IRB Barcelona celebrates 10 years of discoveries in the life sciences

2015 is a momentous year for IRB Barcelona, a year in which we will celebrate our 10th anniversary. In October 2005, the Government of Catalonia, the University of Barcelona and the Barcelona Science Park officially founded IRB Barcelona with the goal of creating an innovative research centre.

Ten years on, it is a time to reflect on the achievements we have made, but also to look forward to the role that IRB Barcelona will play in future biomedical research. We are planning various events to celebrate this milestone, including a year-long series of public lectures, an open house in April and a scientific event on 26 October.

Have we succeeded in becoming a reference in Spain and Europe, with our recipe that merges chemistry, computational and developmental biology, oncology, and medicine? To date, more than 1,200 talented international researchers have thrived in our labs. They have published more than 1,500 papers, and they have obtained important recognitions: their research brought us 9 ERC grants, and 16 ICREA positions, the Catalan Institution for Advanced Research.

Our scientists’ breakthroughs include discoveries in the role of stem cells in cancer and the molecular mechanisms that allow cancer to spread, the design of bioactive molecules such as peptide shuttles as potential drug vectors, the biocomputational modelling of systems, and the use of Drosophila as a model for diseases, such as cancer.

[Continued on page 2].

The ‘Crazies’ are back

Twenty-four teenagers are ready to begin a new ‘crazy’ adventure at IRB Barcelona. For the third year in a row, in collaboration with the Fundació Catalunya-La Pedrera, the Institute hosts ‘Crazy About Biomedicine,’ a pioneering initiative that will bring high school students into the lab for 18 Saturdays in 2015.

Read more on page 6.

Fishing the databases for chemical fragments

Researchers at IRB Barcelona have devised a predictive model that allows them to determine whether a chemical fragment can contribute to—or protect from—a certain disease. Published in Nature Communications, the study may have applications for the design of safer drugs, the detection of co-morbidity, and the extension of current drug uses.

The study has involved the analysis of 10,000 chemical molecules. Together, they amount to 98,077 fragments, associated with 1,176 diseases, a sample representative of all human diseases.

Sònia Armengou reports on page 4.
IRB Barcelona scientists have led ambitious European projects, such as the Mephitis (on protein synthesis in Plasmodium), the Mitin (on the interplay between the signaling pathway and mitochondrial function) and, more recently, have joined strategic networks such as the ELIXIR programme (a European infrastructure for life-science information, see below).

We aspire to turn our findings into applications with real benefit for society. Over the years, IRB Barcelona has seen the birth of 3 spin-off companies, has evaluated more than 70 research results for potential development, has filed more than 25 patent applications and negotiated more than 100 collaboration agreements with companies and other partners, and licensed 8 technologies.

In 2011, IRB Barcelona was one of only eight centres in Spain to obtain the first round of Severo Ochoa seals of research excellence. In 2012, it received the Narcís Monturiol Plaque from the Catalan Government. Furthermore, in 2014, the European Commission awarded the Institute with the Human Resources Excellence in Research seal.

Over the years, IRB Barcelona has made significant efforts to train and inspire the next generation of scientists. We have educated around 300 PhD students and hosted more than 280 postdoctoral fellows, more than half of whom come from abroad. Training starts early here: through programmes such as Crazy About Biomedicine we help brilliant high school students get started on a future career in science.

IRB Barcelona’s output isn’t limited to scientific articles and patents. Our highly trained scientists also make valuable contributions to science in labs across the world. We now have more than 800 alumni spreading the “IRB Barcelona spirit” in institutes worldwide. This same spirit we try to convey daily to society through our pioneering communication and public engagement activities, dance videos included.

We may be ten years older, but we are as ambitious as we were in 2005. We are committed to becoming an international reference in the research on the molecular basis of diseases, able to design molecules capable of becoming therapeutic agents. In this sense, chemistry and biocomputation are powerful tools in their interaction with more traditional fields of biomedical research. Our success depends on the hard work of our scientists and staff, and we also need the continuous support of society. The medicine of the future does indeed start here, and we look forward to continuing to work together to make it happen.

A Spanish node for ELIXIR

Spain is set become a full member of ELIXIR, the European bioinformatics infrastructure created to optimise biological data obtained from life sciences research. Spain is participating in ELIXIR through the National Bioinformatics Institute, a platform of the National Institute of Health Carlos III, whose central node is hosted at the Spanish National Cancer Research Centre. Six institutions are participating in the ELIXIR network, including IRB Barcelona.

ELIXIR coordinates the storage, access and development of the software needed to understand biological data. According to ELIXIR, “for the first time, we are creating an infrastructure – a kind of highway system – that integrates research data from all corners of Europe and ensures a seamless service provision that is easily accessible to all,” and which “will facilitate discoveries that benefit humankind.”

Excellence in Research seal awards good HR practices

In December the European Commission awarded IRB Barcelona the “HR Excellence in Research” seal in recognition of its commitment to continuously improve human resources practices. The seal is given in acknowledgement of fair and transparent recruitment and evaluation procedures for research staff, in accordance with the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers.

One of the advantages of this recognition is that it facilitates visibility and public recognition of research institutes committed to the principles of the Human Resources Strategy for Researchers (HRS4R).

Preparing for the award process has taken two years, involving different actions, such as internal and external analysis and evaluation of HR policies and practices. “The key point for success,” says Olalla Bagüés, who coordinated the process from the HR department, “has been the entire team’s belief, dedication and commitment to the project.”

In two years’ time, IRB Barcelona will face an internal evaluation of the progress made on the strategic action plan, and every four years it will be subject to an external evaluation.
The importance of the “chemical factor”

The effect of a substance on our health can be predicted on the basis of its chemical structure. This hypothesis was the starting point of a study published in December in *Nature Communications* by IRB Barcelona’s network biology scientists Patrick Aloy, ICREA Research Professor, and PhD student Miquel Duran.

The researchers exploited the databases that hold information on thousands of molecules—including drugs, natural substances, and chemical agents found in the environment—that are associated with diseases, either because they have adverse effects or exert a therapeutic action.

By analysing 98,077 fragments associated with 1,176 diseases—these representative of all human pathologies, they have been able to offer a chemo-centric view of human health and disease. “We have enough information on chemical structures to reasonably predict their effects in 20% of human diseases”, states Miquel Duran, “and this percentage will continue to grow as data collection continues.”

The study allowed the information accumulated to be re-examined and reorganised to produce 20% of new knowledge thanks to the exploitation of computerised data. “The data on chemical structures, which on many occasions and above all in the field of molecular biology is not taken into account, can be most useful for biomedicine,” says Patrick Aloy.

The study allows access to valuable information that can serve to identify those chemical fragments to be omitted or included in drug design. The researchers also indicate that their model may serve to detect associations between two diseases, the so-called co-morbidity—meaning one leads to the development of the other—or inverse co-morbidity—that one protects against the development of the other. Finally, it may also reveal potential new uses of current drugs.

Ambulance for the brain

Many neuronal disorders cannot be treated because of a natural barrier—the so-called blood-brain barrier (BBB)—that tightly controls the passage of molecules into the brain. In fact, 98% of potential neurotherapeutics are discarded because they are unable to reach the right target. The solution to surpass this obstacle may now be a bit closer. In January’s advanced edition of *Angewandte Chemie*, chemists at IRB Barcelona presented a promising BBB shuttle that is able to transport various kinds of substances across the BBB in vitro and in vivo. This is the first shuttle based on peptide chemistry that is protease-resistant—a property that ensures that the shuttle remains in the blood for 12-24 hours. The advantages of this BBB shuttle are so unique that Meritxell Teixidó, Ernest Giralt, and Roger Prades have patented its use to assure future development. They are already working with clinical teams to test it for three fatal orphan diseases: glioblastoma, a type of pediatric brain cancer, and a rare neurodegenerative disease called Friedreich’s Ataxia. “These projects are highly motivating because the diseases are interesting themselves and because we need to adapt our shuttle to very different cargoes. This work will bring about new knowledge of the potential use of peptides as delivery systems,” states Teixidó.

Natural product analogues against malaria

A team led by Group Leader and ICREA Researcher Professor Lluís Ribas reported on a new family of molecules to combat *Plasmodium*, the parasite that causes malaria. They described two derivatives of borrelidin that completely remove the parasite load from mice and confer immunological memory to fight future infections, a feature not achieved previously in an antimalarial drug. The results were published in December in the journal *Proceedings of the National Academy of Sciences* (PNAS).

Light-controlled drugs on the way

Researchers from IBEC, IRB Barcelona and the UB have used light-regulated molecules to control clathrin-mediated endocytosis, a process whereby cells absorb certain substances. In doing so, they’ve made a discovery that greatly expands the field of potential inhibitors, and calls into question the need for previously supposed design requisites of these molecules. Their results appear in the latest issue of *Chemistry & Biology* and “are another step forward in a general approach to using light to control therapeutically-relevant intracellular protein-protein interactions,” says Group Leader Ernest Giralt.

A new Interactome map

Group Leader and ICREA Research Professor Patrick Aloy and Research Associate Roberto Mosca participated as structural biology and bioinformatics experts in an international research team that produced the largest-scale map to date of direct interactions between proteins encoded by the human genome, the so-called the Interactome. The results were published in *Cell* on 20 November.
Cell membrane proteins research on the verge of opening new therapeutic paths

Cell membranes were at the centre of the 25th edition of the Barcelona BioMed Conferences series, an event organised in collaboration with the BBVA Foundation that took place as is customary in the Institut d’Estudis Catalans (IEC) on 17-19 November.

About 5,000 human genes code for cell membranes proteins: this means that around a third of our genome is dedicated to these key structures in charge of transport, reception and transmission of signals, and channel opening to allow the passage and exchange of substances.

Group Leader Manuel Palacín is one of the few experts in Spain working on the atomic structure of these kinds of molecules. “The therapeutic potential of these proteins is enormous, and there is great interest among the biomedical community and industry to unravel how they work at the molecular level; the atomic structure of only a small percentage of these proteins is known, but this scenario is now changing,” he explains.

Palacín, together with IRB Barcelona Group Leader Miquel Coll and Sir John Walker, from the University of Cambridge, organised this Barcelona BioMed Conference.

“This is an ideal moment for this meeting,” says Palacín. “We are on the verge of an important paradigm shift, especially on membrane proteins used as molecular machines thanks to new techniques, such as ultra cryo-electron microscopy. Spanish scientists are trying to incorporate this cutting-edge technique in a new line at the ALBA Synchrotron. It was very stimulating to talk to people using it elsewhere.”

“New detectors and software have pushed the resolution limits of electron microscopy,” says Miquel Coll, “allowing the determination of atomic structures without the hurdles of crystallisation.”

Advisors praise progress, endorse plans

The international scientific experts who sit on IRB Barcelona’s External Advisory Board gathered on 10-11 November for their regularly scheduled evaluation of the Institute’s progress in science and strategic development. This meeting, the fifth to take place over IRB Barcelona’s history, produced a positive report card for the healthy pace at which IRB Barcelona is establishing itself as a worldwide reference in biomedical research.

This time, EAB members were tasked with evaluating the candidates for the strategic Group Leader positions in the call opened in 2014, and undertaking the 5-year evaluations of Group Leaders Jens Lüders and Xavier Salvatella, the latter who is also ICREA research professor. They also were asked for their input on the proposed Strategic Plan 2015-2017.

Following their recommendations, positions have been offered to the successful Group Leader candidates, and Xavier and Jens both received positive feedback and look forward to building on the excellent work they have achieved so far. The EAB endorsed the institute’s draft strategic plan and proposed specific actions, including reinforcing the presence of female and international group leaders within our faculty, strengthening key infrastructures, and continuing to find ways to forge collaborations between basic and clinical research.

The next EAB meeting is scheduled in a year and a half.

IN BRIEF

New animal house. As of January, the animal houses of the Barcelona Science Park and the Barcelona Biomedical Research Park have merged to create the PCB-PRBB Animal Facility Alliance. The alliance, led by Juan Martin Caballero, pools together the resources of both facilities and will improve services that support biomedical research in the region.

CIBER funds for inflammation research. Group Leader Antonio Zorzano obtained 670,000 euros for research aimed at studying the different ways chronic inflammation is produced in diseases such as type-2 diabetes, obesity and Crohn’s disease. The funding has been granted by the CIBER (Network of Biomedical Research) in the framework of integrated research of excellence that fosters collaboration in different scientific areas.

Alzheimer’s marathon. Natàlia Carulla, Associate Researcher in the Peptide and Protein Laboratory, and colleagues have been awarded 330,000 euros by the “Marató de TV3,” charity telethon which focused on neurodegenerative diseases. The funds will allow the researchers to determine the 3D structure of the oligomers, describe their effect on the cell membrane, and
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It was a humbling phone call, and one that showed us the enormous value of reaching out to our community. With our dancing theatrics we managed to inspire 450 school kids—and their families—to take an interest in our science and to take action to contribute to it.

Needless to say, we were delighted to help out with their day and sent researchers to lead hands-on activities for the kids, while Joan Guinovart gave a talk on diabetes for the parents. We even brought back a commemorative calendar made by the school featuring IRB Barcelona.

As often happens, one good thing leads to another: the Zürich Schule, another school in Barcelona, has also since been in touch to make a donation of the profits from their own fundraising day.

While we may have inspired these kids to take an interest in science and take an active part in it, there is no doubt that they are also a tremendous source of inspiration for us. (ss) ●

‘A future in biomedicine,’ for undergrads and PhDs

A great opportunity for university students to discover their vocation for science.” This is how Patricia Nadal, Academic Coordinator at IRB Barcelona, describes a new initiative launched by IRB Barcelona on 13 January.

‘A future in biomedicine’ is a pioneering activity for outstanding and highly motivated students enrolled in the fourth year of their degree at a local university. Four students will be given grants to work with researchers at the Institute for up to seven months.

January is also the time that IRB Barcelona opens its International PhD Fellowship call. This year, the call combines “la Caixa” – Severo Ochoa, Spanish Ministry of Economy and IRB Barcelona grants (respectively, 2, 3 and up to 4 grants). The deadline for this call is 18 February. You can find more information on our web. (sp) ●

finally validate their structure as a therapeutic target for Alzheimer’s disease.

A new Spark for schizophrenia. A public-private consortium led by Iproteos, and including the biopharmaceutical company Ascil-Biopharma, IRB Barcelona, the CRG and the University of the Basque Country has launched a project to advance the development of a new neuroprotective drug for the treatment of the cognitive impairment associated with schizophrenia and other mental disorders. The project, called ‘Spark,’ has just received a 500,000-euro grant from the Spanish Ministry of Economy.

Holiday Party. On 18 December, IRB Barcelona staff said farewell to 2014 with a cava celebration, a bake-off competition, and a raffle to raise funds for charity. All proceeds—2,529 euros—were donated to the Casal dels Infants del Raval and SOS3Barcelona, the charity selected by our community. We thank all the cooks and our suppliers who contributed prizes to the raffle.

Being a part of it

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The Holiday Party was also the debut for the new IRB Barcelona Chorus, directed by Montse Fàbrega. (Photo S. Saborit)
Welcome on board, ‘Crazies’ 2015!

A batch of 24 enthusiastic high school students is ready to come on board for the new edition of the ‘Crazy About Biomedicine’ programme, organised in collaboration with the Catalunya-La Pedrera Foundation. This year the ‘Crazy About Science’ initiative, which began in 2013 at IRB Barcelona, involves 172 high school students and seven research centres in Catalonia.

The inaugural ceremony was held this year on 9 January in Mont Sant Benet, where the class of 2015 students had the opportunity to meet the students taking part in the other programmes of the initiative over a cup of hot chocolate.

“These youngsters are fascinated by science and what they learn in this field will surprise them every day,” explained Joan Guinovart, director of IRB Barcelona at the ceremony. “You will not be coming here to work, but to have a good time and meet other ‘crazies’ about science like you!”, he promised.

The 24 sixteen- and seventeen-year-old students taking part in the ‘Crazy About Biomedicine’ course were selected from 250 students who applied for the programme on the basis of academic excellence and true passion for biomedicine and science. They will be studying and experimenting at IRB Barcelona 18 Saturdays during the year. At the ceremony, they also met two veteran ‘crazies’, Marc Duque and Pablo Martínez, who shared their feelings on their experience and their legacy as pioneers of this innovative initiative. Marc and Pablo are now university students, continuing well on their paths to a scientific career.

With the objective of maintaining connections among the ‘crazies’ throughout the years, IRB Barcelona has formed the Crazy Club. The group, that held its first meeting in November, will ensure that the students maintain strong ties with one another and with the Institute.

In a separate event, on 16 January, the class of 2014 received their diplomas in a ceremony held at IRB Barcelona. The students were greeted by two other veterans: Nil Saez and Marta San José. After receiving their diplomas, the fresh laureates presented a video portraying their enthusiasm for an unforgettable year. Check out the video at this link. (ltb) ●

Your 90,000-word thesis in just... 3 minutes!

How can you summarise a thesis in just a few minutes in an engaging and dynamic talk? What seems like a daunting task for anyone is a challenge that many PhD students at IRB Barcelona will now easily face thanks to a new workshop coordinated by Public Engagement and Science Education Officer and monologist Helena González.

The initiative is inspired by the 3MT (Three Minute Thesis), a research presentation competition that originated at the University of Queensland in 2008. Since then, the programme has spread to several universities and research centres worldwide, now including IRB Barcelona.

The 30 students who took part in the sessions have been challenged to step back and look at their research from a completely different perspective. Their science is much more interesting for the general public than they imagined! (ltb) ●

IN BRIEF

Inspiring science. IRB Barcelona participated in the 19th edition of Science Week in Catalonia (14-23 November). This yearly initiative has the goal of bringing science closer to the general public. In collaboration with the PCB, various researchers at the Institute undertook three activities: an open-house event called “Express PhD!”, the hands-on “Do Research” workshops at “la Pedrera,” and guided tours of the IRB Barcelona and PCB labs entitled “Biomedical Research in Primary School.”

First IRB Barcelona member at TED. Helena González was invited in January by TEDxBarcelona to take part in a special session dedicated to emerging trends in education to give an inspirational talk on humour in science. The day-long event also allowed Helena to organise an engaging workshop where she gave the audience some tips on how to make sure a scientific monologue captivates the public. A video will be available soon on the tedx-barcelonaeed.com page.

MIT students in Barcelona. Five undergraduates from the Massachusetts Institute of Technology visited IRB Barcelona in January. They were in Catalonia on an exchange programme of the Fundació Catalunya-La Pedrera, invited to give science classes in Catalan schools. They also visited some of the facilities and labs at the Institute, such as the Stem Cells and Cancer Laboratory, the Advanced Digital Microscopy Facility and the Structural Characterisation of Macromolecular Assemblies Lab.
Science and patients, side by side

Recalling the six months she recently spent at St. Jude Children’s Research Hospital (Memphis, USA) brings a big smile to Berta Terré’s face. “I went there mostly to learn new techniques for brain analysis in Peter McKinnon’s lab,” says this PhD student in Travis Stracker’s lab, “such as immunofluorescence of brain sections or the isolation and culture of neural stem cells. And I discovered an incredible place.”

On the campus, besides one of the best hospitals in the world for children’s treatment, you will find the Danny Thomas Research Center, a ‘tower’ where all the research occurs. “Seeing kids with cancer every day was hard sometimes, but it makes you more aware about the relevance of your work,” she explains.

At St. Jude they also have a powerful fundraising organisation called ALSAC. “They organise an incredible number of initiatives,” she notes, “and thanks to the enormous amount of money they receive, they are able not only to grant free health care to all the children at the hospital, and provide them with ‘target houses,’ where they can stay with their families without feeling hospitalised, they also finance research generously. In the labs, they have all the resources needed to carry out highly competitive science.”

In the group, there was only one other PhD student besides her. “Their labs are designed for postdocs. They do not have a structured PhD programme like IRB Barcelona does,” she notes.

Despite the bike accident she had the month she arrived (“cities are designed for cars there,” she recalls), she had a great time and enjoyed the people she encountered. “I travelled a lot, and made some marvelous friends. The last months, I stayed with an American family with 3 daughters. I hope that after meeting me, at least one becomes a scientist!”. In a Grizzlies match, she even met Marc Gasol. “He came to say hello when he saw my Catalan flag!”, she says proudly.

Teachers at the bench, again

Cancer, metastasis and personalised medicine. This was the theme of Professors i Ciència (Teachers and Science), the programme sponsored by the Fundació Catalunya-La Pedrera for teachers to get up to date with the latest advances in research. This was the fourth edition organised at IRB Barcelona. 15 teachers from secondary schools in Catalonia took part in the course, held on 7-8 November.

The first day Elena Sancho, Eduard Batlle and Roger Gomis gave lectures on cancer and health, stem cells and metastasis. The second day began with Rosina Malagrida, from Xplore Health, a European educational portal with hands-on resources for teachers, explaining how to take advantage of this useful tool. Resources include a video on cancer and stem cells featuring IRB Barcelona research.

The teachers then entered in the labs where nine young researchers guided them through a series of experiments in flies, histology, and cancer and stem cells.

“THE teachers had very positive feedback on the whole experience,” says Helena González, Public Engagement and Science Education Officer at IRB Barcelona. She is already working on the next workshop on development in the fly, scheduled for May. “Our priority will be to make sure teachers are able to convert these workshops into something they can use in their classrooms,” she concludes.
Ready for science to leave the ivory tower

Citizen science. Scientists at IRB Barcelona may not be familiar with the concept. This is what led Michela Candotti, a PhD student in Modesto Orozco’s lab, to prepare a talk to explain why this idea captured her imagination.

“It is easier to define what citizen science is not. It’s not sharing science with citizens, or, worse, ‘educating’ them,” she explains. “It’s not letting citizens ‘try’ science as amateurs, either,” she adds.

So, how would you define it?

I would say it is an active participation of the general public in the scientific process; a mutual exchange. People learn and support projects that matter to them while scientists receive help from a large crowd. Today’s technologies facilitate their involvement and there are many examples of citizen science projects, with people identifying tiger mosquitos with an app, or playing a videogame to design RNA molecules, or classifying galaxies.

What do scientists gain?

A larger public gives access to a larger and statically relevant amount of data. Scientists cannot be everywhere to look for the tiger mosquitos, for example. Many interacting users form a collective intelligence that speeds up analysis or even solve scientific problems otherwise unattainable to the individual. It is very important that science find a way to involve society, leaving the ivory tower. Some scientists leave research because they feel they lose contact with society. Citizen science helps us as scientists to be more connected to people.

Any idea on how to start a project in your field of research?

My goal with this session was to plant a seed in my colleagues’ heads. It has to be there, so that the day that a new scientific project arises, researchers keep in mind the possibility of making use of this powerful tool.

What kind of feedback did you receive?

People reacted very positively. It is of course difficult to come up with a good science citizen project right off the top of your head. The goal is to inspire as many researchers at IRB Barcelona as possible. (ltb)