



IRB
BARCELONA

INSTITUTE
FOR RESEARCH
IN BIOMEDICINE

IRB BARCELONA

Celebrating a decade of discovery in the biomedical sciences





Joan J. Guinovart

IRB Barcelona Director

Today we celebrate 10 years since the founding of IRB Barcelona

Over the past decade, IRB Barcelona has grown from a seedling in the minds and hearts of a handful of visionary people with big dreams to a thriving research institute that has taken up solid footing on the landscape of international research in the life sciences, and made vital contributions to the health and well-being of society.

To mark this important milestone in IRB Barcelona's history, we have put together an exciting programme of science and celebration for you today. We are proud to gather our current researchers and staff whose dedication and talent is the root of all of IRB Barcelona's successes and achievements. We also extend a warm welcome to former researchers and staff who have come back to join us within the framework of the newly-established IRB Barcelona Alumni Network. We are especially pleased to have students who have taken part in the Crazy About Biomedicine mentoring programme, the future stars of biomedical research. We also welcome members of the extended IRB Barcelona community: our patrons, friends, sponsors and supporters.

Turning 10 provides us with a unique opportunity. It is a time to recognize and be thankful for the dedication and vision of all those who contributed to establishing IRB Barcelona in its early days, and those who have contributed to helping it to grow along the way. It is a time to celebrate the research we have accomplished and successes we have achieved. It is also a time to remember and reflect on the lessons we have learned over the years, and to ensure that we take those forward to help us shape an even brighter future for the institute.

We encourage you to take full advantage of the day's programme: the morning session is designed to include talks by leading scientists working at the forefront of areas related to IRB Barcelona research, including some of our own former scientists. The afternoon session offers plenty of opportunity for celebration with lively discussions and debates on science-related themes, as well as a few surprises.

Most of all, we encourage you to use today as an opportunity to step out of your lab or office and reconnect with your colleagues past and present, make new friends, and to celebrate 10 years of IRB Barcelona together.

Happy Birthday IRB Barcelona. Per molts anys!

Programme

8.45 Welcome

Joan J. Guinovart, IRB Barcelona Director

Joan Massagué, President of IRB Barcelona External Advisory Board

Session I*

Chair: **Maria Freire**

9.00 **Hans Clevers** (Hubrecht Institute, NL)

Lgr5 stem cells and organoids

9.45 **Wei Yang** (NIDDK, NIH, Bethesda, MD, USA)

Structural exploration of biological processes:

From a chemical bond formation to antibody generation

10.30 Alumni talk I

David Vilchez (CECAD, Univ. Cologne, D)

Proteostasis of aging and stem cells

11.00 Coffee break and networking**

11.30 **Maria Leptin** (EMBL/EMBO, Heidelberg, D)

Cell shape and morphogenesis: sub cellular and supracellular mechanisms

12.15 **François Diederich** (ETH Zürich, CH)

Molecular recognition in biological and chemical systems: a multi-dimensional approach

13.00 Alumni talk II

Jens Januschke (Univ. Dundee, UK)

Asymmetric mRNA localization during stem cell division

13.30 Presentation of the IRB Barcelona Alumni Network

14.00 Lunch

*morning session is sponsored by Eppendorf

**coffee break is sponsored by Bruker

Session II

15.30 IRB Barcelona@10: successes and milestones

Opening remarks by **Boi Ruiz**, **Andreu Mas-Colell**, and **Didac Ramírez** President and Vice Presidents of IRB Barcelona's Board of Trustees

16.30 Growing European Biomedical Sciences

Moderated by: **Joan Massagué**

Maria Freire President of the Foundation for the National Institutes of Health (Bethesda, MD, US)

Maria Leptin Director, EMBO (Heidelberg, D)

Andreu Mas-Colell Minister of Economy and Knowledge, Government of Catalonia (Barcelona, E)

Israel Ruiz Executive VP and Treasurer, Massachusetts Institute of Technology (Cambridge, MA, US)

18.00 Coffee break and networking



Cutting of the IRB Barcelona birthday cake, crafted by Oriol Balaguer

18.30 Creativity and Innovation

Moderated by: **Antoni Bassas** Journalist, ARA

Joan Massagué Director, Sloan Kettering Institute (New York, NY, US)

Ferran Adrià Chef and Founder of elBullifoundation (Roses, E)

Toni Segarra Founder and Creative Director, SCPF (Barcelona, E)

20.00 Wine and cheese reception



Presentation of Vi per Vida first vintage by Xavier Ayala

Session I

Chair: **Maria Freire**



Hans Clevers Hubrecht Institute, NL
Lgr5 stem cells and organoids

The intestinal epithelium is the most rapidly self-renewing tissue in adult mammals. We originally defined Lgr5 as a Wnt target gene, transcribed in colon cancer cells. Two knock-in alleles revealed exclusive expression of Lgr5 in cycling, columnar cells at the crypt base. Using lineage tracing experiments in adult mice, we found that these Lgr5+ve crypt base columnar cells (CBC) generated all epithelial lineages throughout life, implying that they represent the stem cell of the small intestine and colon. Lgr5 was subsequently found to represent an exquisitely specific and almost 'generic'

marker for stem cells, including in hair follicles, kidney, liver, mammary gland, inner ear tongue and stomach epithelium.

Single sorted Lgr5+ve stem cells can initiate ever-expanding crypt-villus organoids, or so called 'mini-guts' in 3D culture. The technology is based on the observation that Lgr5 is the receptor for a potent stem cell growth factor, R-spondin. Similar 3D cultures systems have been developed for the Lgr5+ve stem cells of stomach, liver, pancreas and kidney.



Wei Yang NIDDK, NIH, Bethesda, MD, USA
**Structural exploration of biological processes:
From a chemical bond formation to antibody generation**

Structural analysis has played an essential role in mechanistic understanding of biology. In this presentation, I will show examples of using X-ray crystallography to elucidate mechanism of macromolecular assemblies and enzyme catalysis. The catalytic RAG1-RAG2 complex cleaves DNA at specific sites to initiate V(D)J recombination, which is essential for lymphocyte maturation and generation of a highly diverse population of immunoglobulins and T cell receptors. We have determined the atomic resolution struc-

ture of RAG1-RAG2 complex and used the structure to rationalize more than 60 mutations identified in immunodeficient patients. For decades, intermediates and transition state of chemical reactions catalyzed by enzymes escaped structural determination and remained unknown. Using *in crystallo* catalysis and time-lapse X-ray crystallography, we have captured transient reaction intermediates and determined the catalytic coordinates of phosphoryltransfer reactions.



David Vilchez CECAD, Univ. Cologne, D

Proteostasis of aging and stem cells

While it has long been noted that genome stability is a central function required for survival of stem cells, the role of proteostasis has not been explored. With the asymmetric divisions invoked by stem cells, the passage of damaged proteins to daughter cells can destroy the resulting lineage of cells and possibly accelerate the aging process. Furthermore, the possible retention of damaged proteins by the stem cell can result in diminished stem cell function and possibly premature aging. Therefore, a firm understanding of how stem cells maintain their proteostasis is of central importance. Because experiments with mammalian embryonic stem cells have clearly demonstrated their capacity to replicate continuously in the absence of senescence, we hypothesize that these cells could provide a novel paradigm to study the regulation of proteostasis and its demise in aging. We have recently described that human embryonic stem cells (hESCs) exhibit high proteasome activity compared to their differentiated counterparts. This enhanced pro-

teasome activity is necessary for hESC function. Furthermore, we have uncovered that PSMD11/rpn-6, a key proteasomal subunit, is required for this activity and its mode of regulation and conservation in the aging process of the invertebrate *C. elegans*. Our findings established RPN-6 as a potent regulator of proteasome activity that alleviates the deleterious effects associated with aberrant protein aggregation, providing a powerful candidate to correct proteostatic deficiencies in disorders such as HD. Moreover, our results in *C. elegans* led us to find that FOXO4, a transcription factor associated with longevity, regulates proteasome activity in hESCs and is necessary for hESCs differentiation into neural cells. Therefore, our results established a novel regulation of proteostasis in hESCs that links longevity and stress resistance in invertebrates with hESC function and identity.



Maria Leptin EMBL/EMBO, Heidelberg, D

Cell shape and morphogenesis: sub cellular and supracellular mechanisms

Morphogenesis of an organism requires the development of its parts to be coordinated in time and space. Gastrulation in the *Drosophila* embryo begins with the embryo forming a ventral furrow, which is eventually internalized. It is not understood how the rest of the embryo responds or contributes to this process. We have used Multi-View SPIM microscopy together with infra-red laser manipulation and mutant analysis to dissect embryo-scale cell interactions during early gastrulation. We find that dorsal and lateral cells in the embryo differ in their apical actomyosin network and their behaviours. Lateral cells have a denser medial apical actom-

yosin network and shift ventrally as a compact cohort, while dorsal cells become stretched. We show that the behaviour of these cells affects the internalisation of the ventral furrow. A computational model based on the experimental results predicts different relative cortical tensions associated with tissue behaviour in different populations along the dorso-ventral axis: lateral cells are stiff, while dorsal cells are soft. Experimental analysis confirms that these conditions pertain *in vivo*.



François Diederich Swiss Federal Institute of Technology, ETH Zürich, Switzerland **Molecular recognition in chemical and biological systems: a multi-dimensional approach**

We pursue a multi-dimensional approach towards deciphering and quantifying weak intermolecular interactions in chemical and biological systems. Experimental study in this research involves the investigation of protein-ligand interactions, synthetic host-guest complexation, and dynamic processes in designed unimolecular model systems, such as molecular torsional balances. It is complemented by computational analysis and exhaustive data base mining in the Cambridge Crystallographic Database (CSD) and the Protein Data Bank (PDB). Examples of intermolecular interactions quantified by this approach are orthogonal dipolar interactions, organofluorine interactions, stacking on peptide bonds, and halogen bonding. We also investigate the energetics of the replacement of conserved water molecules in protein co-crystal structures by ligand parts. This multi-dimensional approach is illustrated

in examples taken from a variety of structure-based drug design projects. Lessons learned are directly applicable to ligand design and optimization in drug discovery and crop protection research, but equally to the assembly of synthetic supramolecular systems. Specific examples will include the replacement of water clusters in protein-ligand complexes of tRNA-guanine transglycosylase (TGT), a target against bacterial *shigellosis dysenteriae*. It is shown for protein kinase A (PKA), how the glycine-rich loop at the ATP binding site can be favorably addressed by establishing an intense cooperative interaction network. Ligand development against novel targets for antimalarials is illustrated for serine hydroxymethyl transferase (SHMT), a key enzyme from the folate cycle for which ligands had surprisingly not been reported previously.



Jens Januschke School of Life Sciences, University of Dundee, Dundee, UK **Asymmetric mRNA localization during stem cell division**

A central question of developmental biology is how cells become different to each other. This is important as it generates the cellular diversity of multicellular organisms. One way this can be achieved is through asymmetric cell division where one cell divides to generate two cells that are different from each other. Stem cells can divide asymmetrically. We use developmental stem cells of the *Drosophila* central nervous system to study how cell polarity and asymmetric division are linked. In this system a number of evolutionary conserved proteins localize asymmetrically during mitosis and drive spindle orientation and cell fate generation. We are interested in exploring how cell fate information is stored during consecutive cell cycles, when the cell undergoes dramatic changes in subcellular patterning. One hypothesis that we are testing is

that cellular asymmetry visible at the protein level is pre-patterned by the asymmetric localization of messenger RNAs coding for the proteins involved in asymmetric cell division. Using single molecule FISH in fixed samples and following mRNAs in living stem cells, we found one mRNA that is asymmetrically localized on the mitotic spindle, where it is always associated with the spindle pole that remains in the stem cell. We are currently identifying the molecular mechanism responsible for asymmetric spindle association and probe into the functional relevance of mRNA localisation, by specifically mis-targeting the mRNA to ectopic places within the cell and monitoring potential consequences on asymmetric cell division and lineage specification.

Session II

Opening remarks

IRB Barcelona@10:
successes
and milestones



Boi Ruiz i Garcia
Minister of Health,
Government of Catalonia



Andreu Mas-Colell
Minister of Economy
and Knowledge, Government
of Catalonia



Didac Ram  rez
Rector of University
of Barcelona

Round table discussion

Growing
European Biomedical
Sciences



Maria Freire
President of the Foundation
for the National Institutes
of Health (Bethesda, MD, US)



Maria Leptin
Director
EMBO (Heidelberg, D)



Andreu Mas-Colell
Minister of Economy and
Knowledge, Government
of Catalonia



Israel Ruiz
Executive VP and Treasurer,
Massachusetts Institute of
Technology (Cambridge, MA, US)



Joan Massagu  
Director,
Sloan Kettering Institute
(New York, NY, US)

Round table discussion

Creativity and
Innovation



Joan Massagu  
Director,
Sloan Kettering Institute
(New York, NY, US)



Ferran Adri  
Chef and founder of
elBullifoundation (Roses, E)

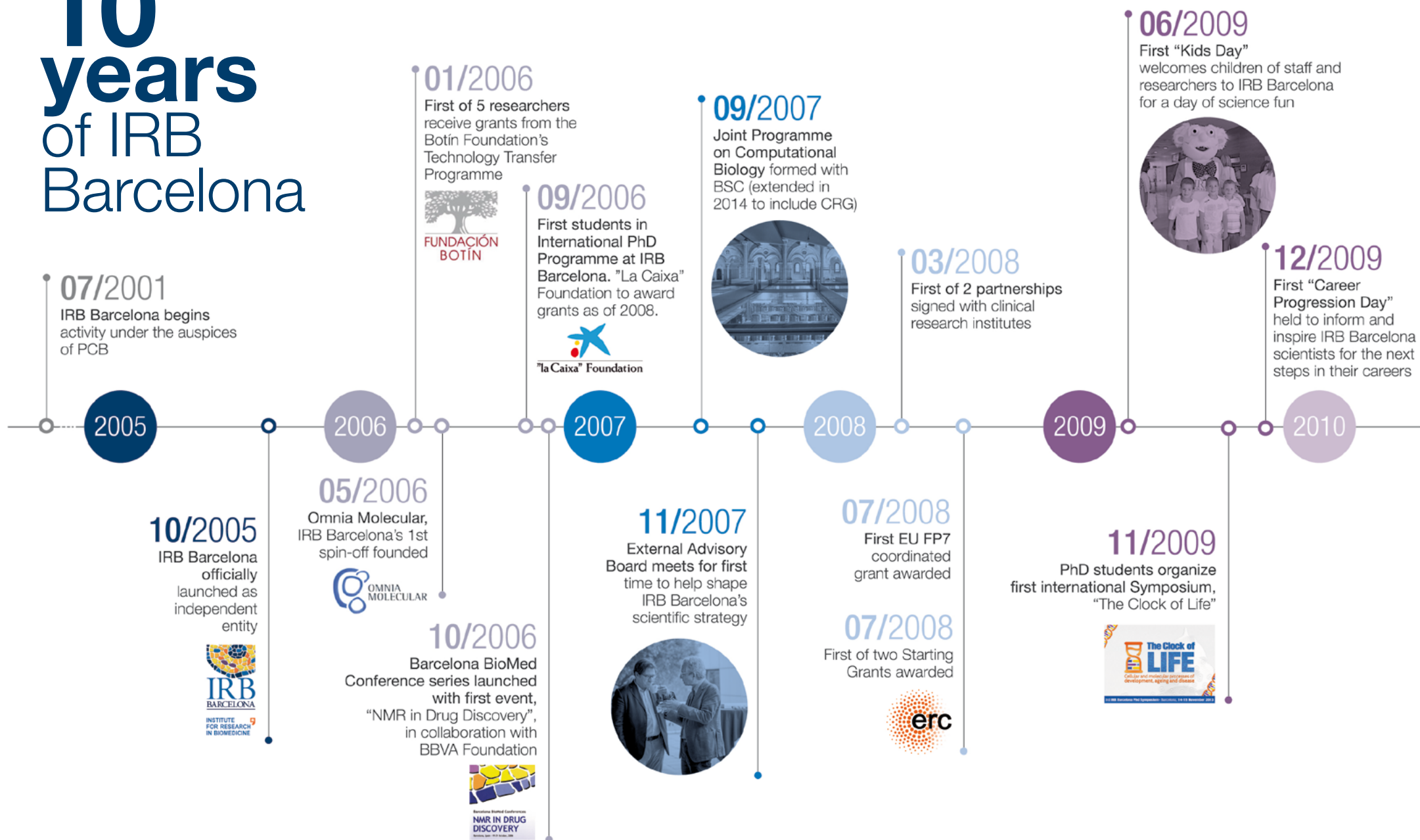


Toni Segarra
Founder and
Creative Director, SCPF
(Barcelona, E)



Antoni Bassas
Journalist, ARA
(Barcelona, E)

10 years of IRB Barcelona



12/2010

First EU COFUND programme launched to provide grants to attract postdoctoral researchers to IRB Barcelona



06/2011

iProteos, IRB Barcelona's 2nd spin-off company launched



iproteos

09/2011

IRB Barcelona awarded first-round Severo Ochoa Award of Excellence



EXCELENCIA SEVERO OCHOA

07/2012

Narcís Monturiol Plaque awarded to IRB Barcelona



09/2012

First of 5 partnerships with international research organizations signed

10/2013

International tech transfer and innovation experts convene for first Business Advisory Board meeting



12/2014

BBVA Foundation and renowned academics join the Catalan Government and the University of Barcelona on IRB Barcelona's Board of Trustees

Fundación BBVA

12/2014

EC awards HR Excellence in Research recognition



HR EXCELLENCE IN RESEARCH

07/2015

IRB Barcelona joins 5 Catalan research institutes to form Barcelona Institute of Science and Technology

07/2015

IRB Barcelona International Alumni Network launched

2011

2012

2013

2014

2015

07/2011

Inbiomotion, IRB Barcelona's 3rd spin-off company begins operations



03/2012

First of four Advanced Grants awarded



erc

01/2013

24 high-school students join first Crazy About Biomedicine programme, organized in collaboration with the Catalunya-La Pedrera Foundation

Fundació Catalunya - La Pedrera



03/2014

First of two Consolidator Grants awarded



10/2014

IRB Barcelona researchers make global impact with their awareness and fundraising viral video



02/2015

First of 2 Proof of Concept Grants awarded



erc

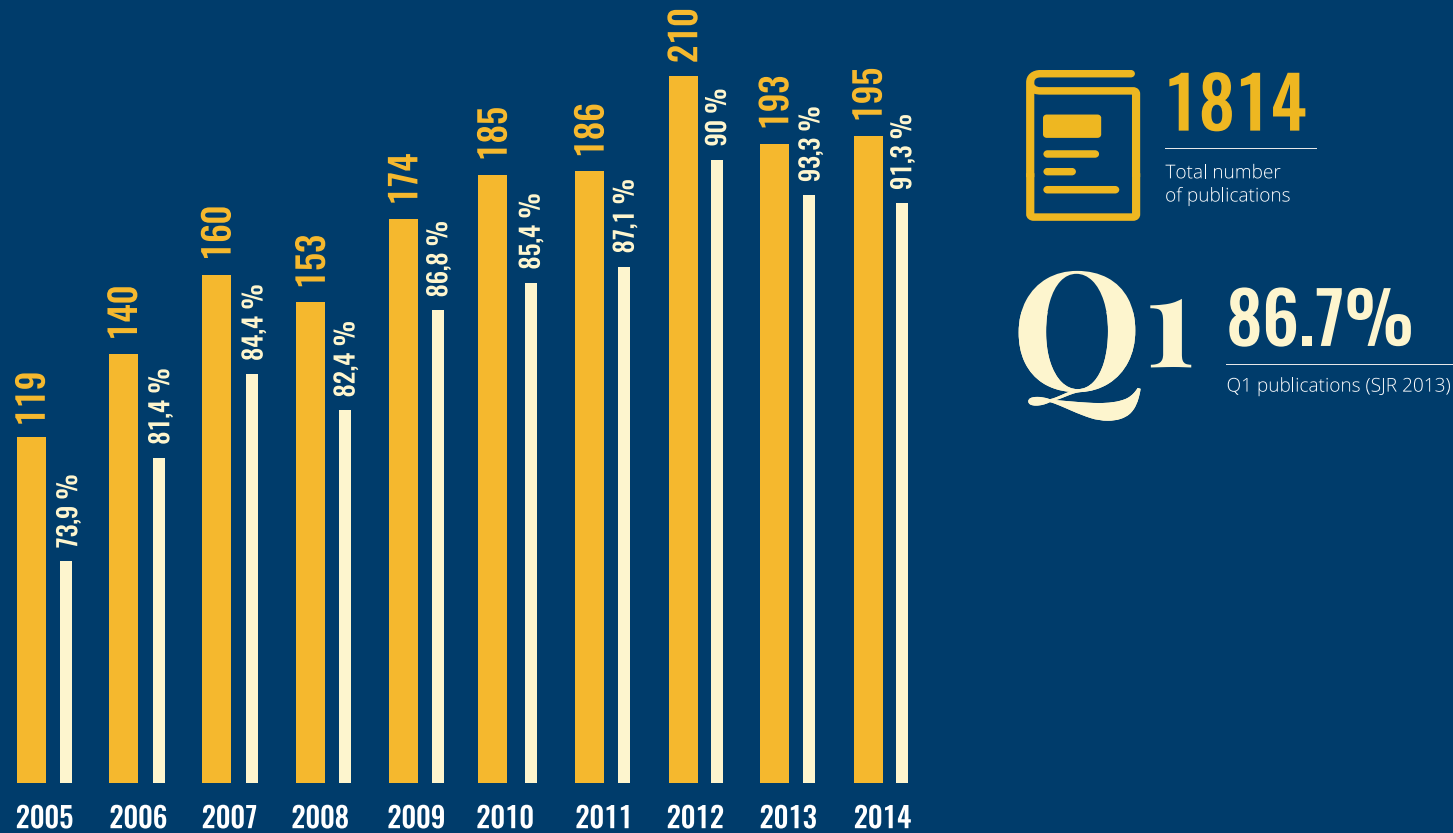


10/2015

IRB Barcelona celebrates 10 years of discovery in the biomedical sciences

10 years of IRB Barcelona at a glance

Scientific Publications



Source: Scopus (2005-2015) and Scimago Journal Rank (SJR 2013).

Who we are and where we come from (2005-2015)



59 Countries

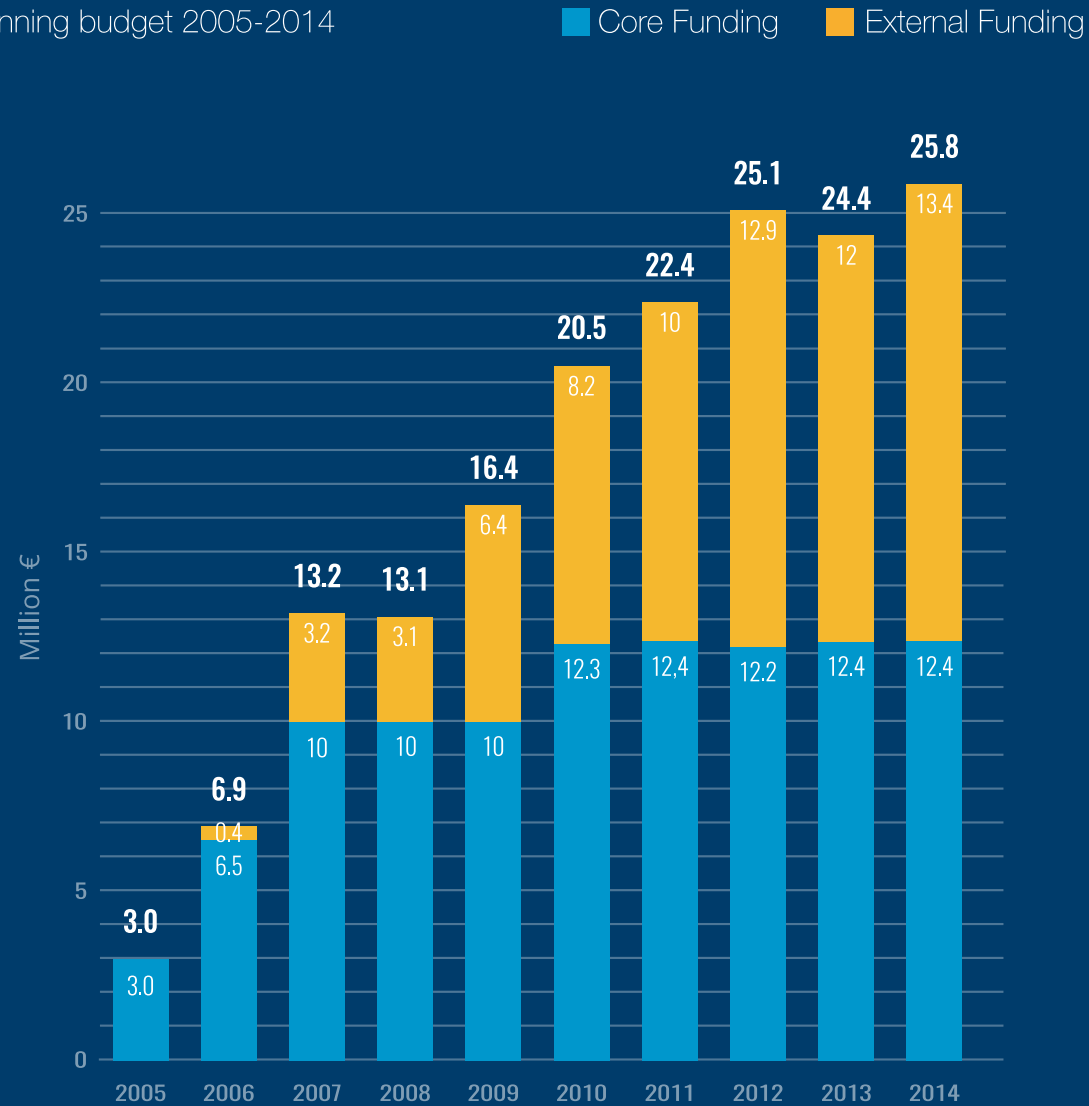
Represented at IRB Barcelona

Algeria	Finland	Norway
Andorra	France	Palestine
Argentina	Germany	Peru
Australia	Greece	Poland
Austria	Guatemala	Portugal
Belarus	Hungary	Romania
Belgium	Iceland	Russia
Brazil	India	Saint Helena
Bulgaria	Iran	Serbia
Canada	Ireland	Slovenia
Chile	Israel	Spain
China	Italy	Switzerland
Colombia	Japan	Tunisia
Croatia	Latvia	Turkey
Cuba	Macedonia	Ukraine
Czech Republic	Malta	United Kingdom
Denmark	Mexico	United States
Ecuador	Morocco	Uruguay
Estonia	Netherlands	Venezuela
Ethiopia	New Zealand	



Funding

Running budget 2005-2014



Innovation

3

Spin-offs

More than
60

Technologies
identified

More than
30

Patent
applications

8

Technology
licensed

More than
100

Collaboration
agreements with
companies and
other partners

Projects

387

Total number of projects



18

Granted by private foundations

59

Granted by the European Union

10

Number of ERC grants

Training

261

Total PhD theses defended

24

Workshops

26

More than
3500
participants

Barcelona BioMed Conferences

1285

Seminars

Public engagement

Primary schools
More than

300

Number of visits to IRB Barcelona from school students

High schools
More than

150

6

Number of teachers workshops

72

Number of high school students trained through CAB programme

1

Open House Day

Around

3500

Total estimated number of people reached through our activities per year (fairs, open days, visits, etc)

Alumni



734

Total Alumni

Anyone who has spent more than 6 months at IRB Barcelona



38

Different nationalities



246

PhD students

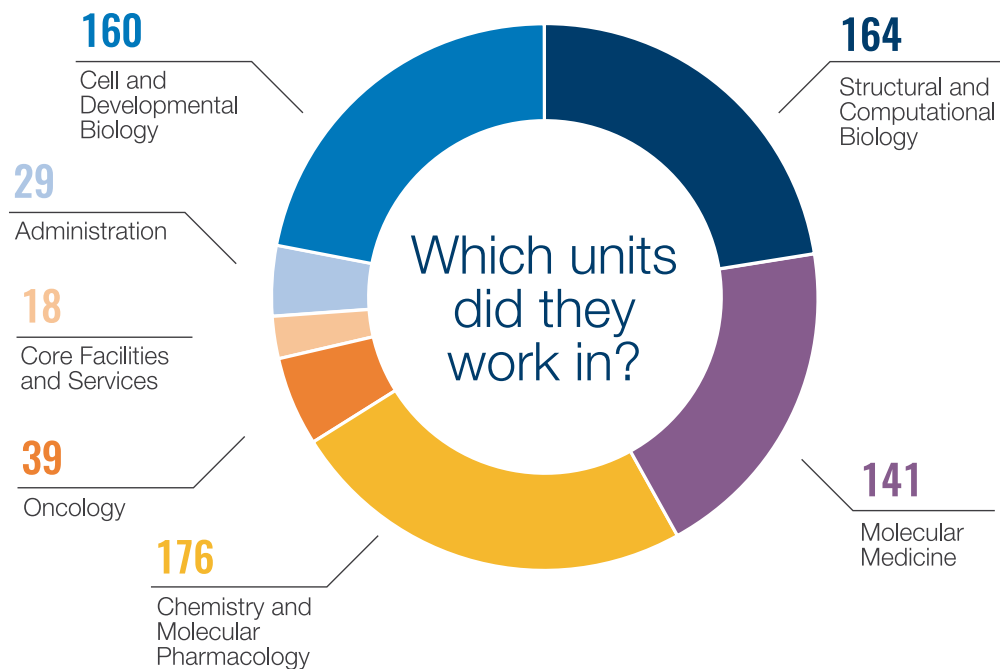
174

Postdocs

35

Research associates

Top 3 positions alumni held at IRB Barcelona



Life after IRB Barcelona

Staying connected through the Alumni network

IRB Barcelona is excited to announce the launch of the IRB Barcelona Alumni Network, a platform that aims to connect current and former IRB Barcelona research and support staff and provide them with a solid and lasting framework in support of their science and scientific careers. Since IRB Barcelona was officially founded in 2005, nearly 800 scientists, students, technical and support staff have passed through our doors. Many have gone on to take the next important and exciting steps in their scientific careers in leading academic institutes and industries across the world. Anyone who has spent at least six months at IRB Barcelona is eligible to join.

Alumni Directory

The Alumni Directory provides a easy and centralized way to find out what your peers are up to now, and to connect with them. Join the network to access this valuable resource.

IRB Barcelona Alumni of Excellence Awards

This award recognizes outstanding contributions to science and the scientific community made by young researchers who have completed a significant part of their training and careers at IRB Barcelona. Former PhD students or postdoctoral fellows are eligible to apply. The deadline for applications is 2 December, 2015. Apply or nominate someone you know.

Priority access to the Barcelona BioMed series of conferences, courses and workshops

A number of spaces in IRB Barcelona's wide range of training activities will be reserved for IRB Barcelona alumni, at no cost. Take advantage of this valuable offer to increase your skills, knowledge and networks.

Register today!

<https://www.irbbarcelona.org/en/alumni>

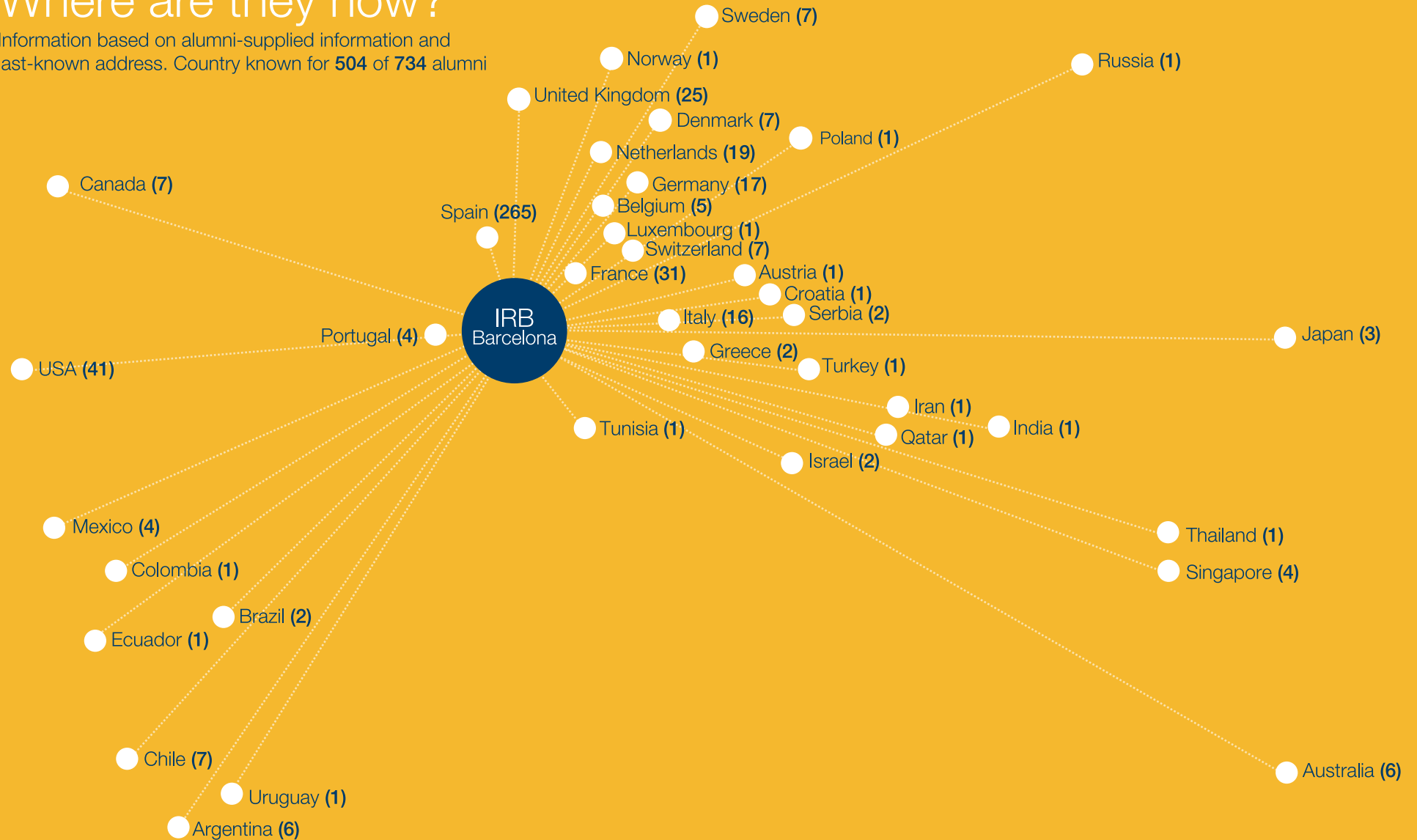
And don't forget to join us on LinkedIn:

<https://www.linkedin.com/company/irb-barcelona>

Alumni

Where are they now?

Information based on alumni-supplied information and last-known address. Country known for **504** of **734** alumni





Celebrating a decade of discovery in the biomedical sciences

Credits

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Photos

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Gianluca Battista/Massimiliano Minocri

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Niugràfic

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RECOGNISED AS:



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PLAQUE RECIPIENT





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MADE OF
GENES
All genomics.
All yours.