SZKOŁA GŁÓWNA GOSPODARSTWA WIEJSKIEGO

Immunology

Educational subject description sheet

Basic information

Field of study Biotechnology	**Didactic cycle** 2024/25
Speciality -	**Subject code** BBTBTjS_D.310K.63359c664d848.24
Organizational unit Faculty of Biology and Biotechnology	**Lecture languages** english
Study level first cycle (engineering degree)	**Mandatory** Obligatory subjects
Study form full-time studies	**Block** Major subjects
Education profile General academic	**Disciplines** Biological sciences

Coordinator	Małgorzata Gieryńska
Teacher	Małgorzata Gieryńska, Lidia Szulc-Dąbrowska, Justyna Struzik, Karolina Gregorczyk-Zboroch

Period	**Examination**	**Number of ECTS points**
Semester 5	Exam **Activities and hours** Lecture: 30 Laboratory exercises: 15	4

Goals

Code	Goal
C1	Basic (contemporary) immunology has its roots in microbiology, genetics, biochemistry, molecular biology, biotechnology, pathology, and clinical observations. The major goal of this course is to impart an understanding of the relations between host defense mechanisms and infectious agents, also the ability of the immune system to recognize the altered self-cells. The effort is focused on understanding mechanisms that enable to design of efficacious vaccines that eventually control animal infectious diseases. The expected learning outcomes of this course are the acquisition, by students, the working knowledge of immunological principles as they relate to the cells and molecules of the immune system, how they develop and acquire the ability to recognize foreign antigens, and finally how they malfunction in autoimmune diseases and how they become inadequate in immunodeficiencies. Upon completion of this course, students should be able to explain innate body defenses and adaptive immune responses and apply this understanding to the pathogenesis of infectious diseases as well as to prophylactic and control measurements. Furthermore, the student will be able to discuss the types and explain the basis of hypersensitivity and the causes and effects of primary and secondary immunodeficiencies and autoimmune diseases. The intention of the course is the presentation of methods suitable for immunity assessment and the possibility of using these assays in the diagnosis of infectious diseases as well as teaching basic serological techniques and evaluation of serological test results. Additionally, a demonstration of the techniques of isolation and culture of the lymphocytes and measuring their activity in vitro will be included. Students should develop the ability to work both independently and within the team in the laboratory, draw appropriate conclusions from experimental results and develop an information base for undertaking appropriate decisions in regard to animal diseases.

Entry requirements

Participation in an Immunology course requires knowledge of the following subjects: biochemistry, animal physiology, and microbiology (according to the study program). The student must know the metabolism and mechanisms of biochemical reactions in an animal cell/organism, the physiology of organs and organism systems, understand the relationship between the activity of individual systems and organs under physiological conditions, know the concepts of pathogenicity, virulence, and invasiveness of infectious agents.

Subject's learning outcomes

Code	Outcomes in terms of	Effects	Examination methods
Knowledge – Student knows and understands:			
W1	the structure and functions of individual parts of the immune system in the context of the physiology of other body systems	BTj_K3_W02_inz, BTj_K3_W06	Written exam, Written credit
W2	the mechanisms of innate and adaptive immunity	BTj_K3_W02_inz, BTj_K3_W06, BTj_K3_W08	Written exam, Written credit
W3	the mechanisms responsible for general and local immune response induction as well as the methods required for the assessment of those types of immune responses	BTj_K3_W06, BTj_K3_W08	Written exam, Written credit
W4	the mechanisms of regulation of the immune response induced by infectious agents and cancer	BTj_K3_W06, BTj_K3_W08, BTj_K3_W10	Written exam, Written credit
W5	the types of vaccines, understands the mechanisms of their mode of action, and the need for immunoprophylaxis of infectious diseases in humans and animals	BTj_K3_W02_inz, BTj_K3_W08, BTj_K3_W10	Written exam, Written credit

W6	the mechanisms related to the transfer of passive immunity from the mother and understands the causes of immune disorders related to maternal antibodies	BTj_K3_W05, BTj_K3_W06, BTj_K3_W08, BTj_K3_W10	Written exam, Written credit
W7	the mechanisms and describes the development of all types of hypersensitivity reactions and the consequences resulting from these mechanisms	BTj_K3_W05, BTj_K3_W06, BTj_K3_W08, BTj_K3_W10	Written exam, Written credit
W8	the causes and effects of the innate and adaptive immunodeficiencies	BTj_K3_W02_inz, BTj_K3_W05, BTj_K3_W06	Written exam, Written credit
W9	the basis of autoimmune diseases in humans and animals	BTj_K3_W05, BTj_K3_W10	Written exam, Written credit
W10	the importance of the use of serological tests (qualitative and quantitative) in the diagnosis of infectious diseases and the relationship between selected disciplines within the areas of natural sciences	BTj_K3_W04, BTj_K3_W07_inz, BTj_K3_W10	Written exam, Written credit
Skills – Student can:			
U1	prepare serum for serological assays	BTj_K3_U01_inz, BTj_K3_U03	Written exam, Written credit
U2	perform a simple serological test (quantitative and qualitative serological assays like agglutination test, immunodiffusion assay, and neutralization test) and can interpret the results of serological tests in the context of the diagnosis of infectious diseases	BTj_K3_U01_inz, BTj_K3_U03	Written exam, Written credit
U3	use monoclonal antibodies conjugated with the appropriate markers in the context of the diagnosis of infections and the assessment of the patient's health (immunofluorescence, immunoenzyme, and radioimmunological assays) and can detect antibodies in the patient's serum or other identification of an infectious agent	BTj_K3_U01_inz, BTj_K3_U03	Written exam, Written credit
U4	isolate specific populations of immunocompetent cells and determine their activity using immunoenzyme and immunofluorescence techniques, and molecular biology techniques	BTj_K3_U01_inz	Written exam, Written credit
Social competences – Student is ready to:			
K1	formulate the opinions in context of the importance of immunology and serological tests, applied in the diagnosis of infectious diseases, autoimmune diseases, and the identification of immunodeficiencies	BTj_K3_K01	Written exam
K2	use immunoprophylaxis against infectious diseases of humans and animals	BTj_K3_K02	Written exam
K3	apply the acquired knowledge and skills in further stages of education	BTj_K3_K02, BTj_K3_K03	Written exam
K4	cooperate with other colleagues by exchanging opinions and sharing the competences	BTj_K3_K04, BTj_K3_K06	Written exam
K5	constantly deepen the knowledge and improve own skills with the use of scientific resources	BTj_K3_K02, BTj_K3_K04, BTj_K3_K05	Written exam

Study content

No.	Course content	Subject's learning outcomes	Activities

1.	Lecture topics: 1. Introduction to veterinary immunology. Primary and secondary lymphoid organs. Types of immunity. Innate immunity. Pattern recognition receptors (PRR), their distribution, and their role in the induction of the immune response. (2h) 2. Cell signaling: chemokines, cytokines, and their receptors; their role in coordinating the functions of immune cells. Cells of the innate immunity (mast cells, phagocytes [monocytes, macrophages, granulocytes], natural killer cells, dendritic cells) and their role in immune response development; humoral and cellular mechanisms of innate immunity – inflammation (2h) 3. Humoral and cellular mechanisms of innate immunity: inflammation, phagocytosis and its relevance, complement system and other humoral mediators (2h) 4. Induction of the adaptive immune response: relevance of antigen-presenting cells (dendritic cells, macrophages, B cells); antigen presentation in the context of major histocompatibility complex class I and class II, as well as in the context of CD1 molecule. Definition of the antigen and superantigen; definition and significance of immunological synapse (2h) 5. Humoral adaptive immunity. B cell formation and maturation; structure and role of BCR. Structure and classes of immunoglobulins. B cells as effector cells of the humoral immune response (2) 6. Adaptive cell-mediated immunity. Formation and maturation of Tgd cells and Tab (CD4+ and CD8+) cells, as well as NKT cells. Induction and effector mechanisms of adaptive cell-mediated immune response (2h) 7. Primary and secondary immune responses and their regulation. Immunological memory and its regulation (2h) 8. Vaccine – active immunization against infectious diseases, introduction to prophylactic vaccination (2) 9. Humoral and cell-mediated mechanisms of local immunity; immunity at body surfaces – mucosal and skin immunity (2h). 10. Protective immunity – bacterial, viral, and fungal infectious diseases; immune evasion by bacteria, viruses, and fungi (2) 11. Regulation of the acquired immunity. T cell and B cell tolerance. Control of the immune response. Regulatory cells. Types of hypersensitivity. Selected topics related to autoimmune diseases (2) 12. Immunity of transplantation: types of grafts, mechanisms related to graft rejection/survival, immunosuppression (2h). 13. Transfer of the immunity from the mother to the young. Maternally derived antibody (MDA) in the protection of the offspring; serotherapy (2h). 14. Primary and secondary immunodeficiencies (2h) 15. Immunity to tumors. Failure of anti-tumor immunity. Immunotherapy in neoplastic diseases (2h).	W1, W2, W3, W4, W5, W6, W7, W8, W9, K1, K2, K3, K4, K5	Lecture

2.	Excercise topics: 1. The introduction to serology. Definition of the serum. Immunodiagnostic techniques. Reagents used in serological qualitative and quantitative tests. Titration of the antibodies. Secondary binding tests: agglutination. 2. Secondary binding tests (cont.). Precipitation. Immunodiffusion and immunoelectrophoresis tests. 3. Immunodiagnostic techniques. Assays that use indicator systems. Serum neutralization and complement fixation tests. Application of serological tests in diagnostics. 4. Primary binding tests. Application of monoclonal antibodies: immunofluorescence, immunoenzyme (ELISA, Western Blotting, immunohistochemistry) assays, and radioimmunoassay. 5. Immunophenotyping qualitative and quantitative evaluation of immune cells. Flow cytometry, magnetic separation. Methods of cell-mediated immunity (CMI) evaluation: proliferation test and cytotoxicity test. Assays for cytokine profile assessment.	W10, U1, U2, U3, U4, K1, K2, K3, K4, K5	Laboratory exercises

Course advanced

Activities	Methods of conducting classes
Lecture	Lecture, E-learning - lecture part, Presentation
Laboratory exercises	Presentation, Problem method, Analysis of source materials, E-learning - exercises part, Teamwork, Individual work, Laboratory (experiment), learning by experiment

Activities	Examination method	Percentage
Lecture	Written exam	50%
Laboratory exercises	Written credit	50%

Activities	Credit conditions
Lecture	Only those students, who participated in the practical classes and obtained a positive grade (grade at least 3.0 and higher), from the three consecutive partial written assessments, will be allowed to the final exam. The final grade, allowing for the final Immunology exam admittance, consists of grades obtained from 3 progressive written assessments during the semester The final exam consists of 8 open questions (maximum 2 points per question), and includes the knowledge student acquired during lectures and practical classes during the semester. It is possible to obtain 16 points from the exam. There is foreseen only one retake with the same criteria applied for both deadlines. In case of excused absence at the final exam, the student does not lose the deadline. No extra assessment methods are anticipated. Possible grades to obtain from the exam Grade number of points 5 15-16 4,5 13-14 4 11-12 3,5 9-10 3 8,5 2 8 or less

Activities	Credit conditions
Laboratory exercises	Attendance during laboratory practical classes is verified – the student can be absent in 20% of classes. That means, 1 absence during the semester - The 3 progressive assessments are conducted in the in-contact form. However, in cases depending on the current external conditions determined by the published legal acts, the form of evaluation tests will be modified from the in-contact form to the remote form, applying either Moodle platform or MS Teams platform. In such a case, the evaluation tests will be conducted in the form of a multiple-choice test. The students will be informed in advance about the changes regarding the evaluation tests. Otherwise, the tests will be carried out in the in-contact form with open-ended questions. - 3 progressive assessments per semester are scheduled at the beginning of the course and are carried out in the in-contact form. Each written progressive assessment consists of 6 open questions (2 points per question), maximum grade 12 points. The knowledge that students acquired by participating in lectures and practical classes will be evaluated. The scope of the material for the partial written assessments will be given at the beginning of the semester. There is 1 retake for each assessment. The same criteria apply to both terms (1 and 2). Possible grades to obtain from one assessment Grade number of points 5 12 4,5 11 4 10 3,5 8-9 3 7 2 6,5 or less

Literature

Obligatory

1. Janeway’s immunobiology - Kenneth P. Murphy, Paul Travers, Charles Janeway, Mark Walport; 8th, 9th, 10th editions (2011, 2016, 2017)
2. Veterinary immunology. An introduction – Ian Tizard; 8th , 9th, 10th Editions (2009, 2013, 2017)
3. Kuby Immunology, J. Punt, S. Stanford, P. Jones, J. Owen, 9th Ed, publisher by W. H. Freeman, 2018

Optional

1. Roitt’s Essential Immunology - Delves P.J., Martin S.J., Burton D.R., Roitt I.M, 12th , 13th editions
2. The Immune Response. Basic and Clinical Principles - Tak W. Mak and Mary E. Saunders, 2005
3. Basic Immunology. Functions and Disorders of the Immune System - Abul K. Abbas and Andrew H. Lichtman, 6th Edition, 2019
4. Current literature regarding the discussed topics, published in international scientific journals
5. Current literature regarding the discussed topics, published by the academic teachers from the Department of Preclinical Sciences

Calculation of ECTS points

Activity form	Activity hours*
Lecture	30
Laboratory exercises	15
Preparation for the test	30
Preparation for the exam	25

Student workload	**Hours** 100
Number of ECTS points	**ECTS** 4

* hour means 45 minutes

Effects

Code	Content
BTj_K3_K01	The graduate is ready to proper storage of data, updating and extending knowledge on topics related to biotechnology and the related sciences;
BTj_K3_K02	The graduate is ready to development and application of one’s skills in practice (including communication, teamwork), which enable effective lifelong learning with respect to biological sciences;
BTj_K3_K03	The graduate is ready to for safe work via the selection and application of a proper technique of handling, storing and disposing of laboratory materials (e.g. using proper techniques in terms of handling, storing and disposing of bacteria, chemical substances and dangerous bio-waste);
BTj_K3_K04	The graduate is ready to initiating and actively participating in the development and implementation of research and social projects;
BTj_K3_K05	The graduate is ready to for thinking and acting in an entrepreneurial way
BTj_K3_K06	The graduate is ready to presenting justified arguments supporting one’s standpoint regarding scientific, ethical and social topics influencing the progress in biological sciences;
BTj_K3_U01_inz	The graduate can utilise proper techniques and knowledge related to biotechnology in practice, under the care of a supervisor;
BTj_K3_U03	The graduate can provide and explain specific examples and apply proper experimental methods associated with the explanation of principles related to gene expression;
BTj_K3_W02_inz	The graduate knows and understands basics related to the life cycle of a biotechnological product, as well as devices and their instrumentation (measurement sensors) used in biotechnological production
BTj_K3_W04	The graduate knows and understands the necessity to use proper simple computational techniques (including statistical analysis, computational tools and computer software suites) for biological data
BTj_K3_W05	The graduate knows and understands the principles which define the three-dimensional structure of biological macromolecules, with the ability to explain and provide the examples of the relationship between structure and function
BTj_K3_W06	The graduate knows and understands the functions of various cells (prokaryotic and eukaryotic), being able to critically explain, how their properties are related to varying biological functions, knowing how they can be tested experimentally
BTj_K3_W07_inz	The graduate knows and understands experimental methods serving the examination of important areas in the field of biotechnology, chemistry, biochemistry, biophysics, molecular biology and the related sciences;
BTj_K3_W08	The graduate knows and understands the features of cellular metabolism and its control, including the knowledge of certain experimental techniques;
BTj_K3_W10	The graduate knows and understands terms, principles and theories related to processes and mechanisms which have shaped the world of nature, knowing how they can be used efficiently;