IRB BARCELONA

INSTITUTE FOR RESEARCH IN BIOMEDICINE

Annual Report Summary 2016

2016: An energetic and productive year at IRB Barcelona

2016 has been an energetic and productive year at IRB Barcelona, and we have continued to go from strength to strength across the board in our research and related areas of activity.

First and foremost, our science made bold headlines in 2016 for discoveries that are likely to have a real impact on human health as well as further our understanding of basic molecular processes. IRB Barcelona researchers made key discoveries in linking lipids to the progression of cancer and metastasis; they used bioinformatics to identify drug combinations likely to overcome resistance to breast cancer treatment; they identified a set of genes associated with a set of poorly understood rare diseases affecting the brain, respiratory tract, and reproductive system; and provided an explanation as to why the genetic code stopped growing three billion years ago. Publications in 2016 totalled 182, with 91% in Q1, and 69% in D1, reaffirming the high quality of our contributions to the scientific literature.

We also took significant steps toward expanding our faculty and reinforcing our research activities in key areas. We were delighted to welcome Núria López-Bigas from Pompeu Fabra University in October, and Fran Supek from the Centre de Regulació Genomica (CRG) and Manuel Serrano from the Spanish National Research Institute (CNIO) in Madrid, who took up their positions in the Spring of 2017.

In terms of recognitions, Eduard Batlle received the Lilly Foundation's 2016 Preclinical Research Prize as well as the 2016 Carmen and Severo Ochoa Prize for his contributions to the understanding of colon cancer. Salvador Aznar-Benitah received the VI National 'Doctores Diz Pintado' Cancer Research Prize.

2016 proved to be a promising year for IRB Barcelona in establishing international collaborations, with the launch of two large-scale projects funded as part of the EU's Horizon 2020 programme. ENABLE is a project through which young scientists will promote excellence in the biomedical sciences in Europe, strengthen scientific careers, and bring biomedicine closer to society through a series of international symposia. Activities for the Multi-scale complex genomics (MUG) project also began during the year. The collaboration has the aim of laying the bioinformatics groundwork for the emerging field of 3D genomics.

It was also a successful year for innovation, with the launch of the spin-off Nostrum BioDiscovery in collaboration with the Barcelona Supercomputing Center (BSC-CNS). Nostrum BioDiscovery aims to use supercomputing to speed up drug discovery.

IRB Barcelona's portfolio of cutting-edge core facilites were enhanced this year with the expansion of the Mass Spectrometry and Proteomics Core Facility. The acquisition of a latest-generation Orbitrap Fusion Lumos firmly brings the facility into the era of high-throughput proteomics, allowing our researchers to advance their studies of diseases, pathways, targets and drugs effects.

In other collaborations, much groundwork was done to lay the foundation for the Barcelona Institute of Science and Technology, of which IRB Barcelona is a founding member. A number of initiatives were launched, including the first inter-institutional BIST postdoc day, and a BIST PhD fellowship programme.

Robust public engagement activities continued at IRB Barcelona with the Tandem collaboration with a nearby primary school, and the long-standing Crazy About Biomedicine flagship programme. Efforts to raise awareness of and funding for biomedical research continued to gain momentum. We launched the "Future" campaign, which raised funds leading to the creation of a special fellowship to allow a PhD student to begin his or her career at the Institute.

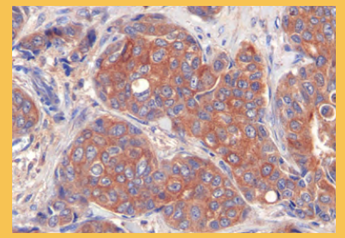
Finally, alumni activities of nearly 900 former researchers and staff continued to thrive. In September we were pleased to award the first IRB Barcelona Alumni of Excellence Award in 2016 to former PhD student David Vilchez, currently a Group Leader at the CECAD in Cologne, Germany.

These remarkable achievements are only made possible by the close collaboration of the entire IRB Barcelona community of talented scientists and specialists who work together to make these advances possible. We look forward to building upon these successes.

For more information about the scientific activities and events that marked 2016 at IRB Barcelona, consult our full annual report: www.irbbarcelona.org/annualreport2016.

Joan J. Guinovart
IRB Barcelona Director

Discoveries in 2016

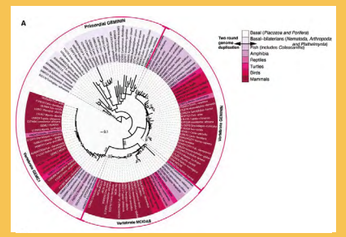


Cancer & metastasis

2016 was marked by two high-impact papers in cancer research. ICREA Research Professor Salvador Aznar-Benitah has identified the cells responsible for promoting metastasis in several types of human tumours. The protein CD36, which absorbs fat from the cell membrane, is essential in determining whether tumour cells become metastatic (*Nature*). ICREA Research Professor Roger Gomis' and UB Professor Joan J. Guinovart's groups have shown that breast cancer cells need to take up lipids from the extracellular environment in order to continue proliferating. They have reported that without the enzyme LIPG, found in the cell membrane, tumour cells stop growing (*Nature Communications*).

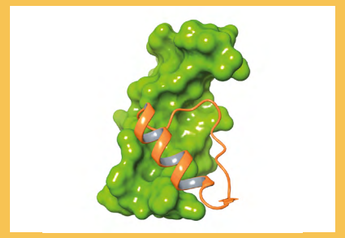
In silico

Bioinformatics brings to light opportunities to fight diseases. An *in silico* analysis of pairing 64 drugs used to treat breast cancer (half already in use and the other half in clinical testing) has allowed researchers at IRB Barcelona to identify ten new and previously untested combinations with the potential to tackle resistance to breast cancer treatment. When ICREA Research Professors Patrick Aloy and Angel Nebreda and their teams tested a combined raloxifene and cabozantinib treatment in mice, the tumour shrank by 60%, while the individual effect of each drug merely prevented further tumour growth (*Cancer Research*).



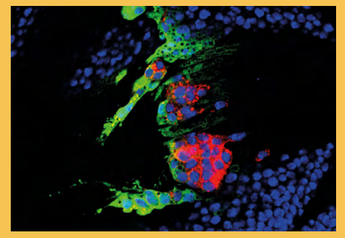
Rare diseases

Scientists at IRB Barcelona are working hard to identify new therapeutic strategies to treat rare diseases. Travis H. Stracker's lab has focussed on ciliopathies and studied GEMC1, a master gene for the generation of multiciliated cells (*The EMBO Journal*). ICREA Research Professor Xavier Salvatella has described a self-protective mechanism that involves the androgen receptor and is capable of delaying the effects of Kennedy's disease (*Biophysical Journal*). Finally, the US NIH has awarded an international consortium $8.5 million over five years to find a treatment for Lafora Disease. UB Professor Joan Guinovart's lab joins scientists from the US, Canada and Spain.



Chemical biology

The Epidermal Growth Factor (EGF) has received little attention as a therapeutic target so far. Molecules synthesized by the lab of UB Professor Ernest Giralt bind EGF to its receptor, an interaction that accelerates the metabolism of tumour cells (*ChemBioChem*). Natàlia Carulla and colleagues have described how to prepare a specific type of amyloid-β peptide (Aβ) aggregate, considered the pathogenic molecular form of Aβ in Alzheimer's disease, with the ability to perforate cell membranes (*Proceedings of the National Academy of Sciences*).



Drosophila melanogaster

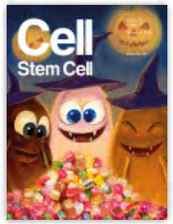
The fruit fly is a highly valued animal model at IRB Barcelona. ICREA Research Professors Marco Milán and Ángel Nebreda have explained details of the relationship between genomic instability, aneuploidy, and cancer (*Developmental Cell*). The team of CSIC Researcher Jordi Casanova has explained that the cells of an organism interact not only with each other but also with the extracellular matrix that surrounds them (*eLife)*. Scientists from this lab have also revealed that the combination of two molecular signals determines which differentiated cells regain their stem cell properties (*PLOS Genetics)*.

Basic research questions

A team of biologists led by ICREA Research Professor Lluís Ribas de Pouplana has proposed an explanation as to why the genetic code stopped growing 3 billion years ago: because of a limitation in the shape of transfer RNAs (*Science Advances*). ICREA Research Professor Raúl Méndez has provided one of the most detailed examples of the regulation of the dynamics of protein aggregates that behave like "droplets of oil in water." These aggregates comprise the protein CPEB4 during cell division (*eLife*). Finally, UB Professor Antonio Zorzano has discovered that Mitofusin 2 is required to preserve healthy muscles in mice (*EMBO Journal*).

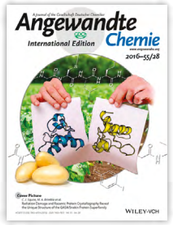
Selected 2016 Publications

Pascual G *et al*, Targeting metastasis-initiating cells through the fatty acid receptor CD36.
Nature, 541 (7635), 41-45 (2017)
Read the news story:
Tumour cells are dependent on fat to start metastasis



Rinaldi L *et al*, Dnmt3a and Dnmt3b associate with enhancers to regulate human epidermal stem cell homeostasis.
Cell Stem Cells, 19 (4), 491-501 (2016)
Read the news story:
Two proteins safeguard skin stem cells

Sebastián D *et al*, Mfn2 deficiency links age-related sarcopenia and impaired autophagy to activation of an adaptive mitophagy pathway.
EMBO J, 35 (15), 1667-1693 (2016
Read the news story:
The absence of a single protein spurs muscle aging in mice

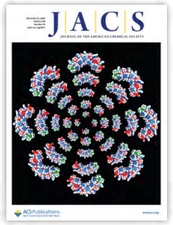


Oller-Salvia B et al, MiniAp-4: A venom-inspired peptidomimetic for brain delivery.
Angew Chem Int Edit, 55 (28), 7988 –7992 (2016)

Ivani I *et al*, Parmbsc1: a refined force field for DNA simulations.
Nat Methods, 13 (1), 55-8 (2016)
Read the news story:
IRB Barcelona develops an advanced method and the first platform of DNA simulations

Terré B *et al*, GEMC1 is a critical regulator of multiciliated cell differentiation.
EMBO J, 35 (9), 942-960 (2016)
Read the news story:
Discovery of a gene associated with a set of poorly understood rare diseases

Clemente-Ruiz M *et al*, Gene dosage imbalance contributes to chromosomal instability-induced tumorigenesis.
Dev Cell, 36 (3), 290-302 (2016)
Read the news story:
Scientists shed light on how cells with an incorrect number of chromosomes lead to tumour development



Darré L, *et al*, Small details matter: The 2'-hydroxyl as a conformational switch in RNA.
J Am Chem Soc, 138 (50), 16355-1636 (2016)

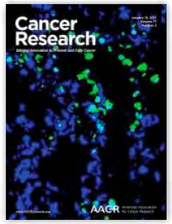
Mikolcevic P et al, Essential role of the Cdk2 activator RingoA in meiotic telomere tethering to the nuclear envelope.
Nat Commun, 7, 11084 (2016)
Read the news story:
Identification of a new protein essential for ovule and sperm formation

Sánchez Huertas C et al, Non-centrosomal nucleation mediated by augmin organizes microtubules in post-mitotic neurons and controls axonal microtubule polarity.
Nat Comm 7, 12187 (2016)
Read the news story: Researchers discover the machinery that neurons use to form and maintain their neuronal extensions

Serra-Batiste et al, Aβ42 assembles into specific β-barrel pore-forming oligomers in membrane-mimicking environments.
P Natl Acad Sci Usa, 113 (39), 10866-71 (2016)
Read the news story: New strategy to obtain a specific type of amyloid-beta aggregate that may underlie neuronal death in Alzheimer's disease

Slebe F et al, FoxA and LIPG endothelial lipase control the uptake of extracellular lipids for breast cancer growth.
Nat Comm 7, 11199 (2016)
Read the news story: Researchers discover that breast cancer tumour growth is dependent on lipid availability

Calderone V *et al*, Sequential Functions of CPEB1 and CPEB4 Regulate Pathologic Expression of Vascular Endothelial Growth Factor and Angiogenesis in Chronic Liver Disease.
Gastroenterology, 150 (4), 982-97.e30 (2016)
Read the news story:
Scientists in Barcelona discover a potential treatment for cirrhosis



Jaeger S et al, Quantification of Pathway Cross-talk Reveals Novel Synergistic Drug Combinations for Breast Cancer.
Cancer Res, 77 (2), 459-469 (2017)
Read the news story:
Bioinformatics brings to light new combinations of drugs to fight breast cancer

Read more about these discoveries on our news webpage: https://www.irbbarcelona.org/news/

Inspiring leaders of the future

ENABLE

From July 2016 until the end of 2020, four European cities, Barcelona (Spain), Copenhagen (Denmark), Nijmegen (the Netherlands) and Milan (Italy), will host in turn a yearly 3-day international symposium on biomedicine organised by and for young biomedical scientists. Entitled EuropeaN Academy for BiomedicaL SciencE (ENABLE), and coordinated by IRB Barcelona, this project received a grant of €500,000 through the Science with and for Society, "Celebrating European Science" section of the EU's Horizon 2020 Programme. The symposia will cover cutting-edge research, the promotion of career development in science, and science outreach activities for schools and the public at large.

Tandem

IRB Barcelona's spotlight public engagement initiative for 2016 was the Tandem Programme. Tandem Schools are innovative educational projects involving a partnership between a school and an institution. The two partners work together to design a school curriculum around a given theme and to boost academic results, the standing of the school, and social cohesion. Promoted by the Catalunya-La Pedrera Foundation, this is the first time this initiative has involved a research centre and a primary school, Escola Montserrat, in Cornellà (Barcelona). Throughout the year, young scientists at IRB Barcelona have provided training for teachers, many of whom lack specific instruction in science, inspired them to design hands-on science workshops and apply innovative teaching technologies.

Innovation

Nostrum

Computational simulation can significantly streamline the drug development process. IRB Barcelona and the Barcelona Supercomputing Center-National Supercomputing Center (BSC-CNS) has launched a new biotech company, Nostrum BioDiscovery, which applies computational simulation to help new drugs and biotech molecules reach the market. The creation of this spin-off was made possible in part thanks to the Bosch i Gimpera Foundation of the University of Barcelona and the Catalan Institute for Research and Advanced Studies (ICREA), and was driven by the Botín Foundation. The Technology Transfer Programme of the latter provides Modesto Orozco's group with support and assessment over five years and has commited €500,000 of start-up capital in the company through its Mind the Gap Programme.

Awards

Eduard Batlle
was awarded the Carmen and Severo Ochoa Prize and the Lilly Foundation Preclinical Research Prize.

Salvador Aznar Benitah
was awarded the VI National 'Doctores Diz Pintado' Cancer Research Prize.

Antonio Zorzano & Joan J. Guinovart
were awarded funding by La Marató de TV3 Foundation.

Joan J. Guinovart
was named *Doctor Honoris Causa* by the Andrés Bello National University (Chile).

Jelena Urosevic
was presented with funding from the Asociación Española Contra el Cáncer (AECC).

Macarena Sánchez & Meritxell Teixidó
The Catalan Reference Network in Biotechnology (XRB) chose their project "Gate2Brain" as one of the finalists in its "Can of ideas" Prize.

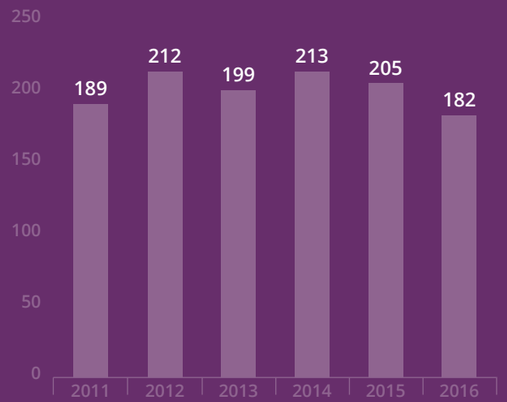
Facts & Figures 2016

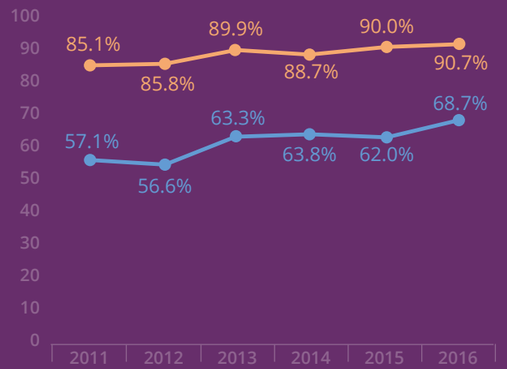
Publications

182
Publications

90.7%
Q1 Publications
SJR 2015

68.7%
D1 Publications
SJR 2015

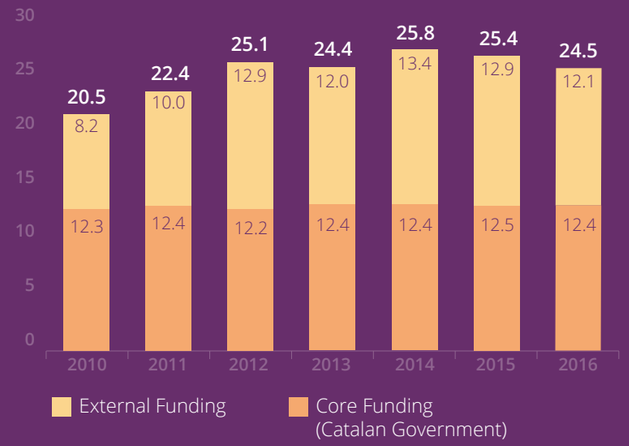




Publications Q1 D1

Funding

Running Budget 2010 - 2016

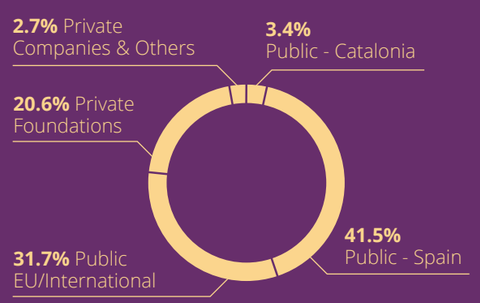


Number of Projects

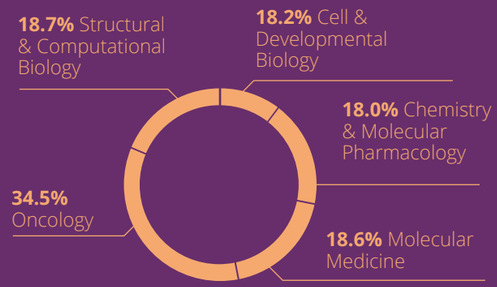
142

National and international research projects and networks

External Funding
by Source



External Funding
by Research Area



Staff

43.5% Men

56.5% Women

395 Total members

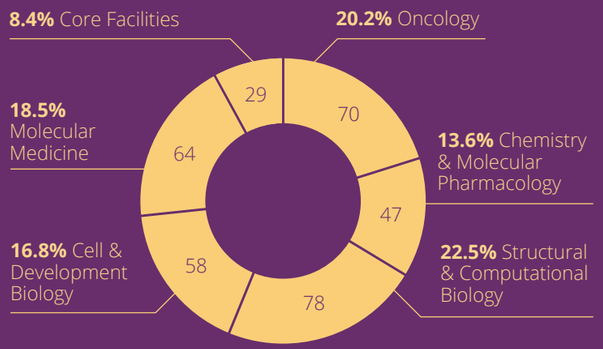
49 Administration

346 Scientific Staff

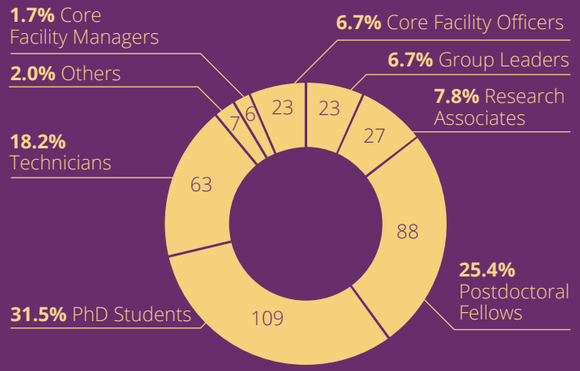
29 Core Facilities

317 Research Programmes

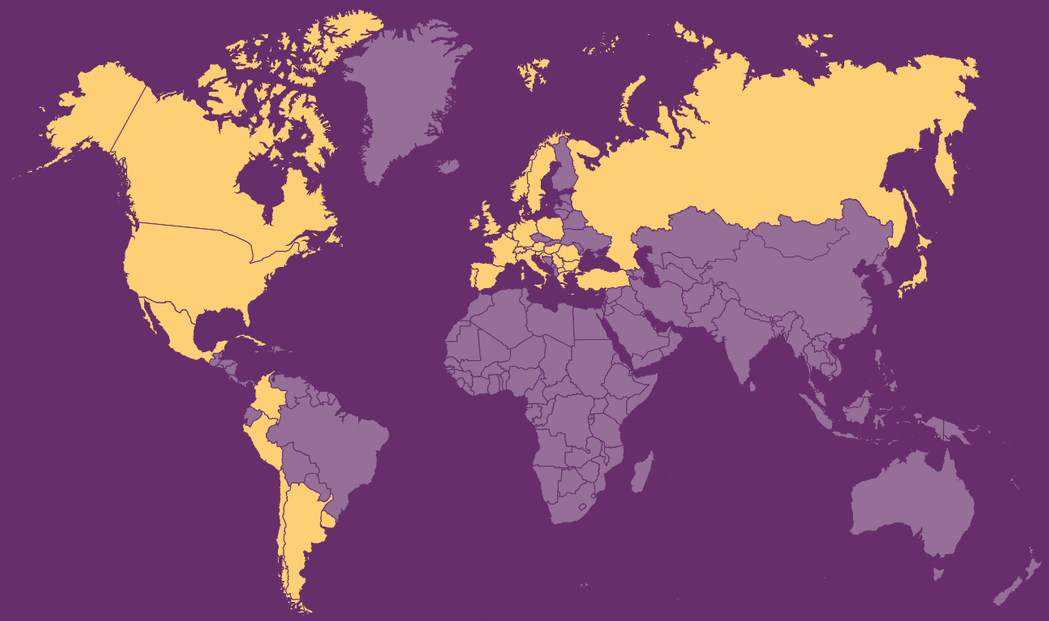
Scientific Staff
by Research Programmes



Scientific Staff
by Professional Category



International



34
Countries are represented at IRB Barcelona

31%
of PhD Students are from outside Spain

52%
of postdocs are from outside Spain

Innovation

15
New technologies identified and under evaluation

7
New patent applications and international patent extensions

15
Agreements with private entities

2
Patents awarded through CERCA's Gínjol Patent Fund

3
Group Leaders in the Botín Foundation's Technology Transfer Programme

1
Entrepreneur-in-Residence

Trainining and scientific events

21
PhD theses defended

10
Complementary training activities

3
Undergraduate training programmes

3
MDs in the PhD4MD Programme

127
Barcelona Biomed Seminars

+900
Researchers attended our scientific conferences

Public engagement and science education

1,135
Primary school students

1,053
Secondary school students

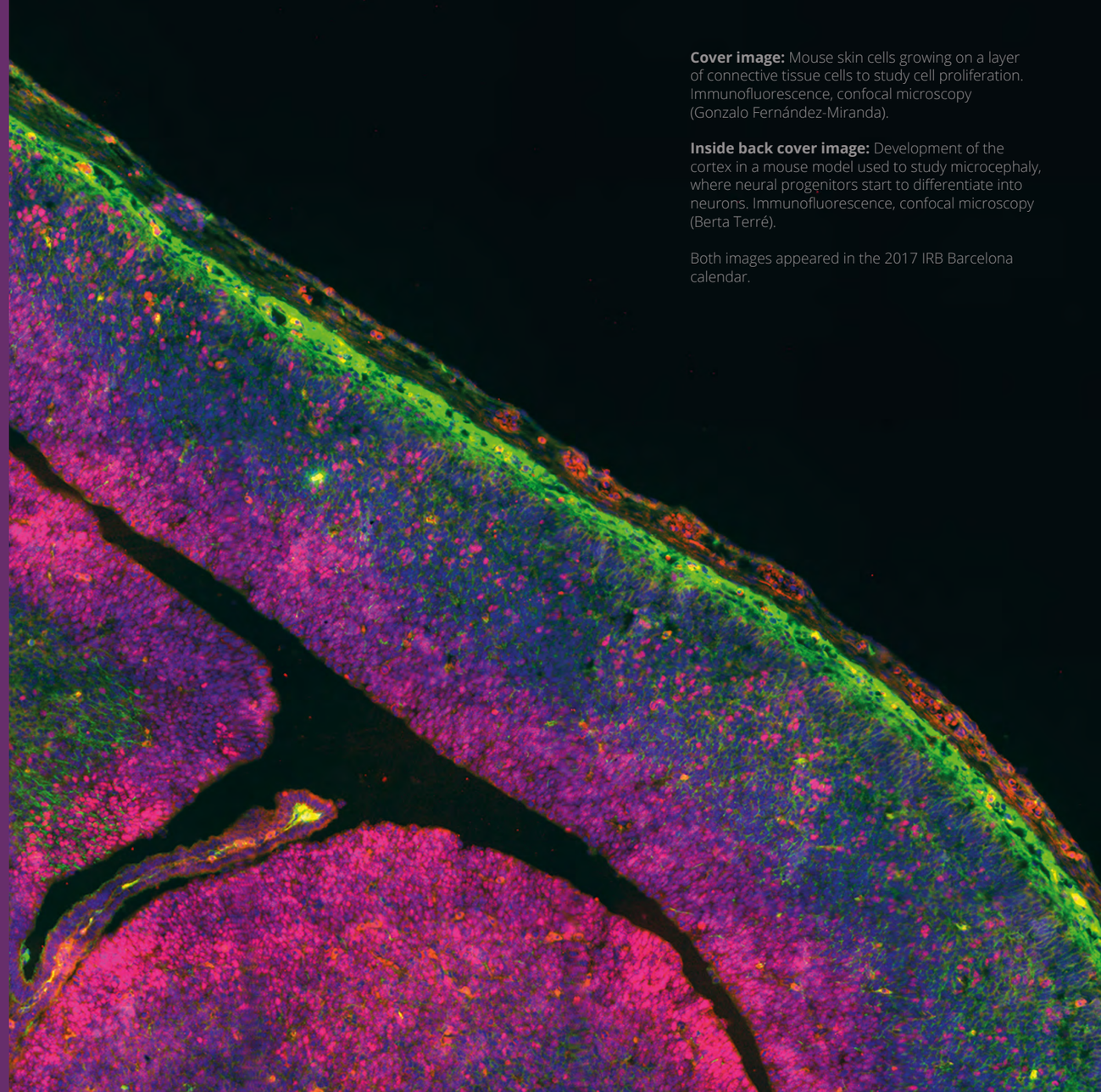
62
Teachers

447
Participants from the general public

Press

67
Press releases

1,772
Media mentions (Spain, digital media & press)



Cover image: Mouse skin cells growing on a layer of connective tissue cells to study cell proliferation. Immunofluorescence, confocal microscopy (Gonzalo Fernández-Miranda).

Inside back cover image: Development of the cortex in a mouse model used to study microcephaly, where neural progenitors start to differentiate into neurons. Immunofluorescence, confocal microscopy (Berta Terré).

Both images appeared in the 2017 IRB Barcelona calendar.

IRB BARCELONA

INSTITUTE FOR RESEARCH IN BIOMEDICINE

IRB Barcelona

Barcelona Science Park

Baldiri Reixac 10

08028 Barcelona, Spain

+34 934 02 02 50

info@irbbarcelona.org

www.irbbarcelona.org

irbbarcelona

irb-barcelona

IRBBarcelona

Photos

Office of Communications and External Relations, Gianluca Battista/Massimiliano Minocri

Design

www.niugrafic.com

Board of Trustees:

Generalitat de Catalunya

Universitat de Barcelona

Fundación BBVA

Location:

Parc Científic de Barcelona
Universitat de Barcelona

With the collaboration of:

Gobierno de España · Ministerio de Economía y Competitividad

European Union
European Regional Development Fund

Recognised with:

Excelencia Severo Ochoa

Narcís Monturiol Plaque

HR Excellence in Research