Delivery of cells, with or without polymeric biomaterials, is currently a central tenet of tissue engineering and regenerative medicine. Despite its scientific merit, cell delivery encounters several barriers in clinical translation. Immune rejection, pathogen transmission, potential tumorigenesis, packaging/storage/shipping, and anticipated difficulties in clinical adoption, cost reimbursement and regulatory approval are among some of the roadblocks. Economic viability of cell delivery, especially if it requires substantial ex vivo cell manipulation, is far from trivial. Here, experimental data are presented to indicate that the regeneration of multiple and, in some cases, complex tissues, is such as dermal, muscle, dental, cardiac, cartilage and bone *in vivo* by the endogenous homing of host cells to the site of interest. Data from independent reports by multiple laboratories suggest an emerging concept that single or complex tissues can regenerate by the homing of endogenous cell lineages, including angiogenesis. A multitude of approaches will be discussed to orchestrate cell homing including active recruitment of host endogenous cells by chemokines, cytokines, drugs and/or polymeric materials. Information on the mechanisms of cell homing will be explored primarily by in vitro studies of cell migration, cell recruitment and cell motility in 2D and 3D models. An additional focus will be to delineate the potentials and challenges to harness the host's own cells, including stem/progenitor cells, for the regeneration of multiple tissues.