Iain Johnston

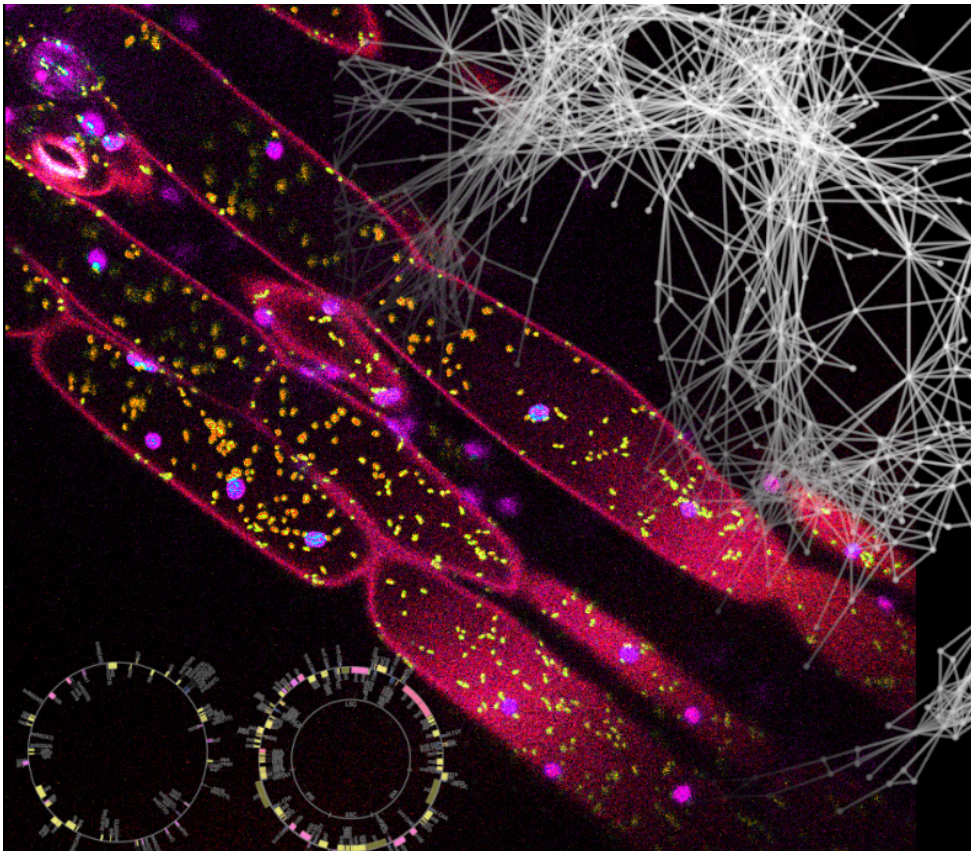
Iain Johnston is a Professor in the Department of Mathematics and the Computational Biology Unit at the University of Bergen, Norway. He leads the Stochastic Biology group which combines mathematical, statistical, and experimental approaches to learn about the biological world, with a particular focus on the bioenergetic organelles: mitochondria and chloroplasts. Iain was awarded the SEB's 2019 President's Medal for the Cell Section.

Tell us about your background. How did you first become interested in computational biology?

As a kid! I loved the idea of simulating what I would later learn were called "complex systems" in a computer, and biology was no exception. In school I wrote a simulation of an ecosystem where rain eroded the landscape, plants grew, and animals moved around eating them. I spent hours tweaking and poking it to see what behaviours emerged. However, it was my graduate training as a physicist that established my professional interest. I was interested in how physical modelling might help answer medical questions, and was fortunate enough to have an MSci project making computer simulations for the self-assembly of virus capsids. I then took a DPhil looking at self-assembly and evolution (both noisy biological processes), and I've been working with noisy biology ever since!

What is your lab working on currently?

A major focus of the group is understanding how bioenergetic organelles (mitochondria and chloroplasts) evolve and are controlled by their host cells. Since their fascinating endosymbiotic origins, these organelles have either lost most of their genes or transferred them to the nucleus, but they keep hold of a small subset in their own "organelle DNA" (oDNA). Why? oDNA can be subject to high mutation rates, and many of the mutations are damaging or fatal. Human mitochondrial DNA mutations, for example, give rise to devastating inherited diseases, and a major aim of the group is to understand the inheritance and onset of these diseases. More generally, we're interested in why organisms retain oDNA, and how cells maintain and propagate oDNA through lifetimes and between generations. Our ERC project "EvoConBiO" (Evolution and Control of Bioenergetic Organelles) is helping us learn more through combining modelling, bioinformatics, live-cell imaging and other experimental approaches.



Above: Iain's work combines microscopy, network analysis, and genetics to understand organelle evolution and control.

What does a typical day look like for you?

At the moment, childcare! Thanks to the generous Norwegian parental leave system I have been working 10% this semester, providing guidance to staff and students and finishing a couple of manuscripts. More usually, my day would contain some proportion of primary research (often building mathematical models and/or simulations, bioinformatics, sometimes microscopy), talking with staff and students and offering guidance, and teaching or grant writing depending on the season. Possibly a run over the Bergen mountains too to air out some synapses, or a café visit to catch up on literature.

What do you most enjoy about your work?

The biological world is a constant source of inspiration – its beauty and complexity are never ending. My group runs a weekly "Tree of Life" meeting where we informally research a particular type of organism – parasitic plants one week, extremophiles the next – and tell each other about what we've found. I love learning about, and (where possible) contributing to, our understanding of this beautiful world, especially when that understanding can potentially be of use to us!

What do you find most challenging?

It's a common refrain but interdisciplinary work raises a wide range of challenges, from requiring a broad knowledge, vocabulary, and literature base to understanding and communicating the different norms involved in training, mentorship, publishing, and funding. Keeping the depth needed to make new insights while establishing the breadth needed to cover different topics is a constant, but exciting, challenge.

"The biological world is a constant source of inspiration – its beauty and complexity are never ending"

What is your lab hoping to work on in the future?

There are still lots of organelle and cell biology questions that we'd like to attack with quantitative approaches, but we're also developing a line of research about a specific evolutionary problem: anti-microbial resistance. Some of the approaches we developed to learn how organelles evolve can also be used to learn about AMR, and we're working with a great range of international clinical collaborators in a new project with CAMRIA (camria.w.uib.no) to see if we can identify and predict how AMR evolves in a given setting.

What advice would you give to aspiring scientists in this area?

Well, gather advice from as many different folks as possible— and be cautious about survivorship bias! I welcome career-based questions from anyone via DM on Twitter (@mitomaths) so feel free to approach me there. One piece of advice you may not hear too often is literally go out of your way to experience other ways of working. If you're a lab scientist, go to seminars on mathematical models, learn applied statistics, learn to code. If you're a theorist, do some pipetting, plate some seeds, shadow some gels and microscopy. It will take time and new contacts, but can help immensely in interdisciplinary collaborations, sparking ideas for future projects. The non-traditional experience you'll gather can also help your CV to stand out.

Who are your scientific heroes?

I have several types of scientific hero, and too many to list exhaustively! The first are folks who in the past have driven science forward with unorthodox ideas. Lynn Margulis and Barbara McClintock are a couple of examples particularly aligned with my research. The second are currently active researchers whose approaches I'd like to follow in some way. Nick Lane, Michael Stumpf, Ricard Solé, Rasmus Nielsen, and Ralf Bock are some exciting researchers from different disciplines who take new perspectives on big questions and provide inspiration for how we work.

Above: Running in the Bergen mountains.

Selected Publications from SEB journals.

Chustecki JM, Etherington RD, Gibbs DJ, Johnston IG. 2022. Altered collective mitochondrial dynamics in the Arabidopsis *mshi* mutant compromising organelle DNA maintenance. Journal of Experimental Botany 73, 5428–5439.

Mitchell J, Johnston IG, Bassel GW. 2016. Variability in seeds: biological, ecological, and agricultural implications. Journal of Experimental Botany 68, 809–817.