

# Preface

The exchange of small solutes and macromolecules between cells is a crucial process for system integration in any multicellular organism. Animals and plants solve the problem of cell-to-cell transport in different ways. In animals transport across the cell membrane is the only, or at least the main, pathway for molecules of different kinds to travel between cells. In plants, however, aside from transmembrane transport, a second (and apparently the most important) transport mode exists, i.e., molecule movement through plasmodesmata—the numerous thin channels connecting living protoplasts. Plasmodesmata allow plant cells to communicate in spite of the cell wall, a more or less rigid layer, surrounding every living plant protoplast. Its presence is responsible for the existence of two different systems—symplasm (protoplasts connected by plasmodesmata) and apoplasm (cell walls and intercellular spaces)—that build every plant organism. Plasmodesmal connections appear as a highly dynamic network, responsible not only for cell-to-cell exchange of organic compounds of a different nature, e.g., carbohydrates and amino acids, but also for movement of signaling macromolecules involved in plant development, such as transcription factors and nucleic acids. Symplasmic transport in plants also regards the movement of solutes and macromolecules over a distance of several meters or even more, by using specialized cells, sieve cells or sieve elements; however, the mechanism of such long-distance transport differs from that of cell-to-cell transport. Hence, symplasmic transport (being responsible for the exchange of solutes and signal macromolecules between cells, tissues, and organs) integrates the plant as the unit.

In the presence of many outstanding papers and books on the processes of transport, the symplasmic transport of molecules in plants seems to have been left aside. In this book we would like to emphasize what an important role symplasmic communication plays in plants. Herein, we would like to concentrate on symplasmic transport of small molecules, although the cell-to-cell transport of macromolecules will also be discussed. We are going to characterize the efficiency of symplasmic transport, mechanisms of molecule passage via plasmodesmata, and the external and internal factors that regulate plasmodesmatal conductivity. In this context, we will concern ourselves with the role of symplasmic domains in plant development, as well as the influence of environmental stresses on the plasmodesmata.

Besides cell-to-cell symplasmic transport, the significance of long-distance symplasmic transport of solutes in phloem elements will likewise be reviewed. We intend to present the mechanism of phloem transport, the processes of symplasmic loading and unloading, as well as the role of pre- and post-phloem transport, with special attention paid to symplasmic transport in wood. Finally, the relevance of the spread of both macromolecules and viruses, via plasmodesmata and phloem, will be presented.

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