

Cycle C: Growth and Development

Coordinator: Anne Spang

C1: Membrane Traffic and Cytoskeleton – 14476

(2 hrs/week; 2 CP; Spring 2021)

St. Helliwell, H. Hermann-Lerdon, J. Pieters, A. Spang, **M. Spiess**, M. Steinmetz

The organization of a eukaryotic cell, the positioning of the organelles, the distribution of proteins and their transport routes, as well as cell shape and motility depend on the cytoskeleton. This lecture covers on the one hand how proteins are targeted to organelles, inserted in to the lipid bilayer, and transported with membranes in the secretory and endocytic pathways. On the other hand, it describes the major components of the cytoskeleton, their assembly and regulation, their plasticity and regulation, and the role of the cytoskeleton in signaling, intracellular transport and cell division.

C2: Functional Organization of the Cell Nucleus – 13182

(2 hrs/week; 2 CP; Fall 2020)

S. Gasser

This course will describe the structure and function of the eukaryotic nucleus. The nucleus serves as the "brain" of the cell. It contains the genetic information and ensures that it is properly replicated, segregated, transcribed and repaired. Within the nucleus are functional compartments such as the nucleolus, whose function it is to produce ribosomes. The nucleus, which is membrane bound, has nuclear pores, which are complex, regulated machines that control the flow of material into and out of a nucleus. In this course, all features of the nucleus from regulated import/export through pores, to the compartmentalization of transcription, splicing, replication and repair will be covered. We will cover the pathology of nuclear defects, with a focus on mutations in structural components of the nucleus and how they compromise the integrity of the genome to cause tissue-specific disease. The structure and function of lamins and pore proteins in transcriptional control will be presented, as well as the structure and folding of chromosomes and their dynamics through the cell cycle. Subdiffusive movements of chromatin in interphase nuclei and the role of this dynamic behavior in repair and transcription will be discussed. The lectures will give an up-to-date overview of a complex structure-function problem that touches on crucial aspects of cell identity.

C3: Molecular Mechanisms of Development – 13166

(2 hrs/week; 2 CP; Fall 2019)

M. Affolter, U. Jenal, A. Spang, R. Zeller

Progress in molecular biology, genetic analysis and imaging technology in the past few years has led to a dramatic increase in the understanding of developmental processes. A number of different pathways have been elucidated that lead to the acquisition of different fates by originally equivalent cells. The spectrum of molecules involved in taking these decisions range from receptor-ligand complexes at the cell surface to transcription factors in the nucleus and targets of these transcription regulators. This lecture will present examples for developmental switches in a variety of systems, including single-cell organisms, plants, nematodes, flies and vertebrates. The lecture will illustrate a way of thinking rather than attempt to cover single details of the issues discussed.

C4: Cellular Signalling – 14245

(2 hrs/week; 2 CP, Fall 2020)

M. Affolter, **K. Ballmer-Hofer**

Cellular Signalling: This course gives an introduction into cellular signalling mechanisms. A general introduction will be followed by specific topics covering tyrosine and serine/threonine kinase growth factor receptors, protein/protein and protein/lipid interaction modules, signalling by Ras family G proteins, lipid kinases, phospholipid-coupled transduction systems, protein kinase C, G protein-coupled receptors, the cytokine receptor superfamily and their ligands, MAP kinase pathways, signalling to cell cycle regulators. Details coming up soon.

C6: Stem Cell Biology – 28854

(2 hrs/week; 2 CP; Spring 2020)

F. Doetsch, A. Wodnar-Filipowicz, I. Martin, A. Peters

Stem cell research continues to grow at an extraordinary pace and raises hope for reconstructive therapies. Embryonic stem (ES) cells can divide without limits, while maintaining the potential to make all cell types of the body. Induced pluripotent stem (iPS) cells are derived from somatic cell by "forced" expression of transcription factors, and bear similarities with pluripotent ES cells. As they can be generated from the individuals that may potentially need them for tissue and organ repair, they have the potential to avoid rejection, a problem often seen with heterologous tissue transplantation. This course will also cover so-called adult or tissue stem cells, which are the body's ultimate repair system in places where it is normally at work, such as the hematopoietic system. These immature cells normally maintain a low profile within tissues and selected organs until activated by disease or injury. At the same time, they have some characteristics that are alarmingly close to cancer cells. It is conceivable that cancer stem cells may explain the resistance of some tumors to treatment that typically target rapidly dividing cells, an important aspect of stem cell pathology that will also be covered by this new series.