Our group studies the role of the cell microenvironment in development of healthy and diseased tissues for applications in regenerative medicine and cancer therapeutics. In particular, we focus on cell-cell interactions, soluble signaling and development of biomaterials to control cell behavior. Our efforts are focused on three main areas: 1) In vivo capture of metastatic cells, 2) Cellular dormancy and activation, 3) Transport across physiological barriers, and 4) Biomanufacturing of natural killer cells for cancer immunotherapy.

In Vivo Capture of Metastatic Cells: A major challenge in cancer treatment is the inability to effectively prevent or treat metastasis of the cancer from the site of origin to other organs. We design biomaterial scaffolds that can capture and destroy metastatic cells for various types of cancer. We focus on coupling modulation of the local immune environment upon destruction of the tumor cells with systemic immunomodulation strategies such as checkpoint blockade in order to generate an immune response that can kill any remaining cancer cells throughout the body.

Cellular Dormancy and Activation: Throughout the body there are stem cell populations that help maintain tissue homeostasis. These cells typically remain in a dormant state until injury or growth requires their activation to repopulate cells within the tissue. Disseminated cancer cells can also remain dormant at various sites in the body for years before reactivating and causing recurrence of metastatic disease. We aim to understand the mechanisms that control the switch between cellular quiescence and activation for translational applications such as mobilizing endogenous stem cells for regenerative therapies and inducing dormancy of disseminated tumor cells to prevent disease recurrence.

Transport Across Physiological Barriers: There are various cellular barriers throughout the body that regulate physiological transport. Our goal is to use stem cell-based models of these barriers in order to study transport across these barriers in healthy and diseased tissues. We currently focus on strategies to restore integrity of the blood-brain barrier in diseases such as cancer, stroke, and Alzheimer's disease in addition to developing novel models of the intestinal epithelial barrier to design strategies for oral drug delivery.

Biomanufacturing of Natural Killer Cells for Cancer Immunotherapy: Clinical trials are underway using natural killer (NK) cells to treat blood
cancers and solid tumors. As NK cells can be used for allogeneic transfer, in which cells from a single donor can be used to treat many patients, extensive expansion of the cells is needed for clinical use. We are coupling quantitative analysis of NK cell growth and metabolism with mechanistic studies of cellular activation and functionality to develop robust, feeder-free strategies for large-scale manufacturing of NK cells.

**Awards**

NSF CAREER Award, 2019
Baxter Young Investigator Award, 2013
National Science Foundation Graduate Research Fellowship, 2007-2010
Ronald A. Ragatz Outstanding Teaching Assistant Award, 2008
Interdisciplinary Stem Cell Fellowship, UW-Madison Regenerative Medicine and Stem Cell Cluster, 2007

**Selected Publications**


