

Everything you ever wanted to know about endocytosis

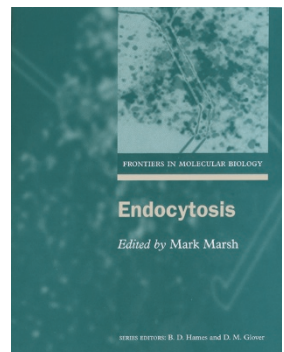
Endocytosis

edited by Mark Marsh

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Nowhere is the interdisciplinary nature of cell biology better illustrated than in the field of endocytosis. In recent years, it has become clear not only that a better understanding of endocytosis is important to studies of membrane trafficking and protein targeting but also that endocytosis is intimately connected to diverse cellular processes including signal transduction, cytoskeleton structure and function, and transcriptional regulation. Furthermore, many inherited human diseases are now explained by disruptions in endocytosis. With these many incentives, an interest in the mechanisms of endocytosis has grown dramatically.

The current explosion of new proteins and interaction motifs, regulatory mechanisms, endocytic organelles and pathways makes this a daunting field to newcomers. This volume, edited by Mark Marsh, performs a great service in two ways—it serves as an excellent introduction to this complex topic for naive readers while simultaneously being complete enough to satisfy aficionados. As evidence for this, I had to fight with my graduate students for my turn to read *Endocytosis*, which is now the most popular book in the lab.

The 11 chapters of the book represent a wide variety of subdisciplines within endocytosis, each written by an acknowledged expert in the field. Although all the chapters are extremely well written and provide succinct, clear overviews of their respective topics, there are a few standout chapters that deserve special attention.

There are known to be several routes of endocytosis. Clathrin-dependent endocytosis (well summarized by Liu, Mallet and Brodsky) has been at the forefront of study in this field for decades. Thus, the questions have reached a sophisticated level and are addressing the biochemical functions and atomic structures of necessary factors. By contrast, studies of clathrin-independent pathways are still in their infancy and are fraught with inconsistencies and confusing system-specific differences. As a

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remedy to these problems, the chapter by Dautry-Varsat provides a very clear description of what is known, what is not known and, importantly, what are the caveats for experimental approaches that are thought to distinguish between clathrin-dependent and -independent internalization routes. Those among us who have been perplexed by the literature will find this chapter very illuminating.

The chapter describing molecular mechanisms of membrane fusion in the endocytic pathway (by Stenmark and Zerial) does an admirable job of presenting the latest models of the proliferation of Rab5 regulators and effectors that govern trafficking through the early endocytic pathway. Rab5 is a regulatory guanosine triphosphatase (GTPase) that is associated with the sorting endosome and participates in endosomal membrane fusion reactions. The discussion covers the use of various model systems to study interactions between the Rab GTPases, SNARE molecules (integral membrane proteins involved in vesicle fusion) and lipids. There are also several helpful illustrations accompanying this chapter.

Moving on to later events, Seaman and Luzio present a comprehensive analysis of lysosomes and other late compartments of the endocytic pathway in both yeast and mammalian cells. This chapter is rather long but is very well written and provides a complete treatise on many aspects of membrane trafficking—summaries of the debate over the origins of organelles (the maturation hypothesis versus vesicular transport), the complexes that govern forward and

retrograde traffic through these late compartments, and the cytosolic signals and coat complexes involved in transport. In fact, this chapter would be an excellent reading assignment for an advanced cell biology class to introduce important general concepts in membrane trafficking.

Unfortunately, space constraints force me to make the difficult choice of only one more chapter to highlight. In the final chapter, Russell and Marsh synthesize information (also included in greater detail in the chapters on phagocytosis and antigen presentation) to explain the roles of endocytosis in pathogen entry and replication. Here, they introduce the wide variety of strategies used by clever pathogenic viruses, bacteria and protozoa to exploit their host's endocytic pathways to gain access to cells and to avoid immune surveillance. By breaking down the various mechanisms into easily understood categories, the authors give a flavour of the differences in how pathogenesis works. They also make clear that many candidates for therapeutic targets can be gleaned from a better understanding of these processes.

One minor criticism is that there are occasional grammatical and typographical errors, and awkward punctuation, which can disrupt the flow of the text. Another is that, as with any volume of this type that attempts to cover a rapidly moving field, many of the chapters are already slightly out of date given the inevitable lag from page proofs to final publication. That being said, the essential truths are there and most chapters are, in fact, surprisingly current. This volume is an important addition to the scientific literature in its clear and complete explanations, which can quickly bring new investigators in the field 'up to speed' yet still be stimulating to those of us who have studied endocytosis for years. I highly recommend it! □

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