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Transfer cells are anatomically specialized cells optimized to support high levels of nutrient transport in plants. These cells trans-differentiate from existing cell types by developing extensive and localized wall ingrowth labyrinths to amplify plasma membrane surface area which in turn supports high densities of membrane transporters. Unsurprisingly, therefore, transfer cells are found at key anatomical sites for nutrient acquisition, distribution and exchange. Transfer cells are involved in delivery of nutrients between generations and in the development of reproductive organs and also facilitate the exchange of nutrients that characterize symbiotic associations. Transfer cells occur across all taxonomic groups in higher plants and also in algae and fungi. Deposition of wall ingrowth-like structures are also seen in “syncytia” and “giant cells” which function as feeding sites for cyst and root-knot nematodes, respectively, following their infection of roots. Consequently, the formation of highly localized wall ingrowth structures in diverse cell types appears to be an ancient anatomical adaption to facilitate enhanced rates of apoplasmic transport of nutrients in plants. In some systems a role for transfer cells in the formation of an anti-pathogen protective barrier at these symplastic discontinuities has been inferred. Remarkably, the extent of cell wall ingrowth development at a particular site can show high plasticity, suggesting that transfer cell differentiation might be a dynamic process adapted to the transport requirements of each physiological condition.

Recent studies exploiting different experimental systems to investigate transfer cell biology have identified signaling pathways inducing transfer cell development and genes/gene networks that define transfer cell identity and/or are involved in building the wall ingrowth labyrinths themselves. Further studies have defined the structure and composition of wall ingrowths in different systems, leading in many instances to the conclusion that this process may involve previously uncharacterized mechanisms for localized wall deposition in plants. Since transfer cells play important roles in plant development and productivity, the latter being relevant to crop yield, especially so in major agricultural species such as wheat, barley, soybean and maize, understanding the molecular and cellular events leading to wall ingrowth deposition holds exciting promise to develop new strategies to improve plant performance, a key imperative in addressing global food security. This Research Topic presents a timely and comprehensive treatise on transfer cell biology to help define critical questions for future research and thereby generating a deeper understanding of these fascinating and important cells in plant biology.