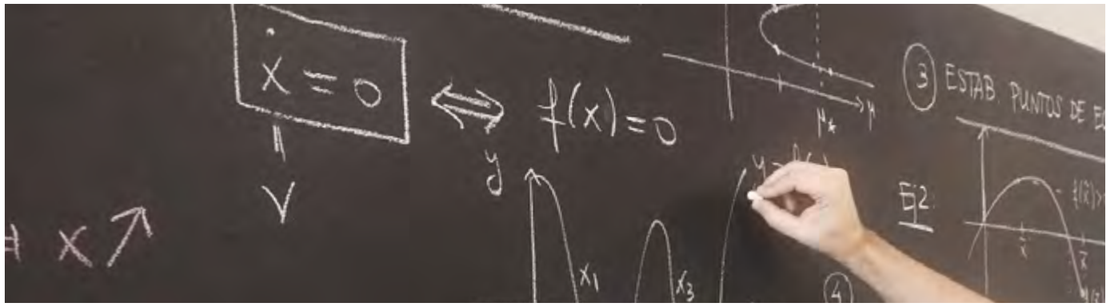
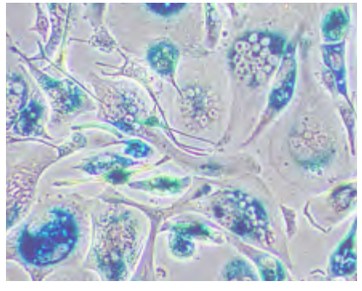
SUCCESS STORIES



SENESCENT CELLS CAPABLE OF ACTIVATING THE IMMUNE SYSTEM

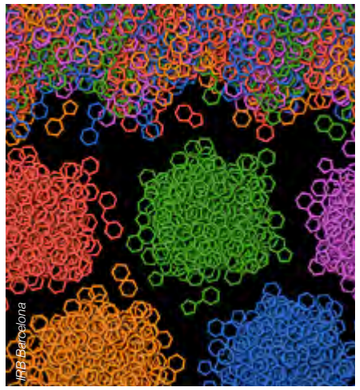
Inés Marín has recently come back from the USA to further her career as a researcher with a post-doctoral residency at Genentech, a firm belonging to the Roche holding. During her PhD research, which she conducted in the lab of ICREA researcher Manuel Serrano at the Institute for Research in Biomedicine (IRB Barcelona), she endeavored to understand how cells entering cellular senescence (a type of response to damaging stimuli) interact with the immune system. She mentions that scientists knew there was some sort of communication between both; less clear, however, was the nature of the generated response, or what would be the effects of inducing cellular senescence on tumoral cells as opposed to other responses to damaging stimuli, such as cell death. For many years the scientific establishment has strived to improve the efficiency of the immune system by presenting it with tumor cells that have perished. The research, which was published in the medical journal *Cancer Discovery*, concludes that senescent tumoral cells are more capable than dead tumoral cells or non-tumoral senescent cells of activating the immune system (hence improving the efficacy of the anti-tumor immune response). The researchers vaccinated healthy mice with senescent cancer cells and then induced tumor generation on them; astonishingly, they discovered that the quantity of animals that ended up developing cancer was notably low.



IRB Barcelona

USING MATH TO RESTORE AND PROTECT BIODIVERSITY

There are currently over 17,000 marine protected areas (MPAs) all around the world, covering approximately 9% of the oceans. However, only 23% of those areas are subject to clear-cut administrative plans; and only 1% are actively monitored and reported upon. For many years there has been – mostly theoretical – research on which qualities should marine areas manifest in order to function effectively. The main question is how to determine the right degrees of protection so as to ensure that marine reserves are not endangered nor suffer too much stress that could jeopardize their maintenance. Josep Sardanyés, a biologist and researcher at the Mathematic Research Centre (CRM), specializes in the study of complex systems using the theories of nonlinear dynamic systems. These systems cannot be comprehended by analyzing their parts separating; due to their non-linearity, the interactions taking place within them are not additive. To put it simply, the whole is more than the sum of its parts. Sardanyés belongs to a European consortium the aims of which are to improve the scope of MPAs by resorting to mathematical and computational modelling in order to the devise lines of action for the restoration and protection of biodiversity. Thanks to mathematical modelling, the extent of changes taking place in ecosystems – which are usually sudden and discontinuous – can be better predicted and understood. Models can predict ecosystems' responses to parameter alterations such as increases in strain due to fishing or disruptions produced by tourism, and thus be significantly helpful in determining the degree of protection required in an MPA and thus ensuring the continuity and survival of a species in a given area.



IRB Barcelona

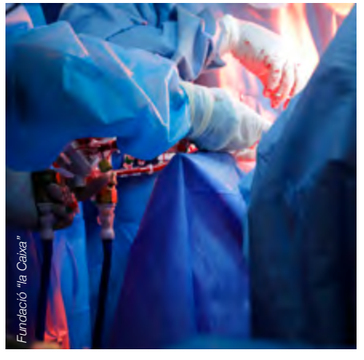
ARTIFICIAL INTELLIGENCE CREATES PERSONALIZED DRUGS

Some years ago, we witnessed the rise of precision medicine, which takes into account the molecular profile of each patient and the properties of all available drugs in order to determine which one suits him or her best. And now scientists are working to devise a truly personalized medicine, which would involve the creation of molecules befitting the specific profiles of each person. The foundations of what might become a reality 20 years from now are being laid out at this very moment. Patrick Aloy, an ICREA researcher at the Institute for Research in Biomedicine (IRB Barcelona), is working to devise drugs considering the particularities of each patient. Scientists like him gather all sorts of information – genetic profiles, cell mutations and patients' response to medicines – to create an AI algorithm capable of guiding them through the development of drugs. They are adamant that when it's time to test it in *in vitro* and *in vivo*, they'll come across fewer problems. They resort to data science techniques, artificial intelligence, systemic biology, chemistry and pharmacology. The intricacies of chemistry are taught to the computer, which then makes use of generative modeling to produce new molecules endowed with specific characteristics. The research group translates the biological data they acquired from cell lines or cancer patients into a language the computer understands, so that the new drugs generated by it already feature the sought-after properties. One of the projects they are working on consists in the production of drugs for the treatment of pancreatic cancer that eradicate specific types of cancer mutations while leaving the rest of cells unscathed.

THE FIRST ARTIFICIAL PLACENTA WORKING PROTOTYPE

After two and a half years of intense work, the CaixaResearch Artificial Placenta project has unveiled a working prototype of an artificial placenta that is able to keep fetuses alive and in good condition for 12 days. The main goal of this device is to increase the survival probabilities of babies born after 6 months of pregnancy or less, as well as to reduce the complications they may suffer. This is achieved by reproducing and extending the physiological conditions of the mother's womb so as to facilitate the correct development of their organs. The artificial placenta is comprised of different elements, all of which have distinct separate functions yet relate to each other and work together as an integrated system.

The next two and a half years will be devoted to achieving a more robust and safer prototype that extends the survival of the prematurely born fetus up to three/four weeks in good condition and without complications and normal development of essential organs such as brain or heart. "We're convinced we can do it", assures Elisenda Eixarch, the project's senior scientific coordinator. "Our system works, all the pieces are in place; we only need to do some minor adjustments to overcome the existing shortcomings and hence reach longer survival rates". For now, they've tested it on sheep, a type of animal whose size, cardiovascular system and lung development are similar to those of premature humans. After they have achieved their survival rate goals, they will consider carrying out their first clinical study, provided they are greenlit by the relevant regulatory institutions and workgroups tackling the ethical and legal aspects of the matter.



Fundació "la Caixa"

BBRC

UNDERSTANDING THE DEVELOPMENT OF ALZHEIMER'S THROUGH THE MEANS OF BIOMARKERS

Over the last five years Alzheimer's research has witnessed a revolution thanks to a series of scientific breakthroughs that bring us closer to the production of drugs capable of slowing down its development, as well as the use of new biomarkers indicating the emergence of the disease. These biomarkers are cheaper and less invasive than the means of detection and tracking that have been used traditionally, such as medical imaging or the extraction of cerebrospinal fluid. The Barcelona Beta Brain Research Center (BBRC), research center of the Pasqual Maragall Foundation, is developing new ways to detect Alzheimer's through a simple blood test. That is how, sometime in the future, they'll be able to predict and monitor its appearance in its earliest phases.

This type of testing is being introduced to many Alzheimer's research centers, but what sets apart the BBRC's fluid biomarkers platform is the sheer volume of samples they work with. "We have blood samples of healthy people dating from 10 years ago", explains Dr. Marta del Campo, the researcher in charge of the project. "Through the study of samples in this preclinical stage we will be able to track how the pathology associated to Alzheimer's develops – some of the markers will be altered while others won't." We know that 10% of the elderly develop this disease, and that its related physio-pathological changes start taking place 20 years before actual symptoms appear. Therefore, the possibility of studying these samples is extremely valuable, since a percentage of them will develop the disease. It is crucial to start treatments against it during the preclinical stage, because when symptoms surface it is usually impossible to reverse the neural degeneration. The study of the disease's preclinical phase, then, is essential to stop its development before it's too late.