

Faculty of Medicine
International Master Program
Molecular and Developmental Stem Cell Biology

Module sheet

Title of module	I Stem Cell Physiology
Module - coordinator	Prof. Dr. Beate Brand-Saberi

Credit points	10	Semester(s) in which the module is taught	1 and 2
Contact hours	3	Workload	300 hours

Lecturer(s)	Böing, Brand-Saberi, Brösicke, Faissner, Reinhardt, Theocharidis, Wiese
Type of teaching	Lecture (2 hours per week) Seminar (1 hour per week) Discussions in context with lectures and seminar; lecturers ask for feedback regarding understanding and progress; Blackboard Skills for efficient research interactions will be trained during the seminars which will be taught in a compact course organized as a mini-symposium organized by the students themselves.
Relation to curriculum	Compulsory; For master students of Biology/Biotechnology and Biochemistry of RUB, this module is suitable as an elective lecture.
Recommended prerequisites	No prerequisites from curriculum; Students taking this module will be expected to have a basic understanding of cell biology.
Aims	The module “Stem Cell Physiology” provides a molecular, cytological and developmental basis by which students will acquire a deep insight into the physiology, derivation and characteristics of well-known types of stem cells.
Learning outcome	<p>Knowledge:</p> <p>Students can describe the principles and chronology of vertebrate development and stem cell types (Stem Cell Physiology I). They can outline the molecular background underlying differentiation control versus stem cell self-maintenance, including cell-to-cell and ECM-to-cell signaling cascades (Stem Cell Physiology II).</p> <p>Skills:</p> <p>Students have understood and are able to explain basic processes of development. They can summarize and interpret developmental and stem cell related primary literature. Students can interpret basic and advanced problems in stem cell biology and relate morphological data.</p> <p>Competencies:</p> <p>Students can integrate and evaluate relevant stem cell-related textbook knowledge and research data at the morphological, developmental and molecular level. They can design and adequately present advanced level Power-Point based talks, relate them to background knowledge and critically discuss new data. They are capable of communicating in a scientific context in front of an international audience.</p>

<p>Contents of module</p>	<p>Semester 1: Cell cycle control and its implications for stem cell biology Principles of vertebrate development Gametogenesis and fertilization Early development: cleavage, blastocyst, gastrulation The three germ layers: ectoderm, mesoderm, endoderm and their derivatives Species-specific aspects of development Stem cell classification: - Hematopoietic stem cells - Mesenchymal stem cells, mesangioblasts - Embryonic stem cells - Fetal stem cells - Adult stem cells - Induced pluripotent stem cells - Stem cells in invertebrates Reproductive medicine</p> <p>Semester 2: The stem cell niche Neural stem cells as a paradigm for stem cell physiology Neural development from neural induction to synaptic plasticity Signaling processes in stem cells</p> <p>- Signal transduction pathways: protein kinaseA as a paradigm for molecular mechanisms of action; structure–function relationships of the kinase superfamily - receptor protein tyrosine kinases and their signaling mechanisms: subclasses: insulin-receptor, FGF-receptor, PDGF-receptor, intracellular signaling pathways: Ras-MAPkinase, PI3-kinase - non-receptor tyrosine kinases: structure-function relationship of src Kinase family - signal transduction for cellular survival and apoptosis: TNFalphaR , PI3Kinase: Bcl-2 protein family, Bcl-xL, Bak, -Serine-threonine receptor kinases: TGF-β receptors - Phosphotyrosin -phosphatases: catalytic mechanism, PDZ-domains - Cytokine (class I to IV) receptors and signaling mechanism, class I: growth-hormone, erythropoietin. Janus kinases (JAKs), (STATs), IL-6 receptor-family. Concepts of gene-therapy, class II : interferon α, β, γ, class III: (Fas, TNFR1, p75NTR), signaling: TRAFs, TRADD, FAAD, RIP, death-domains, initiator- and effector-caspases (9,3,1) class IV: interleukin-1-receptor, IRAP - GPCRs: GTPase-cycle, G-proteins, transducin signaling as paradigm, calcium-dependent signaling, Ca/Calmodulin, arrestin</p>
<p>Study and examination requirements; Forms of examination</p>	<p>Students performance during discussions and interactions in the context of the lectures and in the seminar with lecturers and fellow students; Presentations during the seminar</p> <p>The mode of examination will be one multiple choice test for each semester. Each examination will be of one hour and the question paper will consist of 30 questions with five choices for each question. The assessment will be based on the average mark obtained in the two semesters. Each exam thus contributes 50% to the overall module mark.</p>
<p>Literature</p>	<p>Developmental Biology, 9th edition 2010 Scott Gilbert, Sinauer Principles of Development, edition 2010 Lewis Wolpert Oxford University Press Embryology Keith Moore, Vidhya Persaud edition 2007 Elsevier Langman's Medical Embryology, 12th edition 2011 Thomas W. Sadler Lippincott, Williams & Wilkens D Voet/J. Voet:4th edition , Biochemistry, John Wiley</p>