Stem Cell Biology and Regeneration

Course code: JAL 304
Credits: 3-1-0

Instructor: Dr. Megha Singhal

Unit 1: Introduction to Stem Cells

Concepts of Stem cell biology, Pluripotent stem cells from vertebrate embryos, Embryonic stem cells, Epidermal stem cell, Intestinal stem cells, Pancreatic stem cells, Liver stem cells, Organoids, Direct reprogramming of Somatic cells to a pluripotent state, Clinical translation of stem cells

Unit 2: Basic Biology/Mechanisms

Molecular basis of pluripotency, Stem cell niches and mechanism of Stem cell renewal, Cell cycle regulators in adult stem cells, how cells change their phenotype, cell fusion and the differentiated state

Unit 3: Tissue and organ development

Differentiation in early development, Stem cells in extraembryonic lineages, Amniotic fluid derived pluripotent cells, Cord blood and hematopoietic stem cells and progenitor cells, neurogenesis in vertebrate emb

ryo, multipotent adult progenitor cells

Unit 4: Chemical Biology of Stem cells

Discovery based chemical approaches, Rationale based chemical approaches, Chemical approaches modulating in vivo regeneration, small molecules modulating stem cell maintenance, small molecules that induce stem cell differentiation, small molecules that modulate reprogramming, modulating stem cell trafficking and homing, Self-renewal of tissue-specific stem and progenitor cells

Unit 5: Applications, Ethics and Regeneration

Cancer stem cells, Use of embryonic stem cells to treat heart disease, Stem cells to treat muscular dystrophy. Orthopedic applications of stem cells, Embryonic stem cells in tissue engineering, Stem cell gene therapy, Insulin producing cells for the treatment of Diabetes, Stem cells and mammalian heart regeneration, Ethical considerations, Stem cell research-religious perspective

Suggested reading:

1. Essentials of Stem cell Biology 2nd edition. By Robert Lanza
2. Michaela Prochazkova, MiquellaG. Chavez, Jan Prochazka, Hady Felfy, Vagan Mushegyan, Ophir D. Klein. Chapter 18 - Embryonic Versus Adult Stem Cells. Stem Cell Biology and Tissue Engineering in Dental Sciences, 2015, Pages 249-262
3. Wenlin Li, Ke Li, Wanguo Wei, and Sheng Ding. Chemical approaches to stem cell biology and therapeutics. Cell Stem Cell. 2013 Sep 5; 13(3): 270–283. PMID: 24012368
4. Wenlin Li, Kai Jiang, Wanguo Wei, Yan Shi, Sheng Ding. Chemical approaches to studying stem cell biology. Cell Research volume 23, pages 81–91 (2013)