

Embryonic Stem Cells and Environmental Health Science

Embryonic stem cells (ESCs) are derived from the epiblast cells in the blastocyst stage embryos. They have two defining features: self-renewal and pluripotency. Self-renewal describes their capability to go through cycles of cell division and maintain the undifferentiated state, while pluripotency describes their capability to differentiate into all cell types from the three germ layers. Because of these unique properties, ESCs hold great promises for both basic and translational research. In addition, ESCs can also provide new tools and insights for environmental health sciences.

The long-term goal of our research is to better understand the molecular mechanisms that regulate ESC self-renewal and differentiation. We have previously carried out a genome-wide RNAi screen in mouse ESCs and identified a list of novel regulators of ESC self-renewal. We have since investigated the function of several of the identified factors in ESCs, somatic cell reprogramming, and mouse embryonic development, and uncovered novel mechanisms such as mRNA deadenylation, mRNA export, mRNA alternative polyadenylation, and chromatin remodeling in the regulation of the ESC state. In the future, we will continue to investigate ESC self-renewal and differentiation using genetic and genomic approaches. In addition to the basic research approaches, we are also collaborating with other labs to ESCs to address environmental health science questions. Specifically, we will initially use human ESC differentiation as a culture model to investigate the developmental toxicity of selected environmental compounds. In the long run, we will establish reporter cell lines and screening conditions to systematically dissect the roles of environmental factors in development and diseases. We hope our research will provide new insights to mammalian development and facilitate the use of pluripotent stem cells for translational and environmental health research.