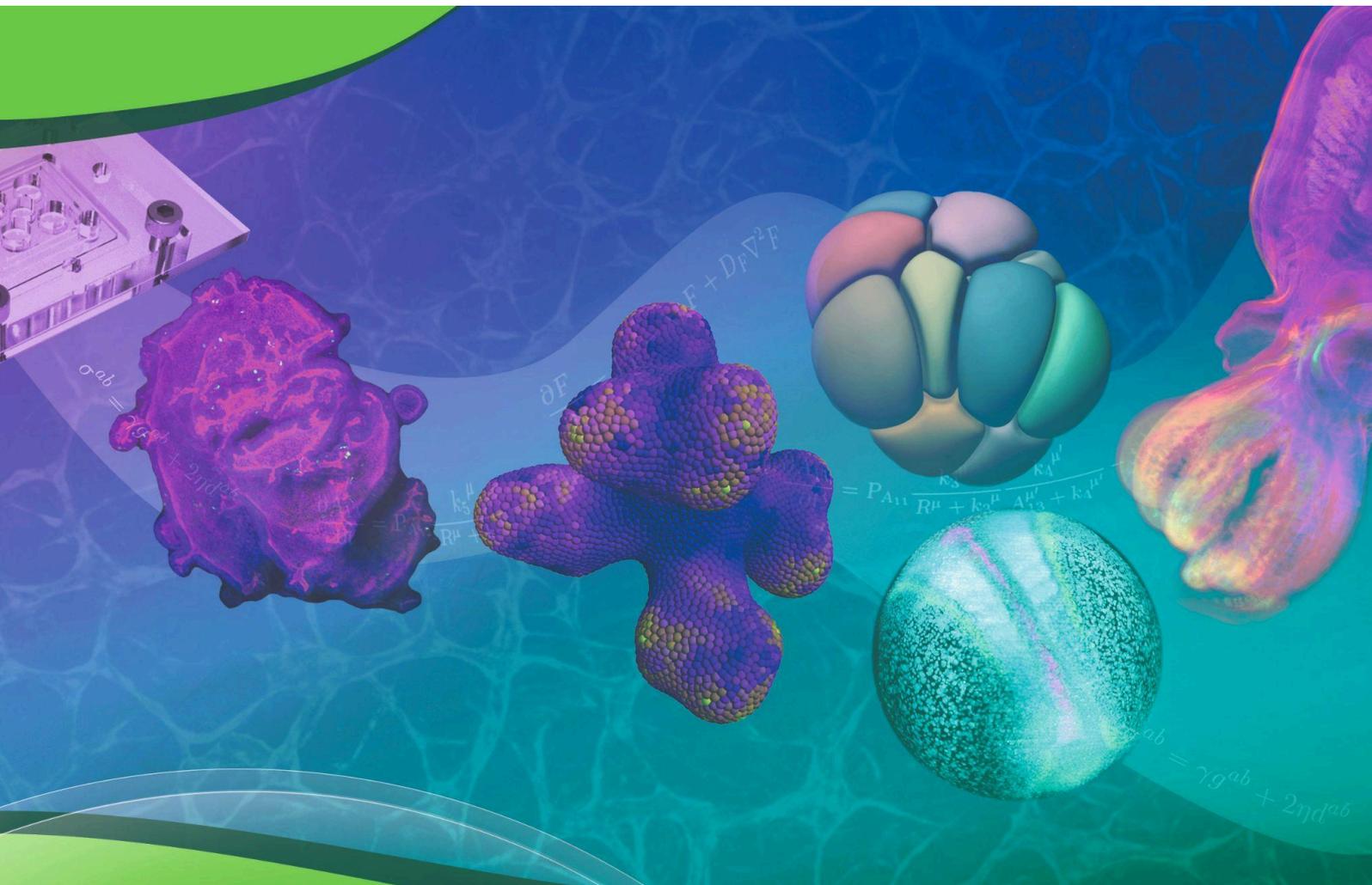


EMBL Barcelona

Highlights Report 2024



Highlights Report 2024

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Welcome to EMBL Barcelona



The coming of age of EMBL Barcelona

2024 has been a particularly exciting year for EMBL Barcelona. Our site is now home to all seven research groups originally envisioned, marking a significant milestone in our journey. The Dayton and Torres-Sánchez groups, which joined us at the end of 2022, have now fully established their teams, bringing our establishment phase to a close.

This sense of completion extends beyond individual groups – it reflects the broader evolution of EMBL Barcelona. Since our founding in 2017, we have worked diligently to establish the unit as a leading center for tissue biology and disease modeling. Today, that vision is a reality, as highlighted by the diversity of scientific achievements covered in this report.

None of this would have been possible without the invaluable support of our collaborators, including the University Pompeu Fabra (UPF), the Centre for Genomic Regulation (CRG), and the Institute for Bioengineering of Catalonia (IBEC). We are also deeply grateful for the continuous support of our home, the Barcelona Biomedical Research Park (PRBB), whose partnership remains essential to our success.

As we reflect on this year's accomplishments, we look forward with enthusiasm to the opportunities ahead.

James Sharpe,
Head of EMBL Barcelona

“EMBL Barcelona is an inspiring and collaborative place to work. As an open, inclusive and international community, this year we have continued to work on the advancement of science while supporting one another and growing together. We take pride in being part of the PRBB’s dynamic biomedical ecosystem, which fosters strong connections with our research institutes neighbors and partners, providing an ideal environment for EMBL Barcelona to flourish.”

Laura Marin,
Head of Administration
EMBL Barcelona



Building tissues to understand them

EMBL Barcelona is home to a creative team of international scientists at the forefront of tissue biology and disease modelling, investigating how cells collaborate to form functional tissues and organs. Moving beyond the molecular and cellular level, our research studies the complex organisation of millions of interacting cells, analysing the chemical, physical, and dynamic processes that maintain healthy tissues.

Our research addresses fundamental questions: How do complex tissues form? Why do these processes sometimes fail? How can damaged tissues be repaired? How do diseases like cancer and malaria disrupt tissue function? Through a combination of highly interdisciplinary approaches, including tissue engineering, 3D imaging, multicellular omics, and computational modelling, we tackle challenges in organ development, vascular dysfunctions, and disease progression.

Located at Barcelona's seafront, EMBL Barcelona thrives within a vibrant scientific ecosystem, collaborating with leading institutions like Centre for Genomic Regulation (CRG), the Institute for Bioengineering of Catalonia (IBEC), the Pompeu Fabra University (UPF), and the Spanish National Research Council (CSIC).

Our history

EMBL Barcelona was founded in 2017 and is an integral part of the European Molecular Biology Laboratory – the world's only intergovernmental organisation dedicated to cutting-edge life sciences, with six sites in five countries. Since its establishment within the Barcelona Biomedical Research Park (PRBB), EMBL Barcelona has grown from a promising idea into an established scientific hub. Today, around 100 researchers work at the site, supported by robust collaborations with local and international partners.

The site's story is one of innovation and camaraderie, marked by key moments: the signing of its host site agreement in April 2017, the completion of its dedicated facilities in 2018, and the recruitment of exceptional scientists and support staff over the subsequent years. In October 2022, EMBL Barcelona [celebrated its fifth anniversary](#), reflecting on years of scientific achievement, interdisciplinary collaboration, and community building.

From hosting major conferences to forging strategic partnerships, EMBL Barcelona has firmly established itself as a leader in tissue biology and disease modelling. The site continues its impactful work, pushing the boundaries of research and fostering an inspiring scientific environment.

Science in action

EMBL Barcelona is currently home to seven research groups, which together cover a wide array of cutting-edge topics in tissue biology and disease modelling, using interdisciplinary approaches that combine molecular, cellular, and tissue-level insights. In particular, we focus on integrating the following approaches:

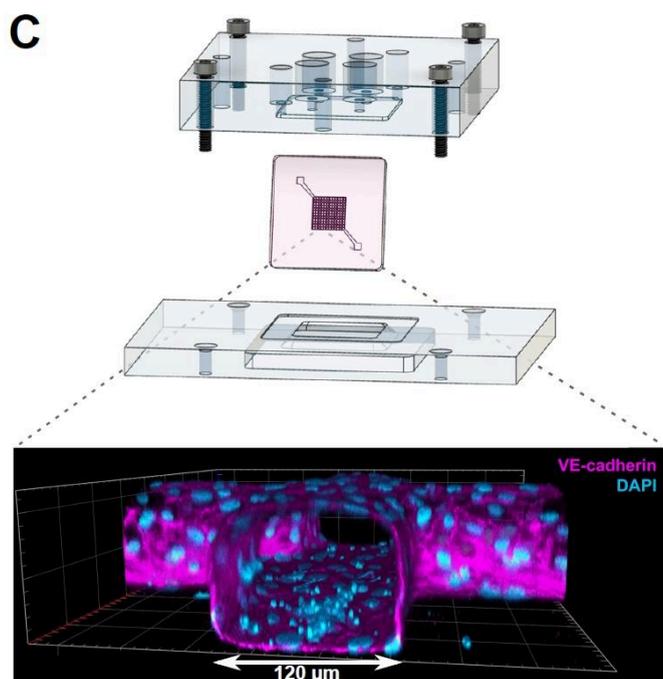
- *in vitro* 3D culture of complex tissues, from embryonic structures to adult vasculature,
- cutting-edge mesoscopic imaging technologies to image tissue dynamics,
- engineering tools and engineering tissues,
- mathematical and computational modelling to understand how tissues work.

Here, we highlight some of EMBL Barcelona's 2024 scientific publications.

Publications

Stopping severe malaria by harnessing natural human antibodies

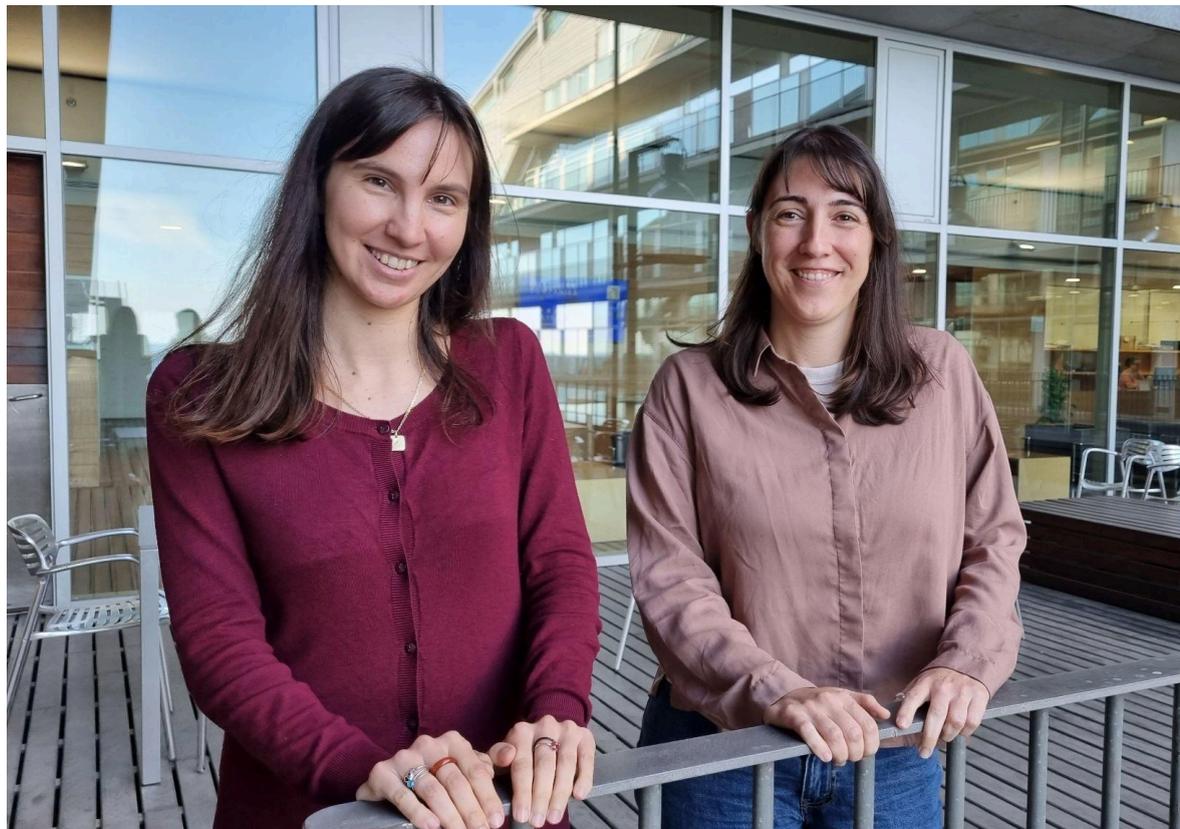
A major milestone for EMBL Barcelona in 2024 was a publication by the Bernabeu Group in the prestigious journal *Nature*. The study, titled '[Broadly inhibitory antibodies to severe malaria virulence proteins](#)', offers promising insights into tackling severe malaria.



Caption: Volumetric reconstruction of a microvessel cross section (120 μm diameter) after immunofluorescence labelling with an anti-human vascular endothelial (VE)-cadherin antibody (magenta) and nuclear staining by DAPI (blue). Parasite nuclei can be identified as smaller, brighter blue foci attached to the endothelial surface. **Credits:** Viola Introini

The research focused on antibodies that block a key mechanism used by the malaria parasite *Plasmodium falciparum* to cause severe disease: binding to blood vessel walls through specific proteins. The team identified two human antibodies capable of broadly inhibiting this binding across many protein variants, preventing parasite accumulation in engineered 3D brain microvessels. These findings could pave the way for new vaccines or therapies to combat severe malaria.

“At EMBL Barcelona, we believe that tissue engineering and growing organs-on-a-chip allow us to study diseases with much more complexity and detail, as well as provide useful platforms for screening vaccine candidates,” Maria Bernabeu

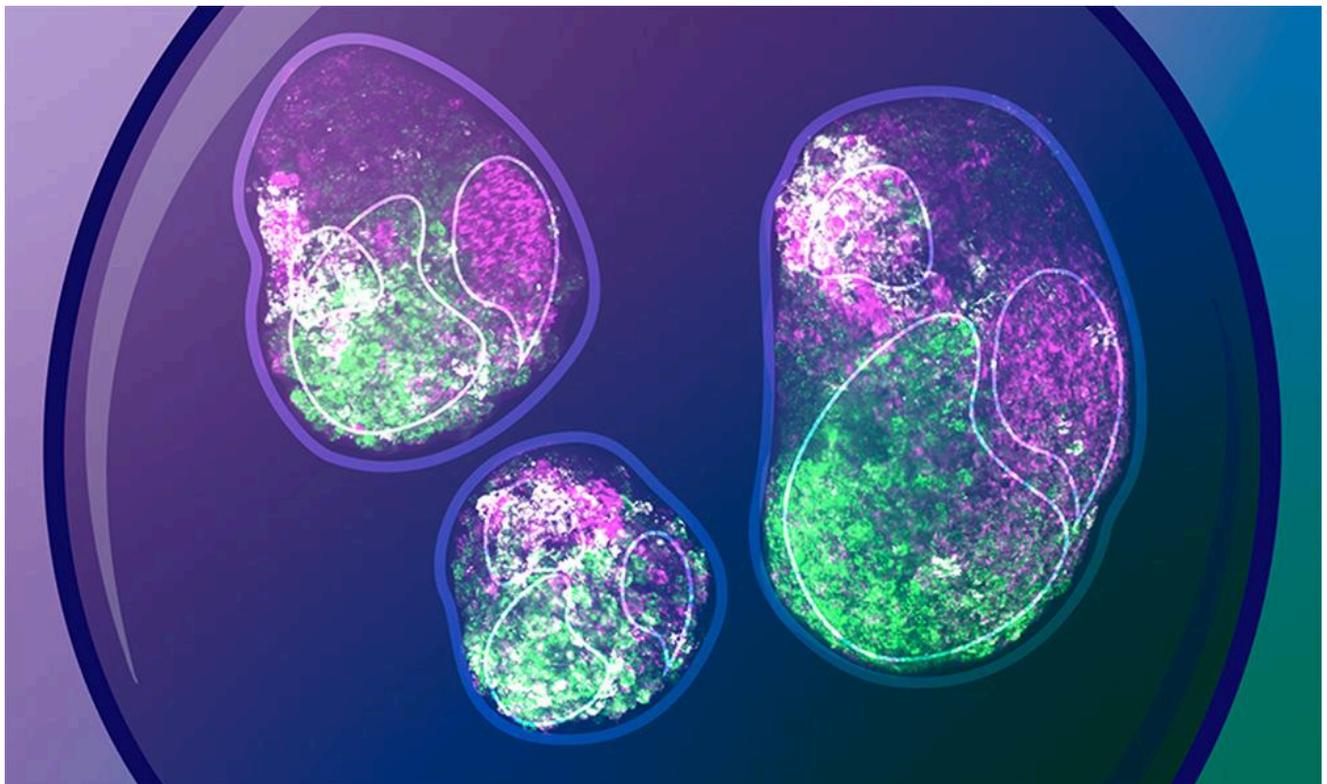


Caption: Viola Introini and Maria Bernabeu, authors of a new study on antibodies against virulent proteins responsible for severe malaria, at the PRBB. **Credit:** Carla Manzananas/EMBL

From head to tail: how cells give rise to our body plan

The Trivedi Group published the paper '[Early autonomous patterning of the anteroposterior axis in gastruloids](#)' in the journal *Development*. Their work explored how 3D stem cell structures called gastruloids can autonomously form a head-to-tail body axis, without external cues. By analysing individual cells, the team uncovered key molecular transitions and found that, despite initial differences, gastruloids develop cell types similar to those in real embryos. This study highlights the potential of gastruloids for advancing our understanding of early development.

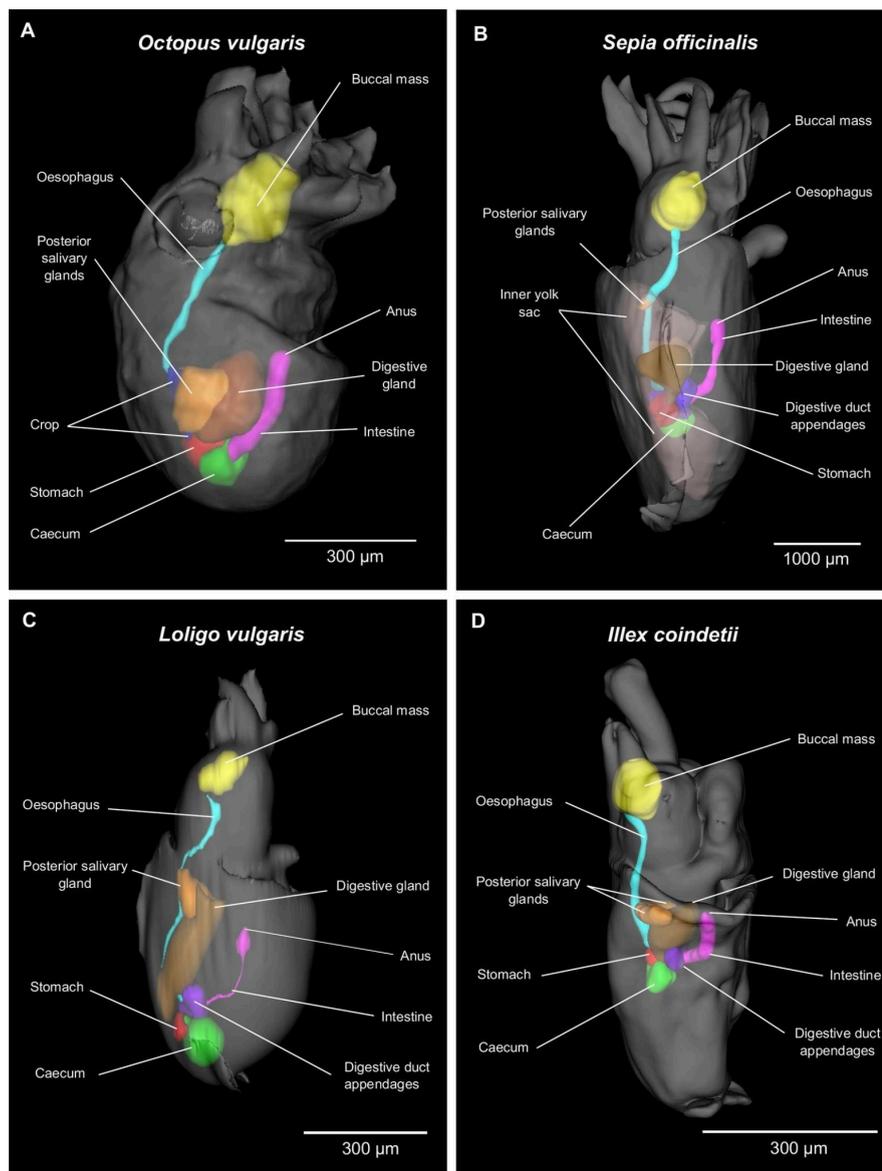
“It is believed that the anterior–posterior axis of our body, that means our head-to-feet structure, requires external signals to be developed. In our study, we show that cells can independently orchestrate the first steps of symmetry breaking, without any external input.”
Vikas Trivedi



Caption: Three gastruloids at 72 hours after they were formed from different numbers of mouse embryonic stem cells. The samples have been stained to highlight important markers for germ layers and the head-to-tail body axis, shown in different colors: Bra/T (green), Sox2 (magenta), and Foxa2 (white). The image highlights how early body patterning remains consistent despite differences in the size of the cell clusters. **Credit:** Trivedi Group, Isabel Romero Calvo/EMBL

Understanding the octopus digestive system

This year, the Mesoscopic Imaging Facility (MIF) contributed to the paper '[Ontogenetic and evolutionary trends on cephalopod digestive systems](#)', published in *Reviews in Fish Biology and Fisheries*. The study used 3D microscopy techniques to explore the digestive system development of the common octopus (*Octopus vulgaris*) and compared it to other cephalopods. The research revealed key stages in the octopus's digestive system growth and highlighted a potential common feeding mechanism across species, shedding light on their adaptation to different ecological niches during development.

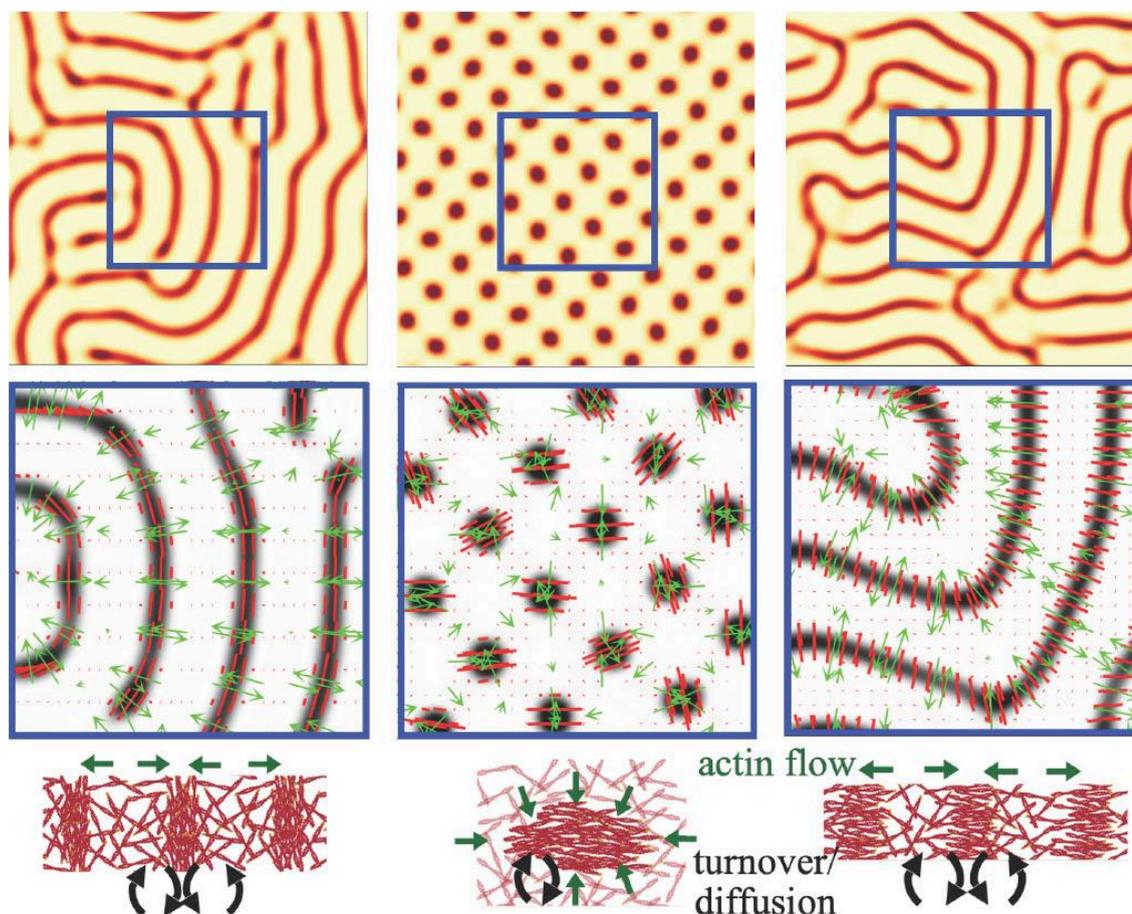


Caption: 3D renders of the digestive system structure of hatchling individuals of the four cephalopod species analysed. Measurements after fixation and clearing. **a** *Octopus vulgaris* competent 0 days post-hatching paralarva (ML 1.3 mm). **b** *Sepia officinalis* 0 days post-hatching hatchling (ML 6.6 mm), including the inner yolk sac. **c** *Loligo vulgaris* 0 days post-hatching paralarva (ML 1.3 mm). **d** *Illex coindetii* 0 days post-hatching rhynchoteuthion paralarva (ML 0.9 mm) **Credit:** Diego G. Vilarnau, Fernando A. Fernandez-Alvarez, Montserrat Coll-Lladó, Nicola Gritti, Jim Swoger and Roger Villanueva

Deciphering cellular behaviour

The Torres-Sánchez Group published a paper in *eLife* this year, titled '[Theory of active self-organization of dense nematic structures in the actin cytoskeleton](#)'. The study explores how the actin cytoskeleton, a crucial part of the cell's structure, organises into dense, nematic bundles, like contractile rings and stress fibres. By using simulations, the research reveals how active forces and tension lead to the self-assembly of these bundles, shedding light on the dynamic and reconfigurable nature of actin gels. The findings provide new insights into how cells organise their internal structure for movement and function.

"We developed a physics-based model that identifies the minimal blueprints for biologists to replicate key cellular behaviours in reconstituted systems within the laboratory. This advancement driven by physics could be crucial for synthetic biology, tissue engineering, and disease modelling, offering a controlled platform to study cellular mechanics outside of living organisms," Waleed Mirza, MSCA Postdoc at Torres-Sánchez

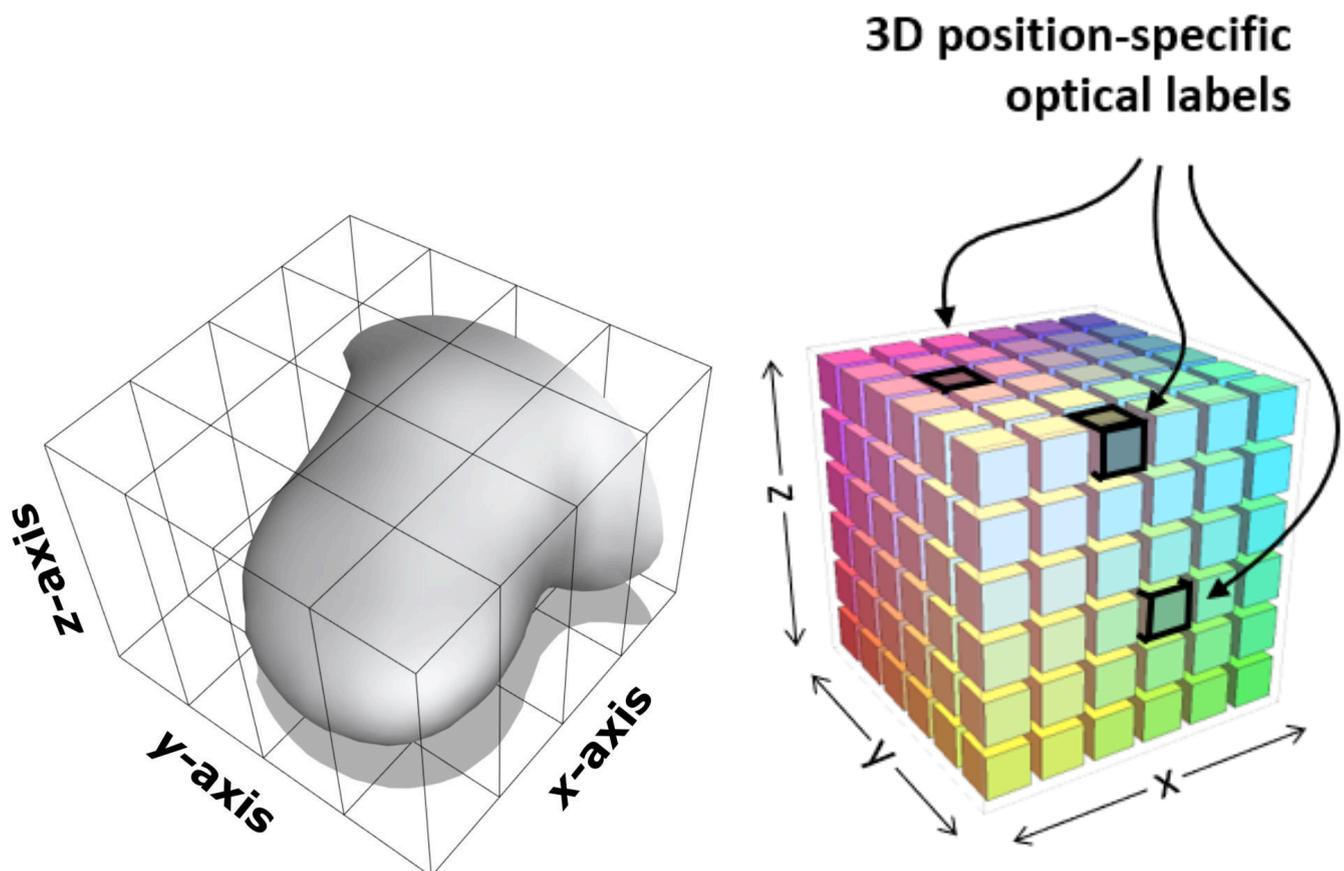


Caption: Active patterns coupling nematic order and density driven by self-reinforcing flows.

Credits: Waleed Mirza

3D spatial transcriptomics for tissues and embryos

The Sharpe Group and the Mesoscopic Imaging Facility (MIF) have developed the first technology to capture genuinely 3D spatial transcriptomics data from tissue and embryos. Their method, called C3PO, was published this year as a pre-print in bioRxiv: '[Cell 3D positioning by optical encoding \(C3PO\) and its application to spatial transcriptomics](#)'. The scientific community is increasingly interested in which cells are expressing which genes within a given tissue or organ, but so far these techniques have been limited to 2D sections cut through the sample. It is hard to understand the structure and function of complex tissues from 2D sections, so the Sharpe Group sought a method that could record the 3D positions of all cells while the tissue is still intact. They invented a novel approach – C3PO – which labels all cells with unique combinations of fluorescent signals, encoding their 3D position in space and thus allowing a map of gene expression to be recorded in 3D.



Caption: C3PO optically bleaches a 3D coordinate framework of fluorescence values into the intact tissue (a different fluorescent colour for each of the 3 dimensions x, y and z). The cells can then be disassociated and pooled, and subsequently their positions recovered by recording the 4 fluorescent channels, prior to transcriptomics. **Credits:** James Cotterell

Scientific Collaborations

The CryoZoo

The Barcelona Zoo Foundation, UPF, the Barcelona Museum of Natural Sciences, and the European Molecular Biology Laboratory (EMBL) in Barcelona, signed the formal agreement of the Barcelona CryoZoo. This collaboration represents a partnership to continue a project dedicated to biodiversity conservation and biomedical research to protect endangered animal species. This is a major collaborative effort among the four main partners and many zoological centres and aquariums from Spain. The project's mission is to preserve the biomaterial of endangered species. By generating and preserving cell lines and molecular data, we are building an invaluable treasure of biological resources for future generations.

The CryoZoo's approach is based on three main pillars:

- cryopreservation of viable cell lines from captive and wild species with priority to the most threatened vertebrates in the IUCN red list,
- characterisation of karyotypes and molecular phenotypes for these cell lines, such as genome, epigenome, and transcriptomics for genomic and comparative studies,
- study and promotion of research in cell reprogramming techniques for iPSCs generation.

This year, the agreement among the four main partners was established, bringing the CryoZoo project to the next level.



The Barcelona Collaboratorium for Modelling and Predictive Biology: building a community

The Barcelona Collaboratorium is a joint initiative between EMBL Barcelona and the CRG. Located just a 10-minute walk from our home in the PRBB, the Collaboratorium brings together professionals from computational biology, theoretical biology, complex systems, and artificial intelligence.

This year, the Barcelona Collaboratorium has continued to grow as a hub for research and has welcomed fellows from prestigious institutions like the University of California San Francisco, USA; Harvard University, USA; KU Leuven, Belgium; or Cinvestav, Mexico; among others. In addition, this year has marked the establishment of its weekly seminars.



Caption: The Collaboratorium is a hub for research which aims to bring together experts from different disciplines to work on modelling and predictive biology. **Credits:** Isabel Romero-Calvo/EMBL

Seminar Series

The Collaboratorium hosted **30 seminars** during 2024, featuring talks from distinguished researchers across a variety of disciplines. Highlights include seminars by Kim Sneppen (Niels Bohr Institute, University of Copenhagen, Denmark), Ramin Golestanian (Max Planck Institute for Dynamics and Self-Organization, Germany), and Nataša Pržulj (Barcelona Supercomputing Center, Spain). These events have provided a platform for lively discussions and idea exchange, furthering the Collaboratorium's mission to bridge computational, theoretical, and experimental biology.

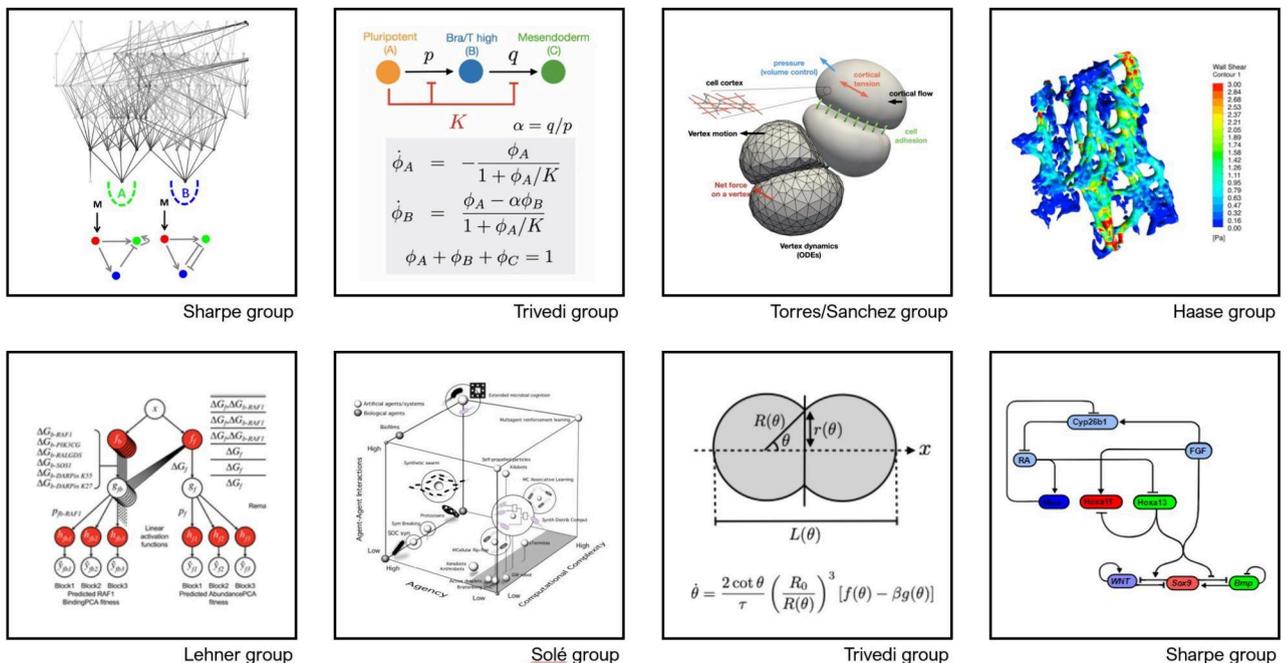
Collaboratorium x Centre for Mathematical Research (CRM)

In December, the Collaboratorium hosted a joint event with the Centre de Recerca Matemàtica (CRM), in an effort to further expand its collaborations. This meeting featured 15-minute talks by selected researchers and flash presentations from attendees, strengthening ties between the Collaboratorium and CRM and fostering synergies between mathematical and biological research.

Visitors

The Collaboratorium welcomed several visitors this year, including:

- Rob Jelier (KU Leuven, Belgium) – Jelier’s research combines experimental and computational approaches, with a focus on genetics and embryonic development.
- Arjendu K. Pattanayak (Carleton College, United States) – Pattanayak’s research is in the field of statistical physics, specifically on theoretical and computational non-linear dynamics.
- James Malone (Oxford University, UK) – Malone spent two months visiting the Sharpe Group to learn about agent-based modelling.
- Mirko Francesconi (ENS Lyon, France) – Francesconi collects, integrates, and analyses large-scale-omics, especially transcriptomics, data, to make quantitative predictions.



Caption: representation of the work that some of the groups and fellows do at the Collaboratorium.

Credits: Sharpe Group, Trivedi Group, Torres-Sánchez Group, Haase Group, Lehner Group, Solé Group.

Scientific Events

In 2024, EMBL Barcelona organised and co-hosted a diverse range of scientific, institutional, and internal events that promoted collaboration and knowledge exchange, while also engaging with the wider community. With a special mention for EMBL's 50 anniversary celebration in Barcelona, here we summarise key scientific events organised by the site.

EMBL Barcelona celebrates EMBL's 50th anniversary

6 November 2024

EMBL Barcelona joined the broader EMBL community in celebrating the 50th anniversary of EMBL, Europe's life sciences laboratory. The event brought together over 200 attendees, including political leaders, Spanish scientific community members, and EMBL alumni, to reflect on the past and look toward the future.

Hosted by EMBL Director General Edith Heard and Head of EMBL Barcelona James Sharpe, the celebration featured speeches from key public authorities such as Eva Ortega-Paíno, Spanish Secretary General for Research, and Jordi Valls, Deputy Mayor for Economic Innovation in Barcelona. The event highlighted EMBL's success and the exciting future ahead, especially in tissue biology and disease modelling at EMBL Barcelona.

Key presentations included Matthias Lütolf from EPFL, Switzerland, who discussed the transformation of biomedical research through tissue engineering, as well as talks by prominent Spanish researchers. The event also featured EMBL alumni sharing how their time at EMBL shaped their careers.

EMBL Barcelona's commitment to advancing tissue biology and exploring the complexity of human diseases was emphasised, with the research site continuing to push the boundaries of our understanding of health and disease through cutting-edge technologies.



Caption: EMBL's 50 anniversary in Barcelona was celebrated in the PRBB Auditorium in an event that combined both scientific and institutional representation. **Credits:** EMBL

EMBL-IBEC 3rd Winter Conference on Engineering Multicellular Systems

24–26 April 2024

EMBL and IBEC aim to contribute to the discussion on challenges and opportunities in the expanding field of engineered multicellular systems. The 3rd edition of this event discussed topics such as cardiovascular engineering, mechanical forces in morphogenesis or the understanding of the human nervous system to tackle diseases.

Among the speakers were Hans Clevers (Utrecht University, The Netherlands), Sergiu Pasca (Stanford University, USA), and Satoru Okuda (WPI Kanazawa University, Japan).

Organisers: James Sharpe, Josep Samitier, Xavier Trepas, Miki Ebisuya, Kristina Haase, Nuria Montserrat, and Vikas Trivedi.

2nd EMBO Workshop on Engineering in Vascular Biology

6–8 May 2024

[In this meeting](#), EMBL Barcelona brought together vascular biologists and bioengineers from across the world to build research synergies and tackle long-standing questions in the field of vascular biology. The scientific sessions covered topics such as developmental vascular biology, aging in vascular biology, lymphatics, and vascular mechanobiology.

This year, many international attendees and speakers joined the event. Among them were Christopher Chen (Boston University, USA), Stefania Nicoli (Yale University, USA), Irene Aspalter (The Francis Crick Institute, UK), Rui Benedito (CNIC, Spain), and Li-Kun Phng (RIKEN, Japan).

Organisers: Maria Bernabeu, Cláudio Franco, Stephan Huvneers, Milica Radisic.

Bioimaging Summer School

17–19 June 2024

The Light-Sheet and Friends Summer School was co-organised by the Mesoscopic Imaging Facility at EMBL Barcelona and the company Bruker Fluorescence Microscopy. This three-day event showed the participants the latest technology in light sheet microscopy and included 1.5 days of lectures along with 1.5 days of hands-on sessions. The summer school welcomed 65 participants with interdisciplinary backgrounds from around Europe.

Organisers: Jim Swoger, Gopi Shah, Felix Weltzien, Elisabeth Kugler, Gabriela Bagordo and Jürgen Mayer.

Collaboratorium Annual Symposium

28–29 October 2024

The 2024 Annual Symposium focused on [‘Modelling biology across scales’](#) and showcased the range of applications of computational, mathematical, and theoretical methods in biology. This event welcomed over 200 attendees from around the globe, with talks by international keynote speakers, flash talks, and a poster session. This year’s scientific topics included mathematical models for biological complexity, high-dimensional spaces in evolution and populations, and machine learning, among others.

The list of speakers included Leonid Mirny (MIT, USA), Irene Otero-Muras (I2SysBio, Spain), Karen Page (UCL, UK), and Olga Troyanskaya (Princeton University, USA).

Organisers: Nora Martin (CRG) and Rosa Martinez Corral (CRG)

Seminars

Throughout the year, EMBL Barcelona hosted numerous seminars, summarised below.

- **One EMBL Seminars:** Every year, we host EMBL speakers from other sites, accompanied by a journal club run by our PhD students discussing an important paper from the speaker.
 - Nicoletta Petridou, 21 Feb 2024, **Collective regulation of cell decisions**,
 - Michael Dorrity, 2 Oct 2024, **Systematic embryo profiling to identify sources of robustness in development**,
 - Aissam Ikmi, 23 Oct 2024, Design principles of Cnidarian shapes,
 - Sinem Saka, 4 Dec 2024, **A DNA toolbox to connect visual phenotypes with molecular players**.
- **Science by the Beach:** This is a special seminar series organised by EMBL Barcelona postdocs, inviting international speakers and open to the whole PRBB community.
 - Jens Puschhof (Principal Investigator, DKFZ, Germany), 13 Feb 2024, Modelling cancer-microbiome interactions with organoids and organ-on-chips,
 - Mark Isalan (Professor of Synthetic Biology, ICL, UK), 16 Apr 2024, Synthetic biology for engineering: Turing patterns,
 - Jan Huisken (Humboldt Professor, University of Gottingen, Germany), 14 May 2024, Flamingo: development, application and dissemination of light sheet microscopy technology,

- Kyle Loh (Assistant Professor for Developmental Biology, Stanford University, USA), 17 Sep 2024, Developmental roadmap to create human cell types from pluripotent stem cells,
- Edouard Hannezo (Group Leader, Institute of Science and Technology of Austria, Austria), 15 Oct 2024, Tissue active matter: integrating mechanics and signalling into dynamical models,
- Trudy Oliver (Professor, Duke University, USA), 19 Nov 2024, Neuroendocrine cancer cell fate and plasticity: lessons from mouse models.
- **Planetary Biology Seminar:** This was organised by the Planetary Biology Transversal Theme at EMBL on 13 Mar 2024. Tomàs Marquès-Bonet from IBE-UPF and Sira Martinez from EMBL Barcelona presented the CryoZoo project to colleagues from all EMBL sites.

Internal activities included several **thesis defences** and the **Unit Retreat** in October, which provided opportunities for internal reflection and collaboration.

PhD graduations

In 2024, five PhD students from EMBL Barcelona successfully defended their theses, showcasing remarkable contributions to their respective fields. These are:

- Carmen Moccia (Haase Group), 12 Apr 2024, A model of mammary microvasculature: evaluating hormone responsiveness and luminal-like tumor integration,
- Maria Costanzo (Ebisuya Group), 26 Jun 2024, “Somitogenesis unbound”: dissecting the spatiotemporal control of mammalian embryo segmentation through *in vitro* models of development,
- Jia Le Lim (Trivedi Group), 9 Jul 2024, The gastrulating zebrafish under heat waves and cold spells: developmental robustness and vulnerabilities under changing temperatures,
- Jorge Lázaro (Ebisuya Group), 24 Oct 2024, The regulation and scaling of developmental tempo across mammalian species,
- Livia Piatti (Bernabeu Group), 28 Nov 2024, When *P. falciparum* meets the brain microvasculature: a 3D blood-brain barrier model to study cerebral malaria.

Making science happen

EMBL Barcelona's success is driven not only by ground-breaking research but also by the cutting-edge facilities and dedicated teams that support its laboratories.

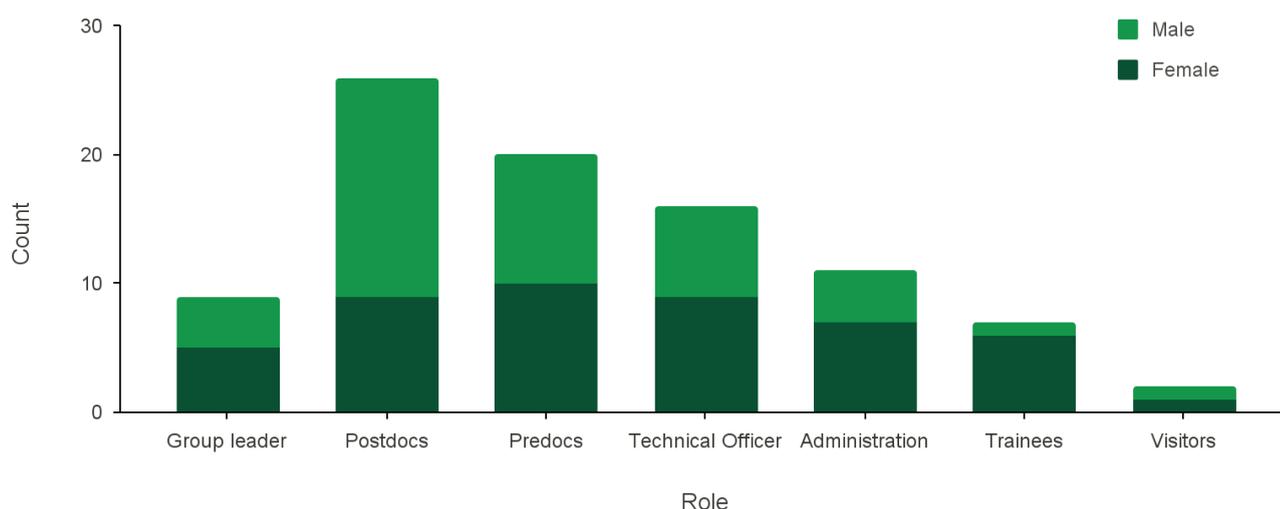
Strategic and operational support at EMBL Barcelona

Behind the scientific achievements at EMBL Barcelona is a dedicated team of professionals who form the backbone of our institution, with the latest addition this year of a new Head of Administration, Laura Marin, to lead EMBL Barcelona operations. The Administration and Operations team ensures the smooth management of day-to-day functions, empowering our researchers to focus on their innovative work. Spanning key areas such as finance, grants management, health and safety, facility operations, IT support, human resources, events coordination, and communications, this team's expertise and commitment are vital to our success.

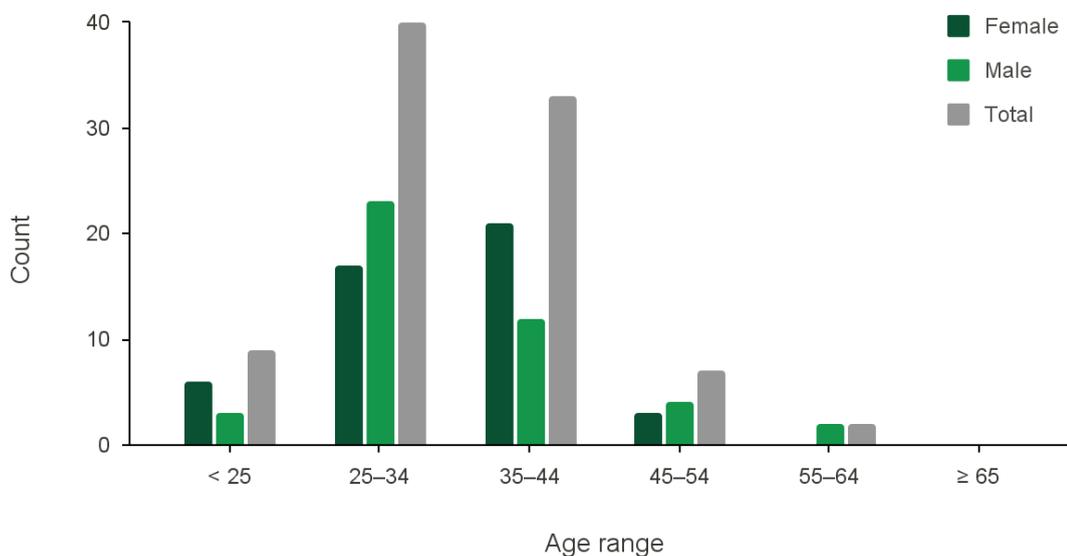
Demographics

EMBL Barcelona strengthened its team with new administrative and research staff throughout the year, welcoming 35 new members and bringing the unit into its full capacity.

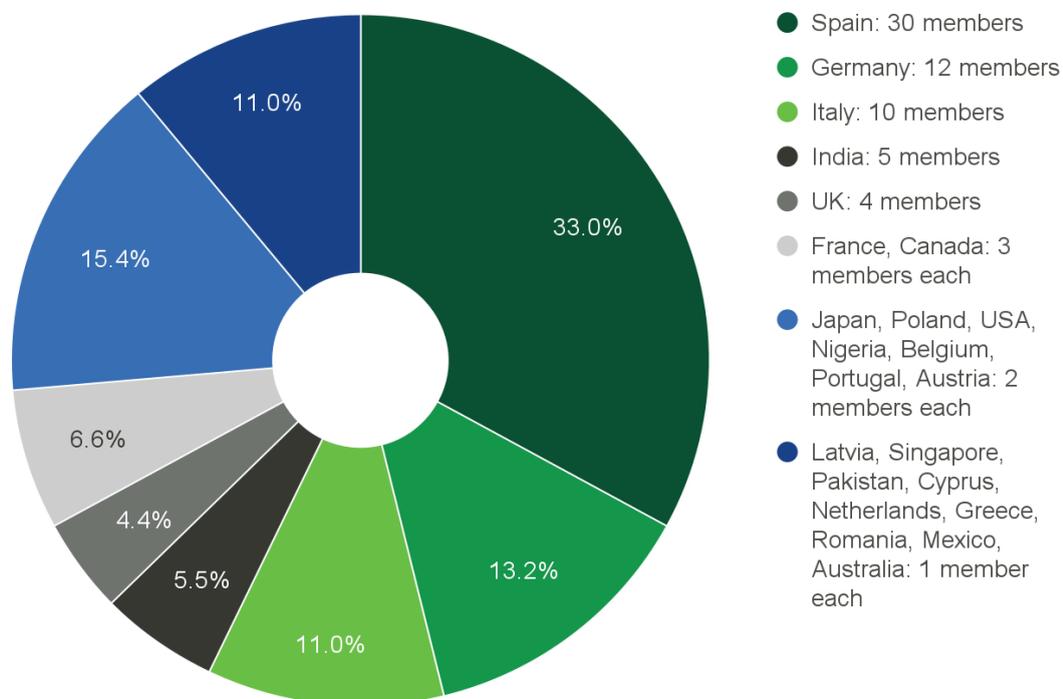
Gender distribution by role at EMBL Barcelona



Members of personnel by age range and gender



Members of personnel distribution by nationality



EMBL Barcelona funds for 2024

In 2024, to ensure smooth research and operations performance, EMBL Barcelona managed the following internal funds and operations:

- Full internal budget: €6,100,000
- Competitive funds spent: €1,400,000

The Purchase and Finance team smoothly managed the procurement needs of the site.

- **1,221 purchase orders** (POs) processed;
- **1,715 products** purchased;
- **28 import transactions** from outside the EU;
- The cumulative value of these POs amounted to **1,705,469.42€**, with **840,272.38€** invoiced to date.

This year's procurement activity reflects the administrative team's significant effort in securing the supplies and equipment necessary for EMBL Barcelona's continued excellence in scientific research.

Grants and awards

Grants and Funding in 2024

In 2024, EMBL Barcelona continued to excel in securing external funding, submitting **19 grant applications** and being successfully awarded **five grants**, totalling **€1,300,000**. These grants represent a significant achievement for the site, highlighting its excellence and the dedication of its scientists. The awarded grants include:

- **two grants from the Spanish Ministry;**
- **one grant from the European Commission**, the prestigious MSCA Postdoctoral Fellowship;
- **one grant from the Spanish Association Against Cancer (AECC)**, a new funding source for EMBL Barcelona;
- **one grant from La Marató Foundation**, marking another first for the site.

While year-to-year comparisons in grant funding can be challenging due to variability in the size and type of awards, 2024 stands out as a successful year, with milestones achieved in diversifying funding sources and obtaining grants from highly competitive programmes.

Some of these grants are highlighted below:

Kristina Haase receives funding from La Marató 2023

La Marató 2023, a prominent charitable initiative that supports science in different areas every year, has recognised Kristina Haase's research. In total, La Marató raised 8.2 million euros in 2023, which served to fund 26 research projects across Catalonia.

The funding will support Haase's work in advancing reproductive health research, focusing on pregnancy-related conditions, including preeclampsia. The grant will contribute to improving the diagnosis, prevention, and treatment of this serious and highly prevalent (5-10% of pregnancies) disease, which has a significant impact on the lives of many women. Haase's recognition highlights the growing importance of local funding in fostering critical health research in Spain.



Caption: The recipients of the La Marató funding gathered in the award ceremony organised by 3Cat, the regional TV of Catalonia. **Credits:** 3CAT/La Marató

Talya Dayton receives funding from Asociación Española Contra el Cáncer (AECC)

Talya Dayton's research group focuses on studying neuroendocrine lung cancers, such as small-cell lung cancer. To investigate the early stages of this disease, her team employs lung organoids — laboratory-grown 3D tissue models that mimic the structure and function of the lung.

In this AECC-funded project, Dayton and her team aim to understand how healthy neuroendocrine cells in these organoids respond to cancer-inducing damage, such as DNA mutations and inflammation. By uncovering the cellular mechanisms that drive the early transformation of healthy cells into cancerous ones, the project seeks to contribute to the early detection of neuroendocrine lung cancer and to the development of preventative therapies and treatments.

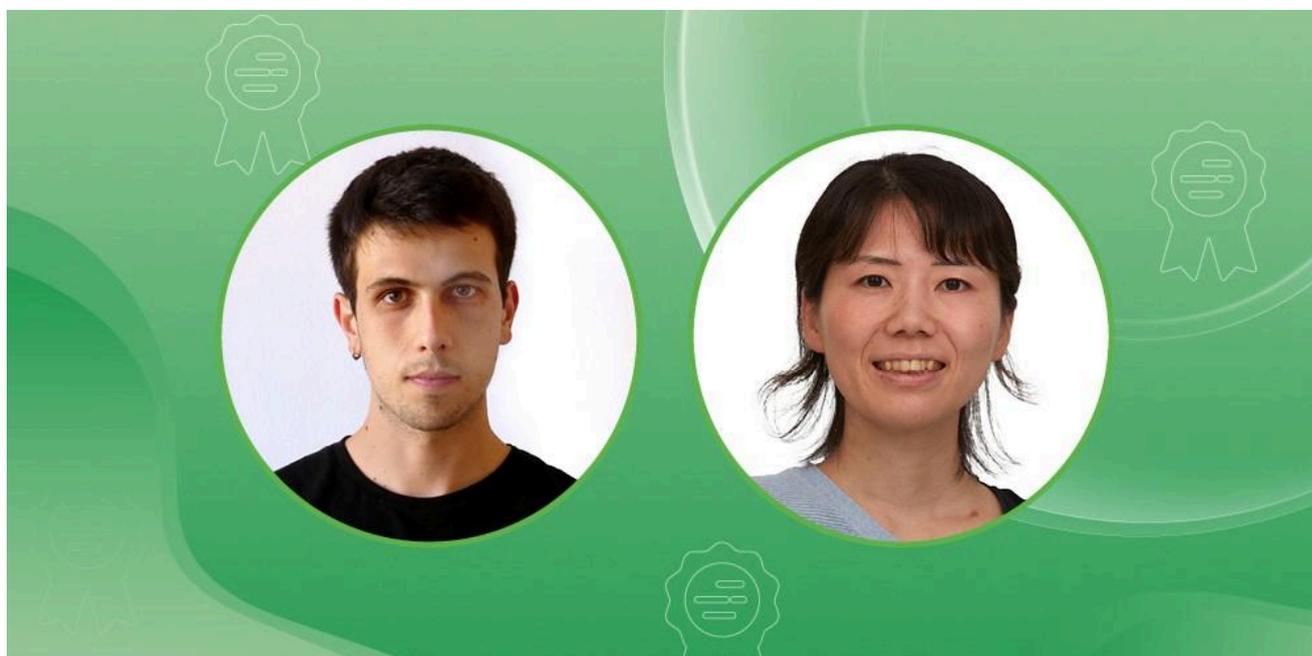
This funding marks an important milestone, as it is the first time EMBL Barcelona has received support from AECC, further diversifying the site's funding sources and strengthening its impact on cancer research.

GSCN Publication of the Year Award for Miki Ebisuya and Jorge Lázaro

Jorge Lázaro and **Miki Ebisuya** from EMBL Barcelona were awarded the **German Stem Cell Network (GSCN) Publication of the Year 2024 Award** for their innovative research on the “stem cell zoo”. Their study compared stem cells from six mammalian species to explore how the timing of development differs across animals.

This recognition celebrates their ground-breaking work in stem cell research, which offers new insights into how organisms develop. The award also included a presentation at the **GSCN Conference** in Germany in September 2024.

This achievement highlights EMBL Barcelona’s commitment to advancing science and fostering collaboration in cutting-edge research.



Juan Carlos Simó Award for Alejandro Torres Sánchez

The Spanish Society of Numeric Methods in Engineering (SEMNI in Spanish) annually awards the Juan Carlos Simó Award for young researchers in the field of numerical methods. This year, SEMNI recognised the work of Alejandro Torres-Sánchez in the field of computational modelling of multicellular systems.

Solutions for the real world

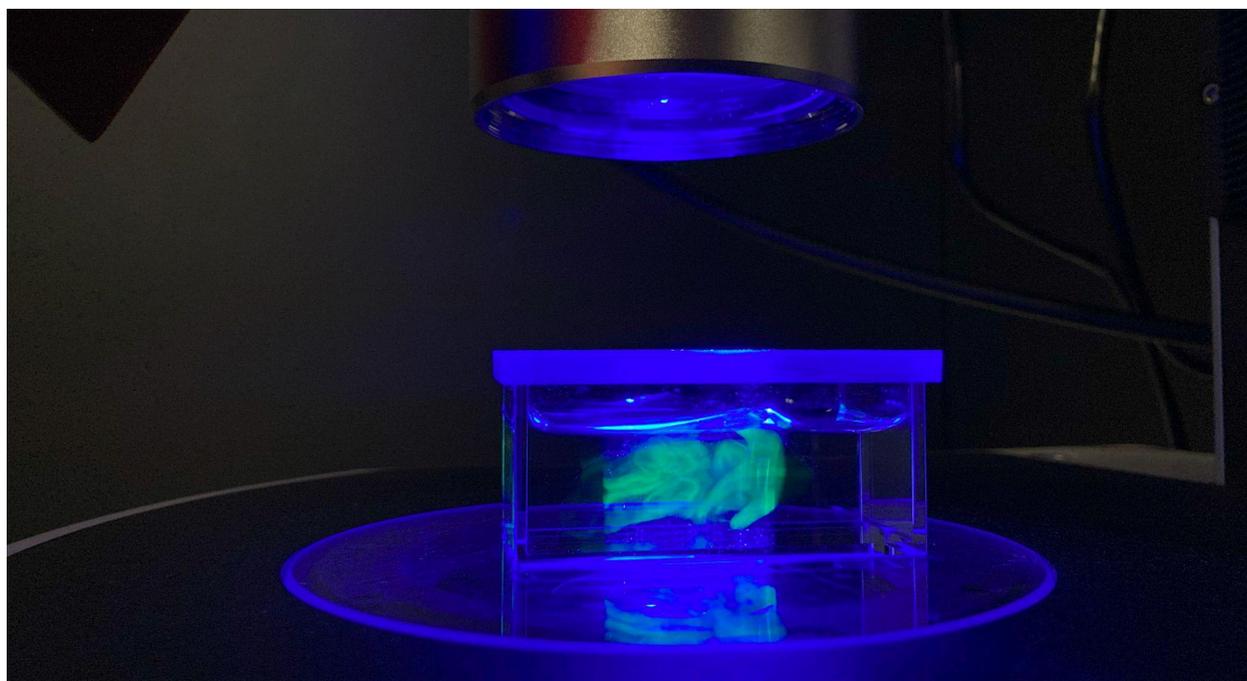
The Mesoscopic Imaging Facility

Expansion microscopy: advancing imaging capabilities at the Mesoscopic Imaging Facility

The **Mesoscopic Imaging Facility (MIF)** specialises in 3D imaging of biological tissues, enabling researchers to study the intricate structures and dynamics of organs and tissues over time.

In 2024, the MIF made significant strides in **expansion microscopy**, a cutting-edge technique designed to enhance imaging resolution by physically enlarging biological samples. Under the guidance of Montserrat Coll-Lladó, Imaging Scientist at the facility, Laura Campamà, student at the UPF, did her internship at the MIF and successfully optimised and implemented this technique.

Drawing from established protocols and tailoring them to the facility's unique requirements, Campamà expanded E12 mouse embryo samples, enabling more detailed visualisation of their structures. This advancement underscores the MIF's commitment to pioneering innovative imaging methods and supporting the research community.



Caption: Expanded E12 mouse embryo inside a cuvette under the lens of AxioZoom from Zeiss. **Credits:** Laura Campamà and Montserrat Coll Lladó.

3D spatial transcriptomics

The Sharpe Group and the MIF have developed the first technology to genuinely capture 3D spatial transcriptomics data from tissue and embryos. Their method, called C3PO, was published this year as a pre-print in bioRxiv '[Cell 3D Positioning by Optical encoding \(C3PO\) and its application to spatial transcriptomics](#)'. Jim Swoger and Spyridon Bakas from the MIF developed a custom pipeline for bleaching fluorescent gradients, a method that enables recording of 3D positions of all cells while the tissue is still intact. They are working on a dedicated optical system for this application. Once established, this method could potentially be offered as a service by the facility.

Strategy and support for external users

The MIF has been working towards providing service to researchers beyond EMBL, such as labs from the PRBB building, which houses EMBL Barcelona along with seven other research institutes. In addition, MIF aims to develop relationships with the local universities, hospitals, and industry partners to establish itself as a hub for bioimaging focused on large sample imaging. With this in mind, Gopi Shah was appointed as the Manager of Strategic Imaging Initiatives in October 2024. In this role, she will work on strategies to increase the visibility of the facility as well as on developing new projects with institutions in and around Barcelona. The MIF has already started bringing new users from the neighbouring institutions such as IMIM and IDIBELL. Groundwork to streamline processes for bringing external users for training and access to the MIF was set up earlier in the year with the help of HR. Furthermore, a pipeline was established for data processing and sharing with external users by Nicola Gritti, Bioimaging Project Manager, with help from IT specialists. These steps have been crucial in providing seamless end-to-end service to users from within EMBL as well as external users.

In 2024, the MIF had 53 users from 22 different groups.

µFabLab: Organoids research automation and monitoring

The µFabLab is an inter-institutional project, a space for collaboration and development of new micro-to-macro scaled tools located in PRBB. The project is promoted by [EMBL Barcelona](#), CRG, UPF, and [PRBB](#). The space itself is a “makerspace” for scientists, open to all employees of the institutes within the [PRBB](#). It is not a service, but rather a resource which researchers can use themselves after being trained, to develop their own new devices and technologies.

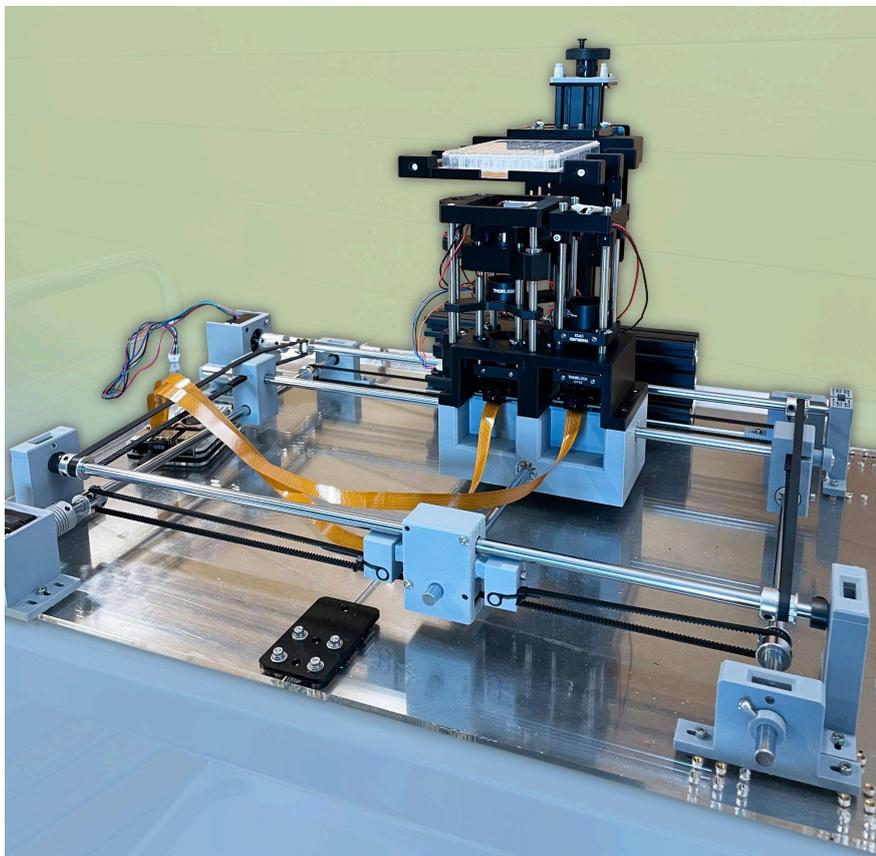
Technology development

In pursuit of advancing organoid research, Matteo Bernardello, an ARISE Fellow at the Trivedi Group, is working on automating key wet-lab procedures related to organoids, embryos, and tissue samples. The goal is to enhance experimental protocols that require a large number of samples, which must be generated, maintained, and analysed in a standardised, high-throughput manner.

Using the state-of-the-art equipment at the [μFabLab](#), Bernardello has developed affordable solutions for monitoring organoid and tissue sample development within incubators. These systems allow for continuous, 24/7 monitoring, all while protecting samples from potential contaminants and avoiding abrupt changes in culture conditions that could affect the results.

In addition to monitoring, the team is also working to automate the media exchange process during organoid culturing and the staining operation. These innovations aim to increase the efficiency and reproducibility of experiments by reducing the need for manual intervention. By minimising human factors such as variability in experience and attention, this automation ensures more consistent results.

This automation of routine tasks is expected to free up valuable time for researchers, allowing them to focus more on experimental design, data analysis, and advancing scientific insights, ultimately leading to more efficient and reliable organoid research.



Caption: A prototype of an imaging module built with the equipment at the μ FabLab space. The microscope can move to scan and retrieve images of samples contained in e.g., multiwell plates.

Training and users

Kristina Haase and Vikas Trivedi hosted students from the Pompeu Fabra University to deliver the first microfluidics course organised at EMBL Barcelona. The course included hands-on activities supported by μ FabLab Lead Specialist Roberto Paoli and Farid Serral, Master's Student at the Haase Group.

In 2024, Roberto Paoli, the μ FabLab Lead Specialist, trained 31 users and established a network of 30 active users from EMBL Barcelona, CRG, and UPF.



Caption: At the μ FabLab, the PRBB community can build micro- and macro-fabricated parts through rapid prototyping. **Credits:** Kinga Lubowiecka/EMBL

Do it right and let it show

A strategic communications plan

EMBL Barcelona focused its communications activities on highlighting the groundbreaking research conducted at the site and at EMBL as a whole. This strategic initiative seeks to strengthen ties with the Spanish scientific community and further integrate EMBL Barcelona into the region's dynamic scientific ecosystem.

As part of this effort, EMBL Barcelona has established a distinct visual identity, under the One EMBL brand, that helps to enhance recognition and visibility among peers, collaborators, and partners.



Caption: The Creative Team at EMBL led the design of the new visual identity of the unit.

Credit: Creative Team/EMBL

EMBL in the Spanish media

As part of EMBL's media engagement efforts, EMBL Barcelona's research and contributions were highlighted in numerous mainstream media. In 2024, EMBL was mentioned more than 180 times in Spanish online, print, and broadcast media. The examples below illustrate the types of media coverage that have reached a broader audience in Spain and beyond:

- “Barcelona tendrá un arca de Noé de células de especies amenazadas” La Vanguardia (September 20, 2024)
- “Más allá del descubrimiento: los beneficios sociales de la ciencia para Europa” El País (October 21, 2024)
- “La mayoría de los agroquímicos dañan a los insectos sin ser insecticidas” El País (October 24, 2024)
- “Ingeniería de tejidos: de sembrar células a cultivar órganos en un chip” Diari ARA (November 9, 2024)

Sustainability in science

At EMBL Barcelona, sustainability is becoming an integral part of our research environment. All research groups have proudly achieved the LEAF Silver Certificate, demonstrating their commitment to reducing carbon footprint while maintaining excellence in research quality.

The Laboratory Efficiency Assessment Framework (LEAF) is a tool specifically designed for wet labs, setting out 56 criteria across categories such as waste management, energy efficiency, chemical handling, and equipment use. By following these guidelines, EMBL researchers are not only optimising their lab practices but also fostering a more sustainable approach to science.

In addition to this programme, which aims to create greener laboratories, EMBL Barcelona has developed a sustainability plan tailored to the characteristics and needs of the site. One of the first steps of this plan has been to perform a waste audit to evaluate the current status and look for improvements over the next few years. This plan aligns with the overall EMBL mission to conduct innovative research in a more sustainable manner.



Caption: from left to right: Alexandre Robert, Facility Manager, Cassandra Villava, Sustainability representative at EMBL Barcelona and Marta Rodriguez, Sustainability Officer, hold the Silver LEAF certification for EMBL Barcelona. **Credit:** EMBL

A place for everyone

Equality, Diversity, and Inclusion (EDI) at EMBL Barcelona

As part of EMBL Barcelona's commitment to fostering a diverse, equitable, and inclusive work environment, members of personnel actively participated in the PRBB Equality, Diversity, and Inclusion (EDI) Group. This collaboration contributed to impactful initiatives within the Barcelona Biomedical Research Park (PRBB), promoting inclusivity, respect, and accessibility across the scientific community.

Key activities and achievements

- **Inspiring the next generation: International Day of Women and Girls in Science (11 February):** Over 50 female scientists, including three colleagues from EMBL Barcelona, visited schools across Catalonia to celebrate the International Day of Women and Girls in Science. These interactive sessions introduced children to science as an exciting and inclusive field, while also addressing gender stereotypes and highlighting female researchers as role models.
- **#BeRespectful campaign for a discrimination-free environment:** EMBL Barcelona staff contributed to the PRBB-wide **#BeRespectful campaign**, launched on International Zero Discrimination Day (1 March). The initiative tackled various forms of discrimination, including those based on gender, cultural background, age, and disability. Awareness materials, workshops, and policy updates were introduced to promote reflection and dialogue while reinforcing PRBB's anti-bullying stance.
- **Celebrating women in science: International Women's Day (8 March):** EMBL Barcelona participated in the PRBB-hosted roundtable *'Women in Science: A World of Possibilities'*, which brought together 200 secondary school students to explore diverse scientific career paths. EMBL Lab Manager **Heura Cardona**, shared her insights on interdisciplinary collaboration and managing dual roles in research and lab operations, inspiring students to pursue careers in science.
- **Open PRBB:** One of the strategic objectives of the PRBB research centres is to encourage scientific culture. We want to transmit scientific advances and knowledge to society and awaken inspiration and curiosity in young people and future scientists. EMBL Barcelona participated this year in the Open PRBB event with 15 volunteers across three main activities: a lab tour with the Dayton Group, where visitors could learn how organoids can help in cancer research; a collaborative mural for young people to learn about tissue biology, and a talk by Maria Bernabeu about her cutting-edge projects on cerebral malaria. Overall, EMBL Barcelona received almost 200 visitors for the activities.

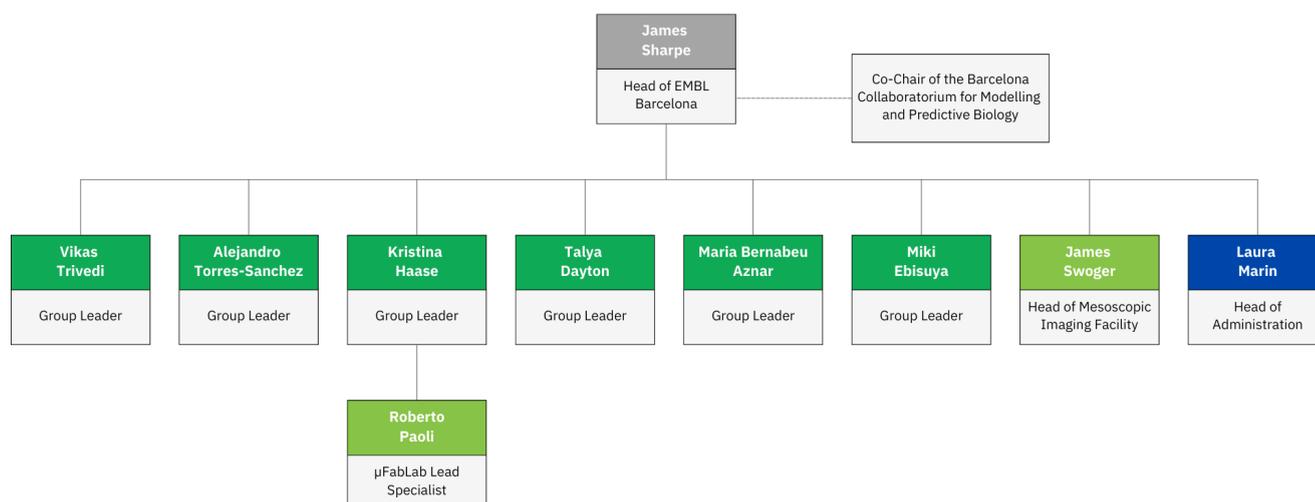
Through active participation in such EDI-focused activities and initiatives, EMBL Barcelona has strengthened its dedication to creating an inclusive and welcoming environment, fostering diversity both within the organisation and within the broader scientific community.



Caption: The Dayton Group opened its laboratory doors to show the citizens their research on cancer and organoids. **Credits:** PRBB

EMBL Barcelona in numbers

EMBL Barcelona organisational chart



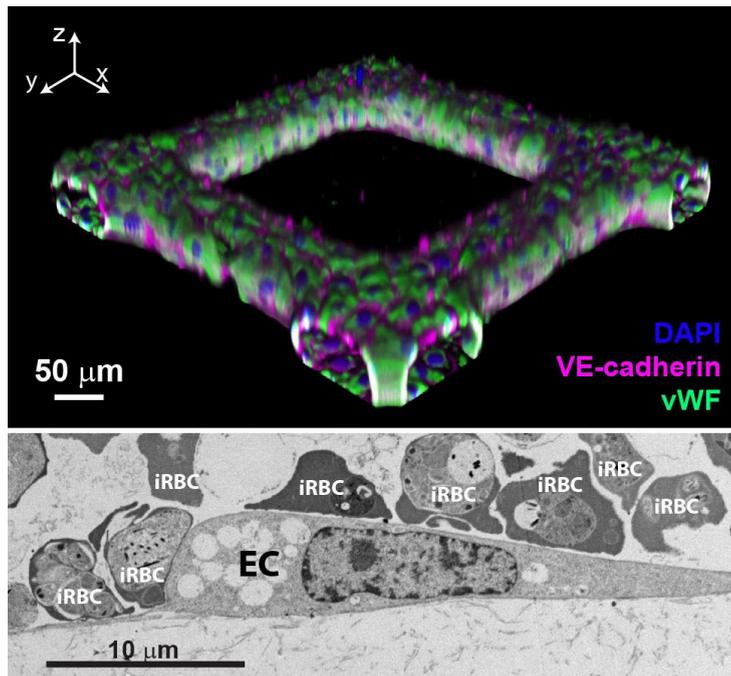
Research groups at EMBL Barcelona

EMBL Barcelona is currently home to seven dynamic research groups, each led by an accomplished group leader. Together, these laboratories cover a wide array of cutting-edge topics in tissue biology and disease modelling, using interdisciplinary approaches that combine molecular, cellular, and tissue-level insights. Looking ahead, EMBL plans to recruit a new group leader in 2025 to further expand its research portfolio, following the planned departure of the Ebisuya group.

The Bernabeu Group

The Bernabeu Group explores how multicellular interactions influence the progression of cerebral malaria. Their research centres on developing an *in vitro* model of the human blood-brain barrier (BBB) to study the pathology of cerebral malaria and other infectious diseases. Key areas of focus include:

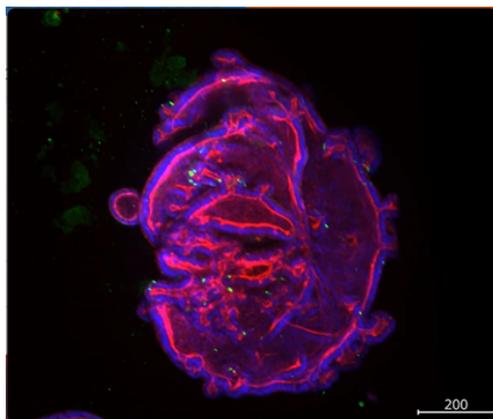
- modelling malaria's impact on the BBB using artificial vascular systems;
- investigating host-pathogen interactions in cerebral malaria with 3D BBB models;
- unravelling malaria parasite infection mechanisms through innovative BBB models;
- creating in vitro systems to examine malaria severity and tolerance.



Caption: Top: 3D reconstruction of 3D brain microvessels. Bottom: Ultrastructural imaging showing multiple *P. falciparum*-iRBCs binding to a primary human brain microvascular endothelial cell (EC) within the 3D brain microvessels. The major focus of the lab is to understand how *P. falciparum* mediates brain vascular damage. **Credit:** Bernabeu Group

The Dayton Group

The Dayton Group examines the molecular, genetic, and environmental factors driving neuroendocrine cancer. By utilising 3D cultures of human pulmonary organoids, they aim to decode the complexities of these cancers. Their research includes:

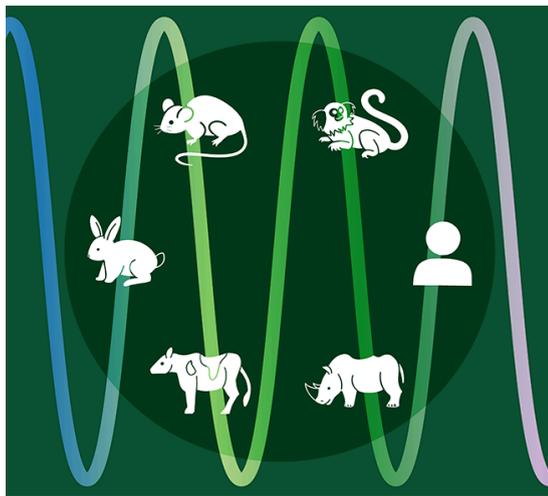


- developing advanced organoid models for neuroendocrine tumours;
- studying the origins of neuroendocrine cancers using pulmonary and tumour organoids;
- understanding the processes that drive cancer development in neuroendocrine cells.

Caption: Image of an airway organoid. **Credit:** Andrés Marco

The Ebisuya Group

The Ebisuya Group investigates the molecular mechanisms underlying fundamental developmental processes across species. By leveraging *in vitro* organoids and synthetic biology techniques, they seek to understand differences in tissue dynamics. Their key contributions include:



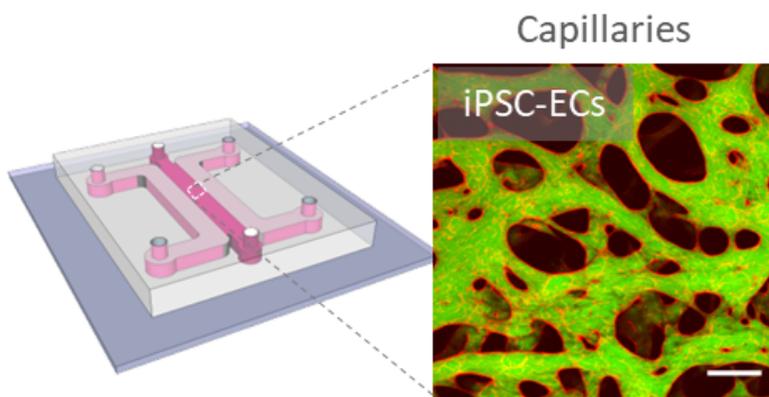
- exploring developmental tempo control with diverse stem cell models;
- studying interspecies differences in somatic clock timing;
- identifying biological oscillators and regulators of development using innovative approaches.

Caption: The stem cell zoo that the Ebisuya Group studies includes cells from human, mouse, marmoset, rhinoceros, cattle and rabbit. **Credit:** Joana Carvalho, Júlia Charles/EMBL

The Haase Group

The Haase Group focuses on understanding vascular development and the role of microvessels in human disease. They develop 3D *in vitro* vascular models to answer fundamental questions related to sex, hormones, and to reveal novel therapeutic targets. Their work includes:

- Engineering tissue-specific human vascular models for cardiac, placenta and tumours;
- Developing new translationally relevant microfluidic platforms;
- Advancing imaging and analysis pipelines using deep learning approaches.

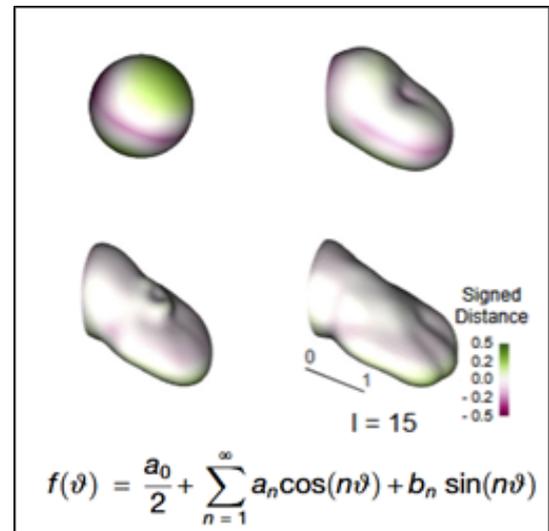


Caption: Illustration of an *in vitro* microfluidic platform that serves to investigate vascular pathology. **Credit:** Haase Group

The Sharpe Group

The Sharpe Group applies systems biology to model organogenesis, focusing on how cells collectively shape tissues and organs – specifically limb development. Their computational and data-driven approaches include:

- developing predictive models of the gene regulatory networks that control vertebrate limb development;
- using computational tools to simulate 3D morphogenesis in mouse limbs;
- exploring reaction-diffusion systems and cellular processes to explain pattern formation.

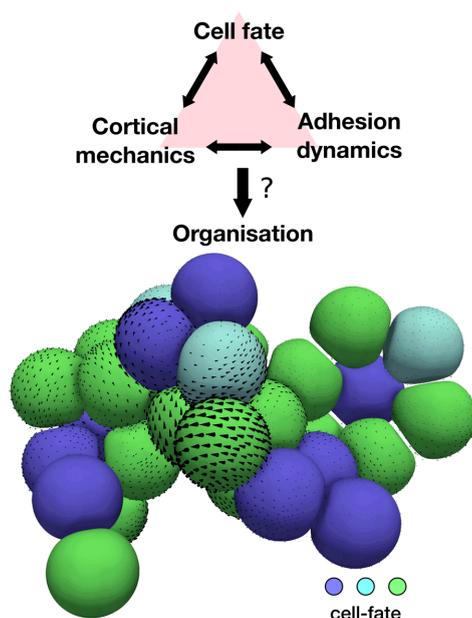


Caption: Reconstruction of a limb using spherical harmonics.

Credit: Giovanni Dalmaso and Marco Musy

The Torres-Sánchez Group

The Torres-Sánchez Group investigates the physical properties and dynamics of multicellular systems. They use computational simulations and mathematical modelling to understand tissue mechanics. Their work spans:

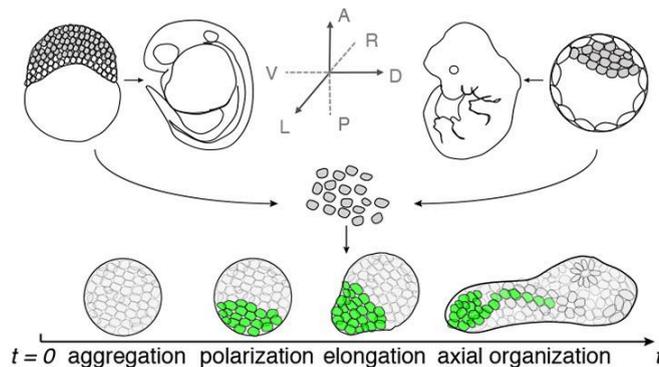


- creating predictive models of cellular systems from sub-cellular to tissue-scale dynamics;
- generating mathematical frameworks to study cell shapes and multicellular behaviours;
- developing models to explore endothelial and vascular biology through cell and tissue mechanics.

Credit: The Torres-Sánchez Group studies the interaction between cell mechanics, such as cortical flows, cell shape changes or cell-adhesion dynamics, and cell-fate decisions, controlled by gene regulatory networks that lead to the organisation of embryos and organoids. **Credit:** Torres-Sánchez Group

The Trivedi Group

The Trivedi group focuses on the mechanisms of self-organisation and cell fate changes in biological systems. Using *in vitro* stem cell models and interdisciplinary approaches, they explore:



- self-organisation and symmetry breaking in natural and artificial systems;
- early developmental processes in gastruloids, pescoids, and immune cells;
- integrating perspectives across experimental, theoretical, mechanical, and environmental factors.

Caption: Embryonic cells, when taken out of their embryonic context and allowed to self-organise in 3D, within homogeneously distributed signals, can generate body axes in a species-independent manner. This hints at a fundamental mode of development that underlies axial emergence in metazoan embryos.

Credit: Trivedi Group

Mesoscopic Imaging Facility

The Mesoscopic Imaging Facility (MIF) specialises in 3D imaging of biological tissues, enabling researchers to study the intricate structures and dynamics of organs and tissues over time. Using advanced techniques like selective plane illumination microscopy (SPIM) and optical projection tomography (OPT), MIF provides:

- high-resolution imaging for large biological samples;
- expertise in project planning, sample preparation, microscope training, and image processing.

Situated within the PRBB campus, the facility collaborates closely with EMBL researchers, visiting scientists, and neighbouring institutes, creating a hub for innovation in developmental biology and disease modelling.



Credit: The MIF works with techniques such as Selective Plane Illumination Microscopy (SPIM) and Optical Projection Tomography (OPT), which combine the ability to capture fine details with the capacity to study relatively large samples for extended periods of time. **Credit:** Kinga Lubowiecka/EMBL

μFabLab

The μFabLab is a collaborative makerspace where PRBB researchers can develop custom tools and prototypes for their experiments. This inter-institutional project, led by EMBL Barcelona in partnership with CRG, UPF, and PRBB, empowers scientists through rapid prototyping technologies. Access is granted after completing safety training, ensuring that researchers can independently design and fabricate devices tailored to their unique research needs.



Caption: The μFabLab is not a service, but rather a resource which researchers can use themselves (after being properly trained) to develop their own new devices and technologies. **Credit:** Kinga Lubowiecka/EMBL

Collaboratorium

The Barcelona Collaboratorium for Modelling and Predictive Biology is a joint initiative between EMBL Barcelona and CRG. It provides an open, collaborative space for experts in computational biology, theoretical modelling, and artificial intelligence to work together. By hosting extended visits, colloquia, and study programs, the Collaboratorium fosters interdisciplinary synergies to tackle challenges ranging from molecular biology to ecosystem prediction.

Administration and Operations

Behind the scientific endeavours at EMBL Barcelona is a dedicated Administration team, ensuring the smooth and efficient functioning of day-to-day operations. The team spans various departments, including finance, grants, health and safety, facility management, IT support, human resources, events, and communications.

By managing these essential areas, the team enables researchers to focus on their science while facilitating strategic collaborations and opening new opportunities. Additionally, the team provides personalised support for international staff, helping them navigate the complexities of relocating and integrating into a new environment. Whether assisting with documentation before arrival or addressing everyday challenges, EMBL Barcelona's Administration team is a reliable partner in making science happen.

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www.embl.org
info@embl.es

EMBL Barcelona
Carrer Doctor Aiguader 88,
PRBB Building
08003 Barcelona, Spain

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