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Single-cell branching morphogenesis: A special issue

I am delighted to introduce this special issue of Developmental Biology focussing on single-cell branching morphogenesis. This is a relatively small field of research studying morphogenetic cell shape changes that give rise to single-cell branched structures.

Tissue and organ morphogenesis and function rely on cell shape and cell interactions with each other as well as with the surrounding matrix. Cell shape is intrinsically connected with its function in a determined tissue or organ and it varies enormously throughout nature. From round dividing cells, to cuboidal epithelial cells to highly branched dendritic arborisation neurons. Branched cellular networks are a very common feature of multicellular animals and underlie the formation and function of numerous tissues and organs including the nervous system, the respiratory system, the vasculature and the structure of many internal glands. These networks vary from subcellular branched structures such as dendritic trees to large multicellular branched tissues such as the lungs. Multicellular branched structures rely on many cells that form the different branches, whereas subcellular branches are formed within a single cell. The production of branched structures by single cells, also known as subcellular branching, has been mainly described in neurons and in cells of the respiratory and vascular systems and involves complex cytoskeletal remodelling events. Single-cell branching can be transient as, for instance, during cell migration and cell-cell fusion events or enduring as in dendritic arborisation.

Failure to achieve single-cell branching or excess subcellular branching can be found in many human disorders from mental retardation to autism and in vascular disorders and angiogenesis, highlighting its importance in organismal biology.

This special issue on single-cell branching morphogenesis is devoted to different model systems currently used to study this type of cellular branching. It has been tailored to show different approaches to the analysis of how single cells branch and what are the molecular mechanisms involved. This different model perspective allows for the encounter of common and specific traits, summarizes the current ground between different approaches and provides a frame from which to draw future challenges in the field.

We start the issue with a Q&A with Maria Leptin, one of the pioneers in single-cell branching research using *Drosophila* tracheal cells and head of a research laboratory of reference in the field. We continue with Review and Research articles covering single-cell branching in different model systems and organisms.

Benedikt Best from the Leptin laboratory at the EMBL, reviews the current knowledge in single-cell branching morphogenesis in the *Drosophila* tracheal system, from genetic control to environmental factors. Vanessa Lahoue and Helen Cooper from the Queensland Brain Institute in Australia directly address the regulation of dendrite and axonal branching reviewing how guidance cues modulate this type of single-cell branching by influencing the actin cytoskeleton. Anna Ziegler and Gaia Tavosanis, from the DZNE in Bonn, Germany, review what is known on the role of lipids and their associated proteins in establishing correct dendritic morphologies. Steven Harris from the University of Manitoba in Canada, reviews the intricate morphological changes underlying hyphal branching in fungi and the molecular mechanisms involved. Jing Li and colleagues from the Szymanski laboratory at Purdue University in Indiana, USA, review the current knowledge in single-cell branching mechanism in plants centering on cytoskeleton-dependent cell wall patterning, and how combinations of multi-scale imaging experiments and computational modelling are being used to unravel systems-level control of morphogenesis. And Lakshmi Sundararajan and colleagues from the Miller laboratory at Vanderbilt University in Nashville, USA review the power of genetic analysis and live cell imaging of the PVD sensory neuron in *C. elegans* to reveal key molecular drivers of dendrite branching morphogenesis.

This special issue also contains two results articles on dendrite and tracheal single-cell branching in *Drosophila*. Rafael Krämer, Sandra Röde and Sebastian Rumpf, from the Rumpf lab at the University of Münster in Germany, bring us new results on the importance of membrane protein recycling during single-cell branching morphogenesis and how lack of Rab11 leads to defects in larval tracheal elaboration. Alondra Schweizer Burguete and colleagues from the Ghabrial laboratory at Columbia University, New York, USA, report on the central role of the Hippo and TOR pathways in the regulation of cell size and branch complexity in tracheal terminal cells.

Last but not least, Robert Fischer and colleagues from the Waterman laboratory at the National Heart, Lung and Blood Institute, Bethesda, USA, innovate with an article which is both a review of the important role of filopodia in single-cell branching and a research article on how VASP assembles into filopodia and adhesions during zebrafish angiogenesis.

It has been a great pleasure bringing together this collection of articles featuring the current cutting-edge research in single-cell branching. I hope that it provides the reader with both a resource of background information and a glimpse of the latest advances. I am indebted to all the scientists that participated, with their work, in this special issue and to all the people that have advised and helped with putting this issue together. Research on single-cell branching has important applications in a wide range of fields, from developmental to cancer biology and regeneration. This is undoubtedly an area in which the fields of Developmental and Cell

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Biology join together and integrate important knowledge for the advancement of our understanding of the mechanisms of morphogenesis.

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