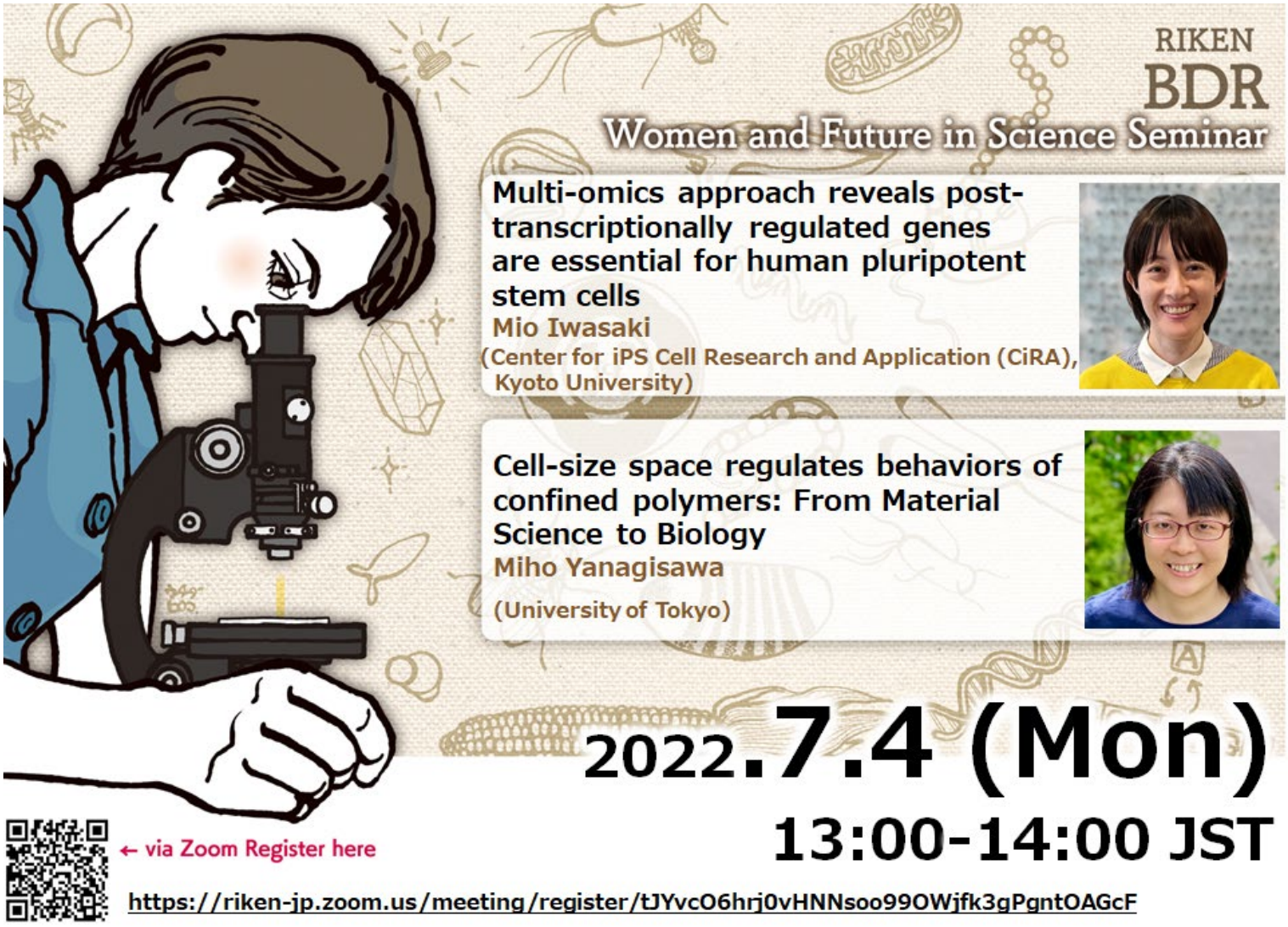

Multi-omics approach reveals post-transcriptionally regulated genes are essential for human pluripotent stem cells

The effects of transcription factors on the maintenance and differentiation of human-induced or embryonic pluripotent stem cells (iPSCs/ESCs) have been well studied. However, the importance of posttranscriptional regulatory mechanisms, which cause the quantitative dissociation of mRNA and protein expression, has not been explored in detail. Here, by combining transcriptome and proteome profiling, we identified 228 posttranscriptionally regulated genes with strict upregulation of the protein level in iPSCs/ESCs. Among them, we found 84 genes were vital for the survival of iPSCs and HDFs, including 20 genes that were specifically necessary for iPSC survival. These 20 proteins were upregulated only in iPSCs/ESCs and not in differentiated cells derived from the three germ layers. Although there are still unknown mechanisms that downregulate protein levels in HDFs, these results reveal that posttranscriptionally regulated genes have a crucial role in iPSC survival.

Cell-size space regulates behaviors of confined polymers: From Material Science to Biology

Biopolymer micromaterials in a liquid or gel phase covered with a membrane are widely used in pharmaceuticals, cosmetics, and foods due to their high biocompatibility. Especially, cell-sized micromaterials of biopolymer solutions covered with a lipid membrane have been studied as artificial cells to understand cells from a physicochemical perspective. Characteristics and phase transitions of biopolymers confined to a cell-size space often differ from those in bulk systems. We call the effect that causes this difference the “cell-size confinement effect (CSE).” However, the specific physicochemical factors remain unclear. This study introduces the analysis of CSE on molecular diffusion, nanostructure transition, and phase separation and presents their main factors, i.e., short- and long-range interactions with the membrane surface and small volume (finite element nature). This analysis serves as a guide for determining the dominant factors in cell-size confinement. Further, we also introduce other factors of CSE, such as spatial closure and the relationship between space size and characteristic lengths produced by biopolymer assemblies through the analysis of protein reaction-diffusion systems and biochemical reactions. We believe that these findings on CSEs will contribute to material science to biology.

Contact information : bdr_diversity_po@ml.riken.jp