Programming Cell State

Richard Young, Whitehead Institute and MIT, Cambridge, MA 02142

Discovering how transcriptional regulatory circuitry establishes and maintains gene expression programs in mammalian cells is important for understanding the control of cell state, the process of development and the mechanisms involved in cellular reprogramming. We are mapping the regulatory circuitry of embryonic stem (ES) cells and induced pluripotent stem (iPS) cells by investigating how key regulators control the gene expression program responsible for self-renewal and pluripotency. We have identified novel transcription factors, chromatin regulators, signaling components and noncoding RNAs that contribute to ES cell regulatory circuitry. Various genome-wide technologies have been used to map how these regulators contribute to control of genome expression. Advances in our knowledge of this regulatory circuitry have provided insights into the mechanisms by which somatic cells are reprogrammed into iPS and other cell types and have revealed how the controls of cell state can be manipulated to enhance reprogramming. These new advances and insights provide the foundation for further understanding developmental processes and are facilitating efforts to manipulate cell fates for regenerative medicine.