NEWSLETTER

SOCIEDADE PORTUGUESA DE BIOQUÍMICA

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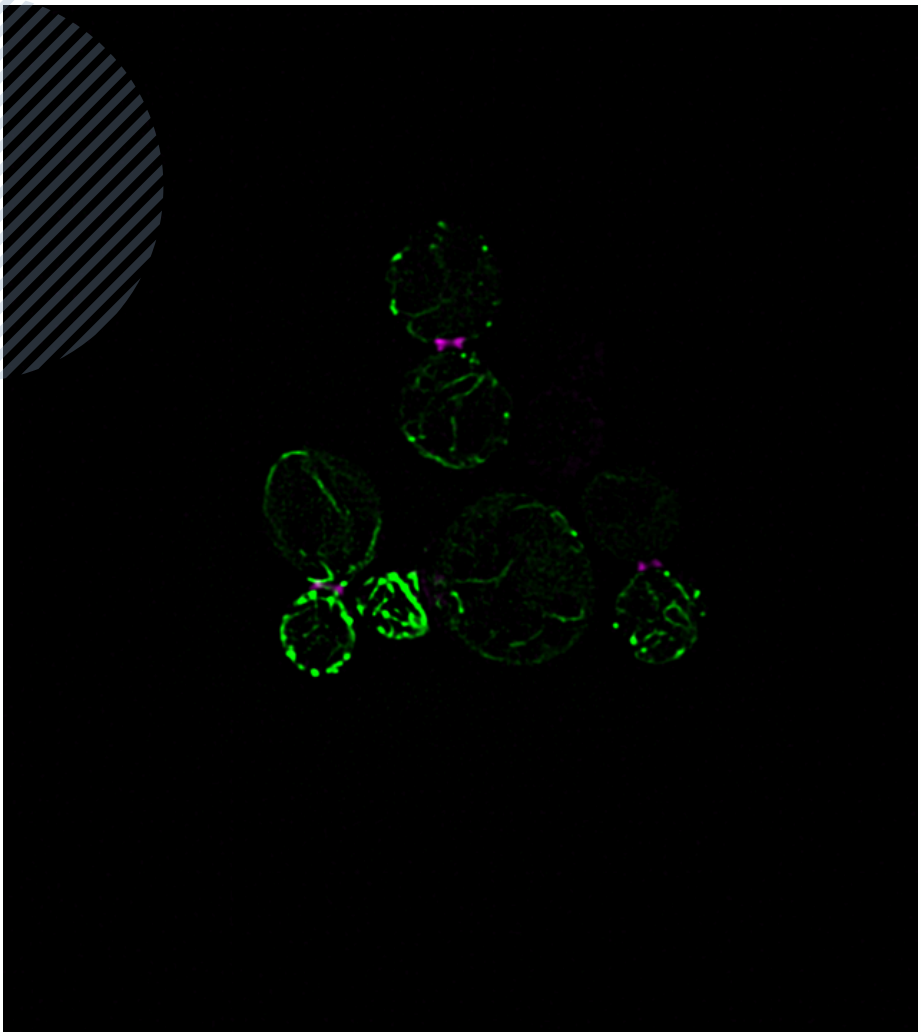
Edition 6



Live fluorescence microscopy image showing the actin cytoskeleton in budding yeast cells expressing Lifeact-GFP (green) and Pfy1-mCherry (magenta).

Miguel Correia, i3S, University of Porto

IN THIS EDITION

Editorial

6th Edition

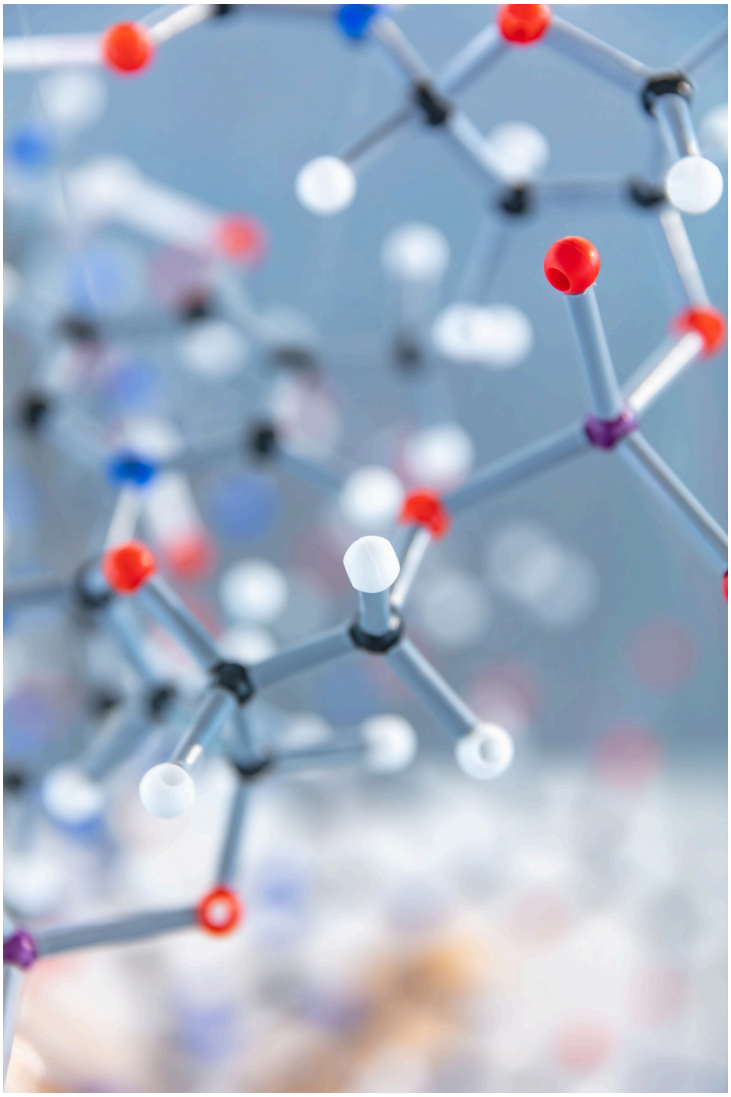
In this Edition:

In this issue of the SPB Newsletter, we feature an interview with Cláudio Soares, from ITQB-NOVA. He shares his experiences and perspectives on his work in biochemistry, his motivations and challenges, and his valuable contributions to the Portuguese Society of Biophysics.

Duarte Barral, from NOVA University of Lisbon, shares his insights into membrane traffic, intracellular organelle biology, and intracellular communication.

This newsletter also highlights the Biochemical Education workshop that took place during the XXII National Congress of Biochemistry, as well as upcoming events, including the Biophysics Festival 2025, the 29th FEBS congress and the FEBS3+ meeting.

We send our warmest wishes to all members of the SPB community.



The SPB Directive Committee

Interview

Claúdio Soares

For this edition's Newsletter, we talked to Cláudio Soares, former president of the Portuguese Society of Biophysics - an affiliated of SPB, Full Professor and group leader at ITQB-NOVA, and coordinator of the R&D Unit MostMICRO-ITQB.

First, what inspired you to work in biochemistry, particularly in molecular modulation of proteins?

Let me start by saying that it is an honor to be interviewed by SPB, a society that I deeply respect and have followed since attending my first congress, which I believe was in Póvoa de Varzim during my third year of the biochemistry degree at the University of Lisbon.

Well, my path to biochemistry wasn't straightforward. When I was choosing between biochemistry and biological sciences, I didn't fully know what biochemistry entailed. At the time, there was limited information about the course, especially outside of major cities, but I came across a book by Stephen Rose titled The "Chemistry of Life", which sparked my interest. It introduced me to the idea of how life processes could be understood through a chemical lens. Additionally, I had a strong passion for computers, which later helped shape my approach to biochemistry.

I enrolled in the biochemistry program at the University of Lisbon, which was relatively new at the time. During my studies, I was particularly inspired by professors like Jacques Calazans, who taught organic chemistry with a quantum chemistry approach, which made me realize how exciting it could be to combine computational methods with biochemistry.

At first, my interest was in experimental areas like enzyme kinetics, and I worked with Ana Ponces Freire at the Rocha Cabral Institute.

But I found that computational biology, including molecular simulation, offered a way for me to control the "imaginary worlds" of scientific models. Instead of struggling with experimental limitations, I was drawn to the ability to simulate complex biological processes and proteins in a more precise and controlled way.

Ana Ponces Freire was actually instrumental in helping me in this transition from fields and from Portugal to Sweden, to pursue PhD studies.

What challenges have you faced, and what have you learned in your career, particularly in the molecular modulation of proteins?

In the early stages of my career, working in molecular simulation was a challenging but exciting endeavor. One of the biggest hurdles was the limited computational power available, which constrained our ability to model and simulate complex biological processes. However, technological advances have completely transformed this field, enabling the development of sophisticated computational methods that are now widely applied in protein structure prediction, drug design, and biomolecular modeling.

The introduction of artificial intelligence (AI) and machine learning into this field has been a game-changer. What was once considered a niche area for "strange people" working on computers has evolved into an essential part of scientific research.

The most significant discovery, or rather transformation, in my career has been how molecular simulation and AI have combined to make scientific research more efficient and impactful.

We're no longer working in isolation with abstract models; we're collaborating with experimental labs to test and refine our computational designs in real-world scenarios. This change has made our work more relevant and applicable to real-world challenges.

What do you consider to be the biggest challenge in your field?

The biggest challenge in molecular simulation and protein modulation is still the limitation of computational power.

Beyond this, a major challenge that I see in scientific research is the need for high-quality, standardized data.

The current explosion of data in the biological sciences is both an opportunity and a challenge. AI and machine learning can only be as good as the data they are trained on, and if that data is inconsistent or unreliable, the models generated will also be flawed.

A perfect example of this challenge is seen in protein structure prediction—while tools like AlphaFold have made incredible progress, mostly because of standard data deposited in the Protein Data Bank and Protein Sequence databases, the predictions are only as good as the data that feed into them.

What is the most surprising discovery you've made during your career?

While I've made some contributions throughout my career, I would like to focus on collective progression on how computational approaches, especially molecular simulations and AI applied to structural biology, have become central to experimental research. This shift from a focus on purely theoretical work to becoming integral to real-world applications has been a revelation for me.

Our lab is now in a position where we don't just create theoretical models; we design and simulate novel proteins and potential drug candidates, which are then tested experimentally by our collaborators.

This symbiotic relationship between computational and experimental research is what I find most gratifying, and it's a change that I believe will continue to shape the future of scientific discovery.

Regarding your role in the Portuguese Society of Biophysics, what was it like to be President?

Serving as President of the Portuguese Society of Biophysics was a very rewarding experience. At that time, biophysics was an emerging field in Portugal, and the society played a crucial role in its development.

I had the opportunity to take over the position of President from Manuel Prieto, who was the founding President of the Society and continues to be associated with it, as well as some other people that are with us since the beginning.

Altogether we focused on expanding the field, especially in education. We created workshops, seminars, and advanced courses, such as those in Santarém, which helped to educate the next generation of biophysicists.

These courses became landmarks in our field and provided students with exposure to both theoretical and experimental aspects of biophysics.

And to finish, how relevant do you see the participation in FEBS activities?

This is fundamental. And the biochemical societies, nationally, I think that they survive largely due to this organization that is extremely strong, very organized and based on funds obtained mainly through publications. This is essential, because staying here in our little corner saying that we do biochemistry doesn't make much sense.

So, this international dimension of FEBS, which I think was a great creation, gave context and really opened ways to the Portuguese biochemical community. And, in fact, FEBS has an interesting, sustainable financial structure, which a local society cannot achieve.

Biochemistry doesn't even exist in high school. Debatable, to say the least, but there are many other shortcomings. Therefore, FEBS gives us this international context and critical mass.

I have always enjoyed working with FEBS. I was on the Advanced Course Committee for several years. I think that FEBS makes perfect sense, it is, let's say, a great European achievement.

News & Views

Membrane traffic and organelle biology: Unraveling the foundation of intracellular communication

Duarte Barral,
NOVA Medical School, NOVA University of Lisbon

Eukaryotic cells evolved towards compartmentalization of their cytoplasm. Indeed, they possess several organelles inside of which specific biochemical reactions and pathways occur. These organelles are surrounded by a double membrane (or two, in the case of the nuclear envelope and autophagosomes), allowing the creation of highly specialized and unique intraorganellar environments.

However, these compartmentalization poses a challenge – to ensure efficient communication between organelles. To solve this problem, eukaryotic cells developed a highly intricate and tightly regulated system called membrane traffic. This system involves the transport of cargo-loaded vesicular carriers along cytoskeletal tracks and, for this reason, is also known as vesicular traffic.

The discovery of intracellular organelles was only possible with the development of the microscope. During the 19th century, scientists described the nucleus, mitochondria and the Golgi apparatus, with the remaining organelles only being described in the 20th century, with the advent of electron microscopy.

In the late 20th century, several scientists dedicated their careers to understanding the different steps of membrane traffic (Fig. 1) and how this system is regulated to ensure specificity. Three of them – James Rothman, Randy Schekman, and Thomas Südhof – were awarded the Nobel prize in Physiology or Medicine, in 2013, for "their discoveries of machinery regulating vesicle traffic, a major transport system in our cells". These scientists were among the pioneers that started deciphering how membrane traffic operates and is controlled.

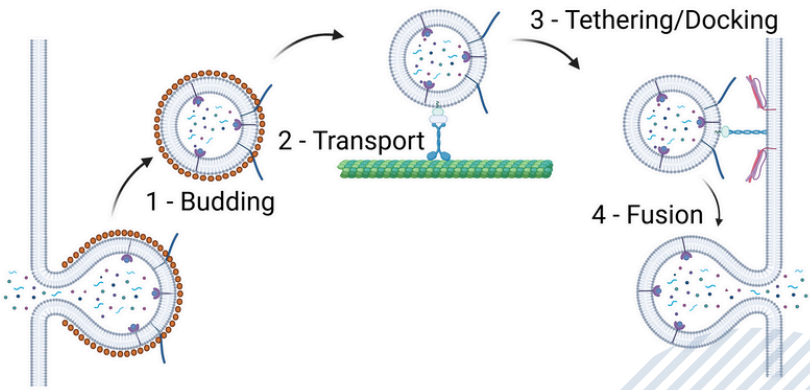


Figure 1: **Schematic of the steps in membrane traffic**. Vesicles bud from a donor compartment (left) and are transported via cytoskeletal tracks and molecular motors to the vicinity of an acceptor compartment (right). After tethering and docking to the membrane of the acceptor compartment, vesicles fuse with it, releasing their cargo. Created in BioRender.

It is now appreciated that membrane traffic is essential for all cell functions. Consistent with this, numerous diseases affecting all organs and systems have been shown to arise from mutations in proteins involved in membrane traffic (**1**). Nevertheless, many more membrane traffic regulators do not seem to be associated with a known disease. The reason for this might lie on the high level of redundancy shown by membrane traffic pathways in mammals, which signals its vital importance. In other words, defects in this essential system are either not compatible with life or can be compensated.

As in other fields of knowledge, technology is allowing us to gain new insights into the molecular underpinnings of membrane traffic mechanisms. The ability to observe dynamic processes in live cells at a high resolution, enabled for example by lightsheet microscopy, is particularly important to study membrane traffic.

Moreover, the combination of electron and fluorescence microscopy and the possibility of imaging tissues and 3D structures like organoids by volume microscopy, promises to unveil new details that remained elusive until now. This is the case of membrane contact sites between different organelles, an expanding area of study within this field.

Contact sites ensure different functions and expand the previously known communication routes between organelles. Their importance in diseases like neurodegeneration, cancer and metabolic disorders has been already appreciated (**2**), but we are still scratching the surface regarding their function in cell homeostasis and pathology. Interestingly, not all organelles are membrane-bound and several membraneless organelles have been discovered, including stress granules and centrosomes. These organelles were already associated with neurodegeneration and cancer, but remain understudied (**3**).

The field of membrane traffic and intracellular organelle biology has come a long way since the dawn of microscopy and the discovery of eukaryotic cell compartmentalization.

Microscopy continues to be one of the most powerful tools to understand this communication system and will remain so with new technological advances.

Importantly, the better we understand how membrane traffic works at the molecular level, the more we advance towards being able to re-establish its function in disease contexts.

(**1**) Yarwood R, Hellicar J, Woodman PG, Lowe M. Membrane trafficking in health and disease. Dis Model Mech. 2020 Apr 30;13(4):dmm043448. doi: 10.1242/dmm.043448.

(**2**) Prinz WA, Toulmay A, Balla T. The functional universe of membrane contact sites. Nat Rev Mol Cell Biol. 2020 Jan;21(1):7-24. doi: 10.1038/s41580-019-0180-9.

(**3**) Li Y, Liu Y, Yu XY, Xu Y, Pan X, Sun Y, Wang Y, Song YH, Shen Z. Membraneless organelles in health and disease: exploring the molecular basis, physiological roles and pathological implications. Signal Transduct Target Ther. 2024 Nov 18;9(1):305. doi: 10.1038/s41392-024-02013-w.

SPB Activities

Workshop "Engaging conversations among participants to delve into the future of biosciences education"

Manuel João Costa, School of Medicine, University of Minho
Rui Oliveira, Department of Biology, University of Minho
Margarida Fardilha, Department of Medical Sciences, University of Aveiro

During the XXII National Congress of Biochemistry, held from October 24 to 26, 2024, in Aveiro, a workshop titled "**Engaging Conversations Among Participants to Delve into the Future of Biosciences Education**" took place, aimed at fostering an open dialogue about the future of Biochemistry education in a rapidly changing world. The audience of more than 60 participants was invited to answer questions using their cell phones, and the discussion was triggered based on the answers obtained during the session.

When asked about the evolution of biochemistry education, the audience identified three fundamental skills for future biochemists: critical thinking, effective communication and a comprehensive knowledge of biochemistry. These points were unanimously recognized as essential to prepare students for the demands of scientific research, health care, and biotechnology.

Regarding the assessment of students for the preparation of future professionals with the critical skills discussed, project-based assessment was highlighted. Additionally, timely feedback from teachers was seen as a way to allow students to learn from mistakes, enabling them to correct their academic record and develop confidence in their abilities. When imagining the biochemistry classrooms of the future, collaborative group work, artificial intelligence (AI) and online learning tools were the most discussed methodologies and tools.

However, in the discussion, participants expressed both enthusiasm and caution regarding the role of AI, highlighting its potential benefits in improving learning and the risks, particularly in relation to privacy and academic integrity. The discussion also highlighted the value of virtual laboratories, allowing immersive learning, and active learning methodologies. These promote the development of critical thinking and prepare students to face the challenges that arise in a more complex scientific scenario, including problems that humanity increasingly faces. The presence of a considerable number of scientists and their participation in the discussion at the workshop on education at the XXII National Congress of Biochemistry reveals the importance of education not only in academic, but also in scientific contexts. This could be a first step towards the emergence of a community on biochemistry education that maintains a debate and development in this area that is expected to continue at the XXIII National Congress of Biochemistry.

Calendar & Events

08-09/05

5th Meeting of Young Biophysicists - Biophysics Festival 2025
NOVA FCT, Monte da Caparica
LINK

18-23/05

31st FAOBMB Conference & 2025 KSBMB International Conference
Bexco Busan, South Korea
LINK

25-30/05

FEBS Special Meeting on Sphingolipid Biology: Breaking Boundaries / International Ceramide Conference
Varna, Bulgaria
LINK

01 - 04/07

Iberian Plant Biology - 2025 Congress
Murcia, Spain
LINK

05-09/07

29th FEBS FEBS Congress
Istanbul, Turkey
LINK

08-10/09

[BC]2 Basel Computational Biology Conference
Basel, Switzerland
LINK

24-27/09

FEBS3+ Meeting
Belgrade, Serbia
LINK

29-31/10

RNA Horizons 2025 Therapeutics Symposium
Palermo, Sicily, Italy
LINK