

EDITORIAL

Imaging development, stem cells and regeneration

Swathi Arur¹, James Briscoe^{2,3,*}, Yka Helariutta⁴, Thomas Lecuit^{5,6} and Liz Robertson⁷

Seeing is believing, the old adage goes. For developmental and stem cell biologists, this is certainly true. The highly complex and dynamic, but precisely choreographed, series of events that underpins embryonic development requires the coordination of multiple molecular and cellular mechanisms. Observing and documenting these has been at the centre of the field for more than a century and our desire to view development as it happens continues to push the limits of imaging technologies. Over the last decade or so, new imaging instrumentation, novel molecular probes and breath-taking advances in computational power have revolutionised the field. These now allow us to visualise cell and developmental processes at extraordinary resolution and in real time. From progress in light-sheet and super-resolution microscopy, to the development of tissue-clearing techniques and sophisticated image analysis platforms, we are able to capture and analyse the beauty and dynamics of development across scales – from individual molecules and cells to complete tissues and embryos. With these advances new challenges emerge, from how to store and analyse large datasets to designing and validating molecular probes that don't interfere with the processes they are designed to measure.

In this Special Issue, we feature primary research as well as review-based articles that showcase the diversity of imaging approaches that are currently used in the field. These range from the fluorescent imaging of individual molecules to CT scans of entire body parts. The Reviews and Primers in the issue exemplify the diversity of topics. The subjects covered include the use of biosensors and single-molecule tracking techniques to quantify specific molecules and molecular processes, as well current

computational techniques for image analysis and approaches to infer mechanical forces within tissues from imaging data.

The core of the Special Issue is a set of 24 Research Articles and Reports that provide an overview of the different uses of imaging in the field. These include studies in plants, *Drosophila*, *C. elegans*, and vertebrates that reveal new insights into developmental systems that vary from the root tips of *Arabidopsis* and germlayer specification in vertebrates, to the formation and regeneration of feathers in chickens. In addition, as befits a field that is driven by technical innovation, the Special Issue contains 10 Techniques & Resources Articles. Several of these demonstrate the increasing importance of automation and computation in the acquisition and analysis of imaging data. Others introduce novel molecular reagents or physical devices designed for imaging specific developmental processes. We hope these prove useful to others in the field.

With this issue, we're also pleased to introduce our new occasional columnist, 'Tsuku Mogami' (not their real name!). In each column, they will be taking a look at an aspect of our field from a different, sometimes unfamiliar, sometimes quirky, perspective. Have a read of the first column 'Developmental Twists: The scan' and let us know what you think, and do look out for more Developmental Twists columns in upcoming issues.

We trust that you enjoy reading this Special Issue and we would like to thank everyone – authors and reviewers – who contributed to it. We also hope this issue inspires you to explore the field further and apply some of these exciting and innovative techniques to address your own research questions. And when you do, please send the resulting study our way!

¹University of Texas M.D. Anderson Cancer Center, 1515 Holcombe Boulevard, Houston, TX 77401, USA. ²Editor-in-Chief, Development. ³The Francis Crick Institute, 1 Midland Road, London NW1 1AT, UK. ⁴Sainsbury Laboratory, University of Cambridge, 47 Bateman Street, Cambridge CB2 1LR, UK. ⁵Aix-Marseille Université & CNRS, IBDM – UMR7288 & Turing Centre for Living Systems, Campus de Luminy Case 907, 13288 Marseille Cedex 9, France. ⁶Collège de France 11, place Marcelin Berthelot 75231 Paris Cedex 5, France. ⁷University of Oxford, Sir William Dunn School of Pathology, South Parks Road, Oxford OX1 3RE, UK.

*Author for correspondence (james.briscoe@crick.ac.uk)