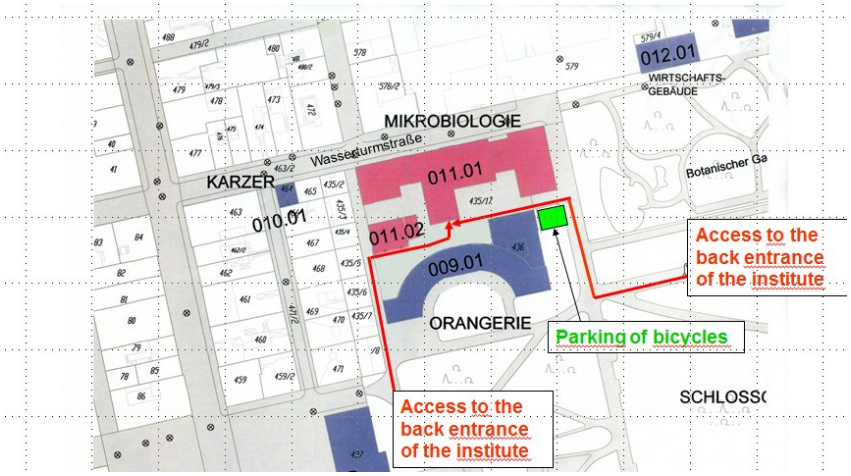
# Advanced Lectures in Molecular Medicine (Molecular Medicine, Master of Science) Part 1: „Immunology“

**Location: Seminar room** of the Institut für klinische Mikrobiologie, Immunologie und Hygiene, Wasserturmstraße 3, 91054 Erlangen (entrance: Schlossgarten, opposite of the Orangery building, 2nd floor).

**Time:** The lectures will take place **every Thursday from 2.15 p.m. until 3.45 p.m. (except for October 26: 1.45-3.15 p.m.)**

**Hygiene rules:** Please note that in accordance with the hygiene rules of FAU and the Bavarian government the **lectures in the winter term 2023/2024 will be given in person.**

**Access to the seminar room of the Institute of Clinical Microbiology, Immunology and Hygiene**




**Lecturers:**
CB: Prof. Dr. med. Christian Bogdan
DV: Prof. Dr. rer. nat. David Vöhringer
KS: PD Dr. med. Kilian Schober
SU: Prof. Dr. med. Stefan Uderhardt

| Lectures | Lecturer | Date |
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| **1. Introduction: Evolution – Components – Function – Dysfunction**<br>• Evolution of the immune system<br>• Tissues, cells, humoral components and functional anatomy of the immune system (including historical account)<br>• Overview: Function of the immune system (anti-infectious defense – anti-tumor-defense – transplant rejection)<br>• Overview: Dysfunction of the immune system (Autoimmunity – Autoinflammation – Immunopathology – Allergy - Immundeficiency) | CB | 26.10.2023 (1.45 p.m.) |
| **2. The anti-infectious immune response (I):** The basics of **innate immunity**<br>• dermal and epithelial barriers<br>• soluble factors: complement, cytokines, chemokines<br>• myeloid cells: types, development,diversity (granulocytes,macrophages, dendritic cells)<br>• concepts of pathogen recognition; pathogen recognition receptors<br>• antimicrobial effector functions of phagocytes<br>• natural killer cells, innate lymphoid cells<br>• principles of innate antiviral responses (type I IFNs) | CB | 02.11.2023 (2.15 p.m.) |

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| **3. The anti-infectious immune response (II):** The basics of **T cell-mediated immunity**<br>• principle modes of thymic T cell development<br>• antigen processing and presentation by MHC molecules<br>• signals for T cell activation (TCR signaling, costimulatory molecules, cytokines; signals 0, 1, 2, 3)<br>• T cell differentation and T cell subpopulations (CD4; CD8; Th1, Th2, Th17, Tregs; memory T cells)<br>• Functions of T cells (B cell help [follicular T helper cells]; macrophage activation [IFN-g, TNF]; cytotoxicity; regulatory) | DV | 09.11.2023 (2.15 p.m.) |
| **4. The anti-infectious immune response (III):** The basics of **B cell- and antibody-body mediated immunity**<br>• principles of B cell- and plasma cell development; B cell-driving cytokines<br>• types and functions of B cells (B1a, B1b; innate response activator B cells; B2; follicular B cells; marginal zone B cells; B cells with regulatory function; memory B cells)<br>• long-lived plasma cells<br>• antibody diversification and affinity maturation<br>• antibody classes and functions<br>• signals for B cell activation (T cell-dependent vs. –independent antigens), BCR signaling | DV | 16.11.2023 (2.15 p.m.) |
| **5. Methods for phenotypic and functional characterization of immune responses**<br>**5.1. in vitro and ex vivo methodologies**<br>• flow cytometry and cell sorting, immunophenotyping<br>• cell proliferation (3H, CFSE) following antigen-specific or polyclonal stimulation<br>• mixed lymphocyte reactions<br>• cytotoxicity assays<br>• determination of antigen-specificity using tetramer technology<br>• cytokine expression analysis: intracellular cytokine staining; cytokine secretion assays; ELISPOTs; ELISA<br>• signal transduction analyses (immunoprecipitations, Western blots)<br>**5.2. in vivo methodologies**<br>• genetic mouse models (knock-out, cell-specific knockouts [Cre/lox], BAC transgenics; reporter-mice; fate-mapping)<br>• mixed bone marrow chimeras | DV | 23.11.2023 (2.15 p.m.) |
| **6. The anti-tumor response of the immune system**<br>• immune surveillance<br>• tumor antigenicity<br>• effector cytokines (type I IFNs, IFN-g, TNF)<br>• effector cells: NK cells (activation vs. inhibition); CTLs; NKT cells; macrophages, dendritic cell subtypes<br>• tumor associated macrophages, myeloid suppressor cells and regulatory T cells block anti-tumour immune responses | KS | 30.11.2023 (2.15 p.m.) |
| **7. Dysfunction of the immune system/immune-related diseases (I): Allergies**<br>• Mechanisms of type I hypersensitivity reactions (IgE reactions)<br>• role of mast cells<br>• role of leukotrienes<br>• atopy, allergic rhinitis, bronchial asthma, food allergies: mechanisms of disease and treatment<br>• genetic factors | DV | 07.12.2023 (2.15 p.m.) |

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| **8. Dysfunction of the immune system/immune-related diseases (II): Autoimmunity**<br>• central and peripheral T cell tolerance<br>• central and peripheral B cell tolerance<br>• organ-specific autoimmune diseases (diabetes, thyroiditis, multiple sclerosis)<br>• systemic autoimmune diseases (rheumatoid arthritis, systemic lupus erythematodes)<br>• mechanisms of pathogenesis (infection breaks tolerance: antigenic mimicry vs. by-stander activation, lowering T cell receptor thresholds; defective phagocytosis of apoptotic cells; TLR9-BCR-crosstalk)<br>• mechanisms of tissue damage (type II, type III,type IV hypersensitivity) | SU | 14.12.2023 (2.15 p.m.) |
| **9. Dysfunction of the immune system/Immune-related diseases (III): Graft vs. host diseases**<br>• principles of tissue compatibility and transplantation immunology<br>• Autografts, isografts, allograft, xenograft<br>• pregancy as a case of natural transplantation (mechanisms of tolerance)<br>• organ transplantation and transplant rejection (examples: solid organs vs. [illegible]) | KS | 21.12.2023 (2.15 p.m.) |
| **10. Dysfunction of the immune system/immune-related diseases (IV): immunodeficiencies**<br>• T cell disorders<br>• B cell/antibody disorders<br>• myeloid cell disorders<br>• cytokine (receptor) deficiencies<br>• signalling defects | KS | 11.01.2024 (2.15 p.m.) |
| **12. Dysfunction of the immune system/immune-related diseases (V): Chronic inflammatory and autoinflammatory diseases**<br>• chronic inflammatory bowel diseases (IBD; e.g. Crohn´s disease): role of genetics. vs. microbiota<br>• autoinflammatory diseases: micromilieu triggers (e.g. gout); environmental triggers (e.g. silicosis, asbestosis); genetic (hereditary periodic fevers: gain of function mutations); inflammasomes: composition, types, function; mechanisms of inflammasome activation | SU | 18.01.2024 (2.15 p.m.) |
| **13. Termination of immune responses and immunotherapy**<br>**13.1. Resolution of inflammation and tissue repair**<br>• macrophage deactivation and alternative macrophage activation<br>• regulatory T cells (and their effectors)<br>• lipoxins, resolvins<br>• transforming growth factor b<br>• protease inhibitors (e.g. SLPI)<br>• reactive oxygen and nitrogen intermediates<br>**13.2. Immunotherapy of allergic, autoimmune, GvH and malignant diseases**<br>• desensitization<br>• Immunosuppressants (e.g. CsA, FK506, steroids, mycophenolat)<br>• cell transfer (dendritic cells, T cells, B cells)<br>• antibodies (biologicals) | SU | 25.01.2024 (2.15 p.m.) |
| **14. Vaccination**<br>• types of vaccines<br>• mechanisms of vaccine-induced immunity and protection<br>• role of B cell, plasma cell and T cell memory depending on the vaccine antigen<br>• mechanisms of action of adjuvants (e.g. Al(OH)3: induction of cell death and DNA release; release of uric acid; direct activation of inflammasomes) | CB | 01.02.2024 (2.15 p.m.) |

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| **Written examination (joint exam together with imaging and neuroscience)**<br>180 minutes (60 minutes per subject)<br>mixture of MC questions and open questions (free text answers)<br>**Examination site: Lecture Hall of the Institute of Biochemistry, Fahrstraße** | | **Friday** 9.2.2024, 10 a.m. to 1 p.m. |