PREFACE

Cellular compartmentalization into and within organelles segregates biochemical reactions and increases local molecular concentrations, thereby promoting efficiency of cellular processes. Within membranes, subdomains generate lateral heterogeneity that organizes the spatial distribution of glycoprotein receptors and membrane proximal effectors. Morphologically identifiable plasma membrane domains include not only clathrin-coated pits and caveolae but also lipid rafts that form a class of membrane domains that are poorly defined morphologically. Cellular organelles, such as mitochondria, the endoplasmic reticulum, the Golgi apparatus, endosomes, and lysosomes, also define morphologically distinct domains whose functionality depends, in large part, on the establishment of "domains within domains." Cellular organization is determined by cytoskeletal elements, including the actin and microtubule cytoskeletons, that generate cell surface microvilli and cilia, respectively, as well as intermediate filaments. Adhesive and communicating domains regulate interaction of the cell with the substrate through focal adhesions, as well as with other cells via adherens junctions, tight junctions, desmosomes, and gap junctions. The latter are particularly expressed in epithelial cells whose apical–basolateral polarization is critical to their transport function. Essentially, all cells are polarized, and the neuron represents a prime example of how cellular polarization results in the formation of functional domains. Nuclear domains control genetic regulation and transcription, and nuclear–cytoplasmic exchange and transport is mediated by the nuclear pore that delivers RNA to cytoplasmic domains that regulate RNA translation and degradation. Molecular determinants of cellular domains therefore include essentially all molecular components of the cell, including DNA, RNA, proteins, lipid, and glycans. Defining domains and understanding the molecular basis of their formation is central to understanding cellular function.

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