

Sasaki, A.T. and R.A. Firtel (2006). Regulation of chemotaxis by the orchestrated activation of Ras, PI3K, and TOR. *Eur. J. Cell Biol.* 85:873-895.

Directed cell migration and cell polarity are crucial in many facets of biological processes. Cellular motility requires a complex array of signaling pathways, in which orchestrated cross-talk, a feedback loop, and multi-component signaling recur. Almost every signaling molecule requires several regulatory processes to be functionally activated, and a lack of a signaling molecule often leads to chemotaxis defects, suggesting an integral role for each component in the pathway. We outline our current understanding of the signaling event that regulates chemotaxis with an emphasis on recent findings associated with the Ras, PI3K, and target of rapamycin (TOR) pathways and the interplay of these pathways. Ras, PI3K, and TOR are known as key regulators of cellular growth. Deregulation of those pathways is associated with many human diseases, such as cancer, developmental disorders, and immunological deficiency. Recent studies in yeast, mammalian cells, and *Dictyostelium discoideum* reveal another critical role of Ras, PI3K, and TOR in regulating the actin cytoskeleton, cell polarity, and cellular movement. These findings shed light on the mechanism by which eukaryotic cells maintain cell polarity and directed cell movement, and also demonstrate that multiple steps in the signal transduction pathway coordinately regulate cell motility.