Although they lack the organelles characteristic of eukaryotes, prokaryotes produce a number of functionally complex compartments and organelles that serve a variety of purposes. A fascinating example is bacterial microcompartments (MCPs) which are widespread family of organelles that play important roles in global carbon fixation and bacterial pathogenesis. The general function of MCPs is to optimize metabolic pathways by enhancing metabolic flux and sequestering toxic or volatile intermediates. As might be expected, this function requires an extremely complex compartment. The protein shells of MCPs act as diffusion barriers that sequester toxic/volatile intermediates but at the same time they also allow the efficient influx of the required pathway substrates and cofactors as well as the efflux of products. MCP function also requires an assembly process that encapsulates diverse metabolic enzymes (as an ordered complex) within a protein shell built from multiple functionally diversified subunits. Moreover, MCPs are thought to require mechanisms for regulation, homeostasis and communication with other cellular systems. In this seminar, I will discuss the importance of MCPs and their underlying principles focusing on a MCP used for 1,2-propanediol degradation by *Salmonella*.