from the RIKEN Institute

(the list is in alphabetical order using the last name of each principal investigator)

See also important information about projects and groups in the next page

Admissions to the Master in Biomedical Research (BIOMED) are prioritized for students that have been accepted in a research group for their *practicum*.

If more than two students are opting to the same group, the master coordinator may recommend that some of the applicants be redirected to other groups based on their motivation profile and academic criteria.

a) If you have already been accepted to a research group for doing the master research *practicum*, please submit the acceptance letter by the group's supervisor/director. The group can be in Spain or in a foreign country.

b) If you do not have a host research group at the time of registering, you must indicate your first 5 choices, in order of preference, **from the list of groups** offered by the BIOMED master. Knowing these choices gives us additional information to assess your application.

Important:

b1) When listing your 5 choices, please write the **name of the PI for each group**. Don't just say "group in tumor modelling" or something like that.

Besides telling us your 5 choices from the list, you can search for a research group (in Spain or abroad) that is not in this list. You do not need to indicate that in addition to your 5 choices above.

b2) Keep in mind that indicating your choices does not mean that you will be assigned to a group automatically. You are encouraged to actively seek acceptance in a group because having a group will increase your chances of being accepted to the master.

You must contact the group you are interested in (from the list provided here from the RIKEN Institute), arrange an online interview, and get the written acceptance of the investigator in charge of that group.

The next page outlines some guidelines to help candidate students to find a research group.

It also has a list of potential laboratories to which you can submit applications. This list can be updated with some new groups in the next months.

“How to: getting accepted in a research laboratory”

1- You have to know what you would like to work on.

2- Be specific: you should be able to say what are the questions that are important to you and why.

Not very good: I want to work in neurosciences, I have always liked it.

Much better: I want to understand the processes and mechanisms that make neurons more sensitive to oxidative stress and oxygen deprivation in patients with neurodegenerative diseases such as...

Not very good: I want to work in regenerative medicine, I think that stem cells have a lot of potential to cure diseases.

Much better: I want to contribute to the identification of proteins that when expressed in a differentiated cell such as a fibroblast, can cause it to dedifferentiate and acquire functional characteristics of a pluripotent cell.

3- Find out who is working on what.

Websites of universities and research centers, PubMed searches, Google...

It takes time! (don’t wait till last minute to begin looking for your favorite lab)

4- Write to the group that interests you.

5- Contacting a group.

a) Motivation letter: tell them why you want to work with them (for this, you need to know something about what they do and about current questions in the field).

It takes time! (don’t wait till last minute to begin looking for your favorite lab)

Also tell them why you are good. Labs appreciate commitment, responsibility, ability to work in a team, ability to persevere and a strong motivation.

Ask them for an interview to show them how good you are.

Do not write a generic letter to copy-paste and send to ten different laboratories changing only the name of the group leader.

Choose your labs and send a personal, specific letter to each one.

b) Keep in mind that a person working full time in a cellular-molecular biology lab can spend more than the equivalent of 1000 euros/month in materials,

besides a lot of time required to train you and supervise you until you begin to get solid results.

Expect that during the first 6 months it is more likely that you will produce more trouble and expenses than productive results. Laboratories are very careful with how they spend their money because they get their funding from competitive grants that are given or denied based on productivity (that means getting results) and publications in internationally respected journals.

Do not get discouraged with rejections, learn from them to improve your application.

c) Do not forget important details in your CV:

1- Give names of senior persons that can be a reference.

Be careful with “clone” reference letters from teachers that don’t really know you and will just say general things.

2- Include your university scores. If they are not too good, you should be ready to explain why, either in your application letter or in an interview. Be honest and realistic about it. If the teaching/exam system of your university hasn’t worked for you, you will know the reasons better than anyone else, so be prepared to speak frankly about it.

University scores are not an exact indicator of who will become a successful scientist, but they say that a person has gone through 4-5 years of serious effort with a better than average performance.

Most people will interpret this as a sign of self-discipline, organization, capacity to work even if you have a bad day, and to get things done regardless of whether they are more fun or plainly boring.

Call for project proposals

Master in Biomedical Research practicum, 2025

Department of Medicine and Life Sciences, Universitat Pompeu Fabra, Barcelona

Project Title:
Multicellular and extracellular matrix dynamics in skin tissue morphogenesis and regeneration

Project supervisor (principal investigator of the laboratory/group)
Name: Hironobu Fujiwara
eMail: hironobu.fujiwara@riken.jp
Group name: Laboratory for Tissue Microenvironment
Institution: RIKEN Center for Biosystems Dynamics Research (BDR)
Webpage of the group: https://www.fujiwaralab.com/

Main grant associated with this project:
Principal investigator: Hironobu Fujiwara
Agency: JSPS, RIKEN
Reference/ years: KAKENHI JP23H04928 / 2023-2027, RIKEN intramural grant / Open-ended

Brief summary of the project or current research lines of the group (please do not include pictures or logos and do not exceed this page):

The dynamic interplay between cells and their microenvironments is critical for determining cell behaviour, fate, and the overall tissue architecture. This is particularly evident in the skin and its appendages such as hair follicles, which originate from simple 2D epithelial/mesenchymal sheets. Yet, the mechanisms by which these flat structures transform into diverse 3D forms, through dynamic interactions with evolving microenvironments, remains largely unknown.

The basement membrane (BM) is a sheet-like extracellular matrix universally presents at the border of all tissues. It serves as a fundamental adhesion platform, controlling cell adhesion, proliferation, differentiation, migration, and so on. Traditionally, the BM has been considered as a static structure. However, our recent studies with our BM imaging mice demonstrate that the BM is far more dynamic as the cells are, and that spatiotemporally-regulated molecular and tissue level dynamics of BM is critical for instructing epithelial progenitor behaviour and epithelial morphogenesis (*Nature* 2021; *Nat Commun* 2021; *bioRxiv* 2023).

This project aims to dissect the molecular and mechanical aspects underlying the BM-driven morphogenesis and regeneration. You will engage in live cell and BM imaging

during mouse hair follicle development, regeneration or cancer metastasis using advanced two-photon microscopy. Techniques like FRAP and photo-conversion will be employed to analyse BM dynamics at multiple scales. You will also experimentally alter BM dynamics to understand the underlying mechanisms.

Call for project proposals

Master in Biomedical Research practicum, 2025

Department of Medicine and Life Sciences, Universitat Pompeu Fabra, Barcelona

Project Title: Mechanisms of chromosome segregation errors in oocytes

Project supervisor (principal investigator of the laboratory/group)
Name: Tomoya Kitajima
eMail: tomoya.kitajima@riken.jp
Group name: Laboratory for Chromosome Segregation
Institution: RIKEN Center for Biosystems Dynamics Research
Webpage of the group: https://chromosegr.riken.jp/index_en.html

Main grant associated with this project:
Principal investigator: Tomoya Kitajima
Agency: JSPS
Reference/ years: KAKENHI JP23H04948 / 2023-2027

Brief summary of the project or current research lines of the group (please do not include pictures or logos and do not exceed this page):

The oocyte becomes an egg through meiosis. The egg fertilizes with a sperm and undergoes repeated cell divisions to give rise to an entire body. We study chromosome segregation during meiosis in oocytes and during mitosis in fertilized eggs, taking advantage of techniques for high-throughput and high-resolution live imaging of mouse oocytes combined with micromanipulation and genetic engineering methods. The first cell division that oocytes undergo is meiosis I. Chromosome segregation in this division is error-prone and the rate of errors increases with maternal age. Subsequently, chromosomes are segregated in meiosis II upon fertilization, and then segregated again in mitosis after DNA replication. We will reveal distinct mechanisms for chromosome segregation during these subsequent but fundamentally different cell divisions. By uncovering the mechanism of chromosome segregation during meiosis I in oocytes, we understand why oocyte meiosis I is error-prone and related to age. Comparing the mechanisms in meiosis I with those found in meiosis II and mitosis may provide insights into the capacity of cells to flexibly use different strategies for chromosome segregation. The findings will be exploited to collaborative studies with reproductive medicine.

Call for project proposals

Master in Biomedical Research practicum, 2025

Department of Medicine and Life Sciences, Universitat Pompeu Fabra, Barcelona

Project Title: In vitro reconstitution of cytoskeletal dynamics

Project supervisor (principal investigator of the laboratory/group)
Name: Makito Miyazaki
eMail: makito.miyazaki@riken.jp
Group name: Laboratory for Bottom-up Cell Biology
Institution: RIKEN BDR
Webpage of the group: https://www.makitomiyazaki.info/

Main grant associated with this project:
Principal investigator: Makito Miyazaki
Agency: RIKEN (Intramural grants)
Reference/ years:

Brief summary of the project or current research lines of the group (please do not include pictures or logos and do not exceed this page):

The cell maintains its life through the assembly and disassembly of various subcellular structures from molecules. How do the tiny molecules self-organize into micrometer-scale structures at appropriate time and space to regulate cell functions? This is a fundamental but non-trivial question in biology. Using an in vitro reconstitution approach, our lab aims to understand the design principles that govern the self-organization of cell-scale structures and biological functions from molecules. Using the cytoskeleton as a model system, we are exploring biochemical and physical conditions under which cytoskeletal structures and biological functions are reconstituted in artificial cells.

Potential projects during the internship program are listed below. Note that the research theme is not limited by the list. We welcome original ideas.

1) Reconstitution of cell motility and division from purified proteins and lipid vesicles.
2) Single-molecule observation of active actin cortex reconstituted on a supported lipid membrane.
3) Biophysics of the cytoskeleton and organelles in the cytoplasmic extracts of Xenopus eggs.
4) Development of new optogenetics tool for manipulation of cytoskeletal dynamics in vitro/vivo.
5) Development of new probes that can measure/manipulate forces acting between cells/in tissues using our artificial cell technology.

Call for project proposals

Master in Biomedical Research practicum, 2025

Department of Medicine and Life Sciences, Universitat Pompeu Fabra, Barcelona

Project Title (for explanation):
Understanding biological systems (e.g., stem cells, organoids, cancer cells, and immune cells) by combination of imaging technique, gene expression analyses, and our developed cell picking robot, etc.

Project supervisor (principal investigator of the laboratory/group)
Name: Katsuyuki Shiroguchi
eMail: katsuyuki.shiroguchi@riken.jp
Group name: Lab for Prediction of Cell Systems Dynamics
Institution: RIKEN Center for Biosystems Dynamics Research (BDR)
Webpage of the group: https://www.bdr.riken.jp/en/research/labs/shiroguchi-k/index.html
http://guppy.riken.jp/index.html

Main grant associated with this project:
Principal investigator: Katsuyuki Shiroguchi
Agency: RIKEN's Intramural Grants
Reference/ years: Every year

Brief summary of the project or current research lines of the group (please do not include pictures or logos and do not exceed this page):

Biological systems consist of heterogeneity, and they work based on the heterogeneity. For example, distributions of the number of molecules or cells in the systems determine the states of higher biological organization-from cells and tissues up to organisms. To understand such biological systems, one of powerful approaches is visualizing the distributions and network in them (e.g., cell-cell network) by accurate system-wide measurements with single molecule, single base, and/or single cell resolution.

In our laboratory, one of the main aims is to develop new techniques and also to improve the existing methods to "see" something unknown, in order to understand more the biological systems at the cellular level. Concretely, we have developed a method that enables the counting of copy number of RNA molecules genome-wide in a digital manner using DNA molecular barcode. Also, we made a new platform including a robot named "ALPS" (**A**utomated **L**ive imaging and cell **P**icking **S**ystem) which enables one to perform gene expression analysis (RNA-sequencing) for imaged cells under an optical microscope (Jin J et al., Proc. Natl. Acad. Sci. USA. 120 (1) e2210283120, 2023). Using these methods, we are studying, e.g., the nature of stem cells that are fundamental to tissue formation in multicellular organisms based on cell morphology and dynamics. Our targets include organoids, immune cells, cancers, and others.

During this internship, you may work on some projects that go along this direction. You will learn related techniques and may study something based on your ideas (if it fits!).

Call for project proposals

Master in Biomedical Research practicum, 2025

Department of Medicine and Life Sciences, Universitat Pompeu Fabra, Barcelona

Project Title: Mechanism of erebosis, a new cell death during homeostatic turnover.

Project supervisor (principal investigator of the laboratory/group)
Name: Sa Kan Yoo
eMail: sakan.yoo@riken.jp
Group name: Homeodynamics team/Physiological genetics lab
Institution: RIKEN BDR/CPR
Webpage of the group: http://www.yoolab.website

Main grant associated with this project:
Principal investigator: Sa Kan Yoo
Agency: RIKEN intramural grant
Reference/ years:

Brief summary of the project or current research lines of the group (please do not include pictures or logos and do not exceed this page):

We recently discovered a new cell death, which we named erebosis (Ciesielski et al. Plos Biology 2022). Erebosis is a completely unique cell death, which is different from major cell death mechanisms such as apoptosis, necrosis and autophagic cell death. This internship project focuses on investigating mechanisms of erebosis using a variety of approaches including genetics, imaging, transcriptomics and metabolomics.

Project Supervisor:
Name: Tatsuo Shibata
Group: Laboratory for Physical Biology
Institution: RIKEN Center for Biosystems Dynamics Research
email: tatsuo.shibata@riken.jp
web page: http://www.qbic.riken.jp/phb/

Field of study:

(Please highlight the most appropiate)

- Computational Genomics

- Structural Bioinformatics

- Pharmacoinformatics & Systems Pharmacology

- **Computational Systems Biology**

- Web development and Bioinformatic Tools

- **Other : Theoretical Biophysics of cell and tissue**

Project Title :

Emergence of collective behaviors in multicellular systems: collective cell migration, and epithelial folding

Summary:

The emergent properties of multicellular systems, which arise when many cells come together, play a crucial role in processes such as development, regeneration, and the maintenance of the body. Among these emergent properties, our laboratory has focused particularly on questions related to collective cell migration and the formation of folds in epithelial tissues. Collective cell movement is a phenomenon in which coordinated movement occurs within a group of cells. We have elucidated the principles by which the cell chirality induces coordination in cell collectives and how cell collectives generate density waves, using both theoretical and experimental approaches. In the context of epithelial folding, we have elucidated the mechanical processes that induce folding and shown how these mechanical processes cooperatively work with epithelial polarity signaling processes to lead to the self-organization of epithelial folding. In the Master's project, students will construct a project based on their interests, with a focus on the theoretical aspects building on the above achievements. The project will involve tasks such as constructing mathematical models, carrying out simulations, and analysing the results.

References:

1. **Yamamoto, T. *et al.* Epithelial cell chirality emerges through the dynamic concentric pattern of actomyosin cytoskeleton. *bioRxiv* 2023.08.16.553476 (2023) doi:10.1101/2023.08.16.553476.**
2. **Wen, F.-L., Kwan, C. W., Wang, Y.-C. & Shibata, T. Autonomous epithelial folding induced by an intracellular mechano–polarity feedback loop. *Plos Comput Biol* 17, e1009614 (2021).**
3. **Yamamoto, T., Hiraiwa, T. & Shibata, T. Collective cell migration of epithelial cells driven by chiral torque generation. *Phys Rev Res* 2, 043326 (2020).**
4. **Hayakawa, M., Hiraiwa, T., Wada, Y., Kuwayama, H. & Shibata, T. Polar pattern formation induced by contact following locomotion in a multicellular system. *Elife* 9, e53609 (2020).**
5. **Wen, F.-L., Wang, Y.-C. & Shibata, T. Epithelial Folding Driven by Apical or Basal-Lateral Modulation: Geometric Features, Mechanical Inference, and Boundary Effects. *Biophysical Journal* 112, 2683–2695 (2017).**
6. **Sato, K. *et al.* Left–right asymmetric cell intercalation drives directional collective cell movement in epithelial morphogenesis. *Nat Commun* 6, 10074 (2015).**
7. **Sato, K., Hiraiwa, T. & Shibata, T. Cell Chirality Induces Collective Cell Migration in Epithelial Sheets. *Phys Rev Lett* 115, 188102 (2015).**

Expected skills:

Physics such as statistical physics, and nonlinear physics, Mathematics such as linear algebra and calculus