Department of Biology
Josip Juraj Strossmayer University of Osijek

Programme of study in Biology and Chemistry

Master level programme of study in Biology and Chemistry Education

accredited by the Ministry of Science, Education and Sports of
the Republic of Croatia on 16 June 2005

Osijek, October 2020

1.INTRODUCTION

a) Modern society is knowledge-based, and biology i.e. the science of life, has a significant role in it. Biodiversity, recombinant DNA technology and nature protection are biological disciplines, without the knowledge of which the modern society would not be able to survive. Therefore it is easy to recognize the value of knowledge gained from a study of natural sciences. With much focus on globalization, we often forget natural processes and it is important to provide education on the importance and functioning of life. Teaching plays and important role in the process of education, and it should provide younger generations with the knowledge that will explain and protect life. Biologists, in all segments of their activity, and whatever they professional interests may be (education, science, or professional activities), are necessary in society, and can find employment in the global job market. In addition to educational and scientific institutions, there is an increasing number of private companies that conduct research or have the production for which they need the expertise of biologists. The core and optional modules are based on the results of the most recent investigations, and provide basic knowledge that will make it possible for our graduates to be competitive in the global market of knowledge.
We are offering a 'major' programme for biologists that is comparable to many study programmes in the European Union (Universities in Wageningen, Heidelberg, Pecs), and the programme structure is agreed upon with other Croatian biology professionals. The programme also provides for vertical and horizontal student mobility.
b) The University Department of Biology was originally the Institute of Biology that was part of the Faculty of Education. Since 1977 educated teachers of biology and chemistry. Based on the Report of the committee for assessment of institutions of higher education in the Republic of Croatia, natural sciences, field biology (section 11 of the Report), we are proposing the bachelor level study programme in biology and master level study programmes in biology, biology education, and biology and chemistry education.
c) Partners in the education process are primary and secondary schools, where graduates will find employment. Partners in the education of graduates with and MA in biology are public institutions involved in nature protection, as well as other research-oriented institutions.
d) Proposed study programmes provide for the horizontal and vertical student mobility, as they are composed of 70% core modules and 30% optional modules like many European 'major + minor' study programmes, and they are comparable to similar study programmes in the Republic of Croatia.
e) Following the recommendations of the above mentioned Report of the committee for assessment of institutions of higher education in the Republic of Croatia (sections 7, 8, and 9), and since we managed to implement our plan to relocate the Institute of Biology and founded the University Department of Biology, we now have much better conditions for research and teaching, and can offer a modern programme of study in biology. Moreover, there have been considerable investments made in order to equip the labs and practicums, and such a positive trend is expected to continue.

2. GENERAL DESCRIPTION

2.1. Biology
Master level programme of study in biology and chemistry education

2.2. Josip Juraj Strossmayer University, Department of Biology
2.3. Duration of studies: 2 years (4 semesters)
Qualifications awarded: MSc in biology and chemistry education
2.4. Admission requirements: completed bachelor programme in biology, passed all exams in the optional module chemistry

2.6. On completion of the master level programme of study in biology and chemistry education, graduates will be able to continue some of the doctoral level programmes in natural sciences. Graduates can be employed to teach subjects in biology and chemistry at primary and secondary schools.

2.8. On completion of the master level study programmes the qualifications awarded are:
MSc in biology and chemistry education

3. STUDY PROGRAMME DESCRIPTION

3.1. The list of obligatory and elective courses and modules with corresponding number of teaching hours and ECTS credits

Obligatory Courses

I semester		**L**	**S**	**P**	**ECTS**	**CODE**
Pedagogy 1		15	15	15	3	BP9100
Psychology in Education 1		15	15	15	3	BP798
Animal Physiology 2		30	15		3	BP755
Plant Physiology 2		30		15	3	BP756
Biochemistry 3		30		15	3	BP754
Fundamentals of Physical Chemistry 1		45	15		5	K058
Practices in Physical Chemistry				60	5	K053
School Teaching Practice 1				30	2	BP7108
	375	**165**	**45**	**165**	**27**	

II semester		**L**	**S**	**P**	**ECTS**	
Pedagogy 2		15	15	15	3	BP9101
Psychology in Education 2		15	15	15	3	BP798-2
Didactics 1		15	15	15	3	BP797
Biological Collections		15		30	2	BP899
Basics of Horticulture		30		15	3	BM861
Methodology of Teaching Biology		30	15	60	6	BP8102
Fundamentals of Physical Chemistry 2		30	15		5	K059
Methodology of Teaching Chemistry		30	15		3	K071
Practices in Methodology of Teaching Chemistry				60	3	K073
School Teaching Practice 2				30	2	BP8109
	510	**180**	**90**	**240**	**33**	

III semester		**L**	**S**	**P**	**ECTS**	
Didactics 2		15	15	15	3	BP797-2
Terrestrial Ecosystems		15	5		2	
Aquatic Ecosystems		30	10		3	
Conservation Biology		30			3	BP91006
Teaching Practice in Biology				30	3	BP9107
Teaching Practice in Chemistry				30	3	K072
School Teaching Practice 3				30	2	BP9110
Study Visit	30					BP9112
Elective Courses	**180**				**11**	
	225	**90**	**30**	**105**	**30**	

IV semester	**ECTS**
Acceptance of MS theses	5
Research work	15
MS theses defence and final exam	10
	30

Elective Courses - Chemistry	L+S+P	ECTS	CODE
Atmosphere and Environment	15+15+0	2	K082
Research Work in Teaching Chemistry	15+0+45	2	K075
Chemistry in Everyday Life	15+0+15	2	K083
Colloid and Interfacial Chemistry	15+15+0	2	K054
Materials of the 21st Century – Technology and Environment	15+15+0	2	K026
Modern Spectroscopic Methods in Chemistry	15+0+15	2	K056
Introduction to Chemical Sensors and Biosensors	30+15+0	3	K066

Elective Courses - Biology

	L	S	P	ECTS	CODE
Biomolecules in Food	15	15		2	BMZ77
Genome Evolution	15	15		2	BMZ79
Plant Pathoanatomy	15		15	2	BMZ80
Plant Microtechnique and Microscopy	30		15	2	BMZ82
Immunocompetence and Transplantation	15		15	2	BMZ84
Animal Behaviour	15	15		2	BM969
Inquiry-based Teaching of Biology	15		15	2	BBZ49
Ecology in Education	15		15	2	BBZ50
Medicinal Plants	15	15	15	3	BBZ51
Fauna Diversity of Croatia	15	15	15	3	BBZ52
Sexuality of Living Creatures	30	15		3	BBZ53
Vegetation Mapping	15		15	2	BMZ92
Protection and Revitalisation of Aquatic Ecosystems	15	15		2	BBZ55
Biofilms	15	15		2	
Herpetology	15		15	2	
Areas of Importance for Croatian Flora	15	15		2	
Introduction to Scientific Research Methodology	15		15	2	
Algae as Biological Indicators	15		15	2	
Socially Useful Learning	3	27		2	
Ecological Immunology	15	15		2	
Ecological Projects	15	15		2	
Neuroimmunology	15	15		2	
History of Plant Physiology Research	15	5	10	2	
Application of Algae and Cyanobacteria	15	15		2	

Course teachers and associates are assigned to courses as of the academic year 2020/2021. The study program will be carried out starting from the academic year 2021/2022.

Obligatory courses

Course title	**Animal Physiology 2**
Code	BP755
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	I semester
Workload/ECTS credits	3
Course status	Obligatory
Course teacher	Assoc. Prof. Dr. Sandra Ečimović
Associate teachers	
Course entry requirements (Preceding courses)	Biochemistry 1, Biochemistry 2, Animal Physiology 1
Course objective	To enable students to acquire knowledge about animal organisms and their physiological mechanisms of adaptation to changes in the environment. To learn about principles of homeostasis regulation and energy balance at lower and higher levels of the biological system. To learn about necessary connection between different levels of the biological system and the integration of physiological processes under the influence of environmental factors. To acquaint students with the principles of adaptation in different types of environment and different environmental conditions.
Learning outcomes	1. Ability to determine the physiological responses of animal organisms in different environmental conditions. 2. Skills in presenting the adaptive mechanisms of animal organisms to changes in the environment. 3. Skills in presenting the principles of adaptation to different environmental conditions in the terrestrial and aquatic environment, and in extreme environmental conditions.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-3	1	Lecture	Lecture attendance and active participation	Records related to active participation in conversations and discussions	5	10
1-3	1	Seminar	Seminar paper. Critical conversation and discussion	Monitoring of student performance at interpreting and solving of exercises	10	15

	1-3	0.5	Exam (written exam)	Preparation for written exam	Written exam	20	35
	1-3	0.5	Exam (oral exam)	Preparation for oral exam	Oral exam	25	40
	Total	**3**				**60**	**100**
	Final grade: **60-70 points: grade 2 (sufficient)** **71-80 points: grade 3 (good)** **81-90 points: grade 4 (very good)** **91-100 points: grade 5 (excellent)**						
Consultation hours	By appointment						

Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	30	15	0

Course content / teaching units

Lectures:

- Introduction into and review of the basic physiological concepts
- Adaptation boundaries
- Restrictive and expansive adaptation
- Physical interactions between the organism and the environment
- Radiation, conduction, convection and evaporation
- Scaling of metabolism and thermal interactions
- Temperature adaptation
- Poikilothermia and ectothermia. Homeothermy and endothermy
- Exchange of matter with the environment
- Osmotic change in aquatic and transitional animals
- Water and sodium chloride exchange in terrestrial animals
- Gas exchange adaptations
- Energetics of locomotion
- Physiological energy balance
- Environmental periodicity and physiological changes
- Physiology of hibernation
- Diversity of digestion and nutrition
- Relationship between the morphology and physiology of the digestive system and the dietary regimes
- Physiological problems related to herbivores
- Fermentation in the digestive tract
- Distribution of secondary plant components in the organism and their influence on physiological processes
- Exophysiology and physiology of extraterrestrial biological systems
- Physiology of high and low air and water pressure
- Pheromones as ecological and physiological factors

Seminars:

- Case study: Adaptations of organisms to high temperatures. Thermoregulation. Adaptation of organisms to high altitudes. Respiratory and circulatory adaptations to depths. Hormones. Environmental stress. Physiology of the endocrine system.

Recommended reading

McNab B.K. (2002) The Physiological Ecology of Vertebrates, Cornell University Press, London.

Randall D., Burggren W., French K. (2002) Eckert Animal Physiology – Mechanisms and Adaptation, W. H. Freeman and Company, New York.

Optional reading	Bradshaw D. (2003) Vertebrate Ecophysiology, Cambridge University Press, Cambridge. Paul J.R. (2001) Physiologie der Tiere, Thieme, Stuttgart. Schmidt-Nielsen K. (1998) Animal physiology, Cambridge University Press, Cambridge. Withers C.P. (1992) Comparative Animal Physiology, Saunders College Publishing, Los Angeles.
Conditions for obtaining teacher's signature	Regular attendance of lectures, successful completion of seminars.
Exam passing procedure	During the course, the teacher monitors and evaluates performance of each student, which refers to 10% of the final grade. Prior to taking written exam, student is obliged to prepare and present a seminar paper, which contributes 20% to the final grade. Passing of written exam refers to 30% of the final grade, and passing of oral exam refers to the remaining 40% of the final grade.
Main language of instruction; other languages	Croatian language
Method of monitoring the quality and efficiency of teaching	Student survey to evaluate the overall quality of the course. Analysis of student success at exams.

Course title	**Biochemistry 3**
Code	BP754
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	I semester
Workload/ECTS credits	3
Course status	Obligatory
Course teacher	Assist. Prof. Dr. Rosemary Vuković Assist. Prof. Dr. Senka Blažetić
Associate teachers	Ana Vuković, assistant
Course entry requirements (Preceding courses)	
Course objective	To enable students to understand the basic principles of biochemical processes in the organism and their connection with physiological functions, as well as the biochemical response of a living organism to environmental changes. To develop students' skills for working on experiments, to apply appropriate biochemical methods and techniques, to collect, analyse and interpret results by using relevant scientific references.
Learning outcomes	1. Knowledge about mechanisms that enable a living organism to react successfully and quickly to environmental changes. 2. Ability to predict and compare the mechanism of ion and molecule transfer across the membrane, and to review the importance of maintaining ionic balance. 3. Ability to make comparison between different pathways of cell signal transduction, and to review cell responses that result from activation of individual signalling pathways. 4. Ability to participate in biochemistry research work, which includes literature analysis, experiment design, selection and implementation of methods and techniques for testing of hypotheses, data collection and analysis, and their interpretation by using relevant scientific references. 5. Ability to make connection between the immune system parts and to determine their function in the organism. 6. Ability to determine the connection of genetic and external factors with the disease development.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-3, 4-6	1	Lecture	Critical conversation and discussion	Records related to student performance during lectures	5	10

	4	0.75	Practices	Independent performance of experimental tasks, data collection and analysis; presentation and interpretation of obtained results	Monitoring of experimental work progress; Work diary; Assessment of presentation and interpretation of obtained results with provision of feedback	25	40
	1-6	1	Written exam	Preparation for written exam	Written exam	10	20
	1-6	0.25	Oral exam	Preparation for oral exam	Oral exam	20	30
	Total	**3**				**60**	**100**

Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)

Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	30	0	15
Course content / teaching units	• Membrane channels and pumps: active and passive transport, ATP in membrane transport, P-type ATPases, concentration gradients, lactose-permease, ion channels (sodium, potassium and aceylcholine channel), action potential, crack compounds, channels for water • Signal transduction pathways: heterotrimeric G-proteins, cAMP, Ca^{2+}, inositol triphosphate and diacyl glycerol as secondary messengers, insulin signalling, epidermal growth factor (EGF) signalling, common features and signalling pathway participants, diseases caused by disturbances in signal pathways • Immune system: specificity and diversity of antibody molecule structure, genetic basis of high antibody variability, synthesis of antibody classes as a part of the immune response, proteins of the major histocompatibility complex (MHC I and MHC II), cells and receptors of immune system cells, (T-cell receptors, T-cell killers and helpers, T-cell selection in the thymus), autoimmune diseases, the role of the immune system in cancer prevention • Sensory systems: sense of smell, taste, sight, hearing and touch • Molecular motors: motor proteins, myosin and actin, muscle contraction, kinesin and dynein in interaction with microtubules, bacterial movement, rotary motors in bacteria, chemotaxis		
Recommended reading	Berg J.M., Tymoczko J.L., Gatto G.J., Stryer L. (2019) Biochemistry (9th edition). Macmillian International Higher Education, New York. Stryer L., Berg J., Tymoczko J. (2013) Biokemija (6th edition, 1st Croatian edition). Školska knjiga, Zagreb.		
Optional reading	Purves D., Augustine G.J., Fitzpatrick D., Hall W.C., LaMantia A.S., White L.E. (2012) Neuroscience (5th edition). Sinauer Associates, INC, Sunderland, Massachusetts, USA. Harperova ilustrirana biokemija (28th edition) (2011) Medicinska naklada. Alberts B., Johnson A., Lewis J., Raff M., Roberts K., Walter P. (2008) Molecular Biology of the Cell (5th edition). Garland Science, New York. Voet D., Voet J.G. (2011) Biochemistry (4th edition). Wiley, New York.		

	Nelson D.L., Cox M.M. (2013) Lehninger Principles of Biochemistry (6th edition). W. H. Freeman & Co, New York. Original scientific papers and review papers
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively and to fulfil all assignments within the course.
Exam passing procedure	During the course, the teacher monitors and evaluates the activities of students by awarding points according to determined criteria. After the course, students take a written exam and then oral exam. During the semester, students can take preliminary exams and substitute them for the written exam if passing each preliminary exam with more than 60% of the total number of points.
Main language of instruction; other languages	Croatian language
Method of monitoring the quality and efficiency of teaching	During the course, the teacher continuously evaluates student achievement, and gives students the opportunity to make oral or written comments. After the course, students are given a survey in which they give their subjective opinion about quality and organisation of teaching, all with the aim to improve future teaching.

<table>
<tr><td>Course title</td><td colspan="6">Didactics 1</td></tr>
<tr><td>Code</td><td colspan="6">BP797</td></tr>
<tr><td>Study programme</td><td colspan="6">Graduate University Study Programme in Biology and Chemistry Teacher Education</td></tr>
<tr><td>Semester</td><td colspan="6">II semester</td></tr>
<tr><td>Workload/ECTS credits</td><td colspan="6">3</td></tr>
<tr><td>Course status</td><td colspan="6">Obligatory</td></tr>
<tr><td>Course teacher</td><td colspan="6">Assist. Prof. Dr. Irena Labak</td></tr>
<tr><td>Associate teachers</td><td colspan="6"></td></tr>
<tr><td>Course entry requirements (Preceding courses)</td><td colspan="6"></td></tr>
<tr><td>Course objective</td><td colspan="6">To teach students about theory of didactics and its practical application in the educational process.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">1. Knowledge about theories, directions and models of didactics, as well as didactic practical orientation in the educational process.
2. Ability to support the autonomy of teachers in the implementation of all prescribed curricula during the planning of immediate educational work.
3. Ability to assess the effectiveness of strategies, methods, procedures and techniques of learning and teaching within the process of defining curriculum objectives.
4. Ability to assess one’s teaching methods by using approaches to evaluation in order to improve learning and teaching.
5. Skills in valorisation of scientific and professional literature referring to education.</td></tr>
<tr><td rowspan="3">Link between learning outcomes, teaching and students’ activities</td><td rowspan="2">Learning outcome</td><td rowspan="2">Share of ECTS</td><td rowspan="2">Form of teaching</td><td rowspan="2">Activities of learning and teaching</td><td colspan="3">Assessment</td></tr>
<tr><td>Methods of monitoring and evaluation</td><td>Grading Points</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>min</td><td>max</td></tr>
<tr><td></td><td>1-5</td><td>0.5</td><td>Lecture</td><td>Critical conversation and discussion; collaborative learning and reciprocal teaching within analysis of different types of information sources</td><td>Records related to active participation in discussions and analysis; portfolio</td><td>5</td><td>10</td></tr>
</table>

	1-5	1	Seminar	Flipped classroom: presentation and analysis of real-life situations; independent development of proposals for improvement of analysed real-life situations and for students' own teaching practices; *Journal Club*	Analysis of proposals of students' own teaching practices with provision of feedback; Records related to student activity in the *Journal Club*; portfolio	20	30
	1-5	0.75	Practices	Independent work on tasks for learning process improvement	Analysis of completed tasks with provision of feedback, portfolio	10	20
	1-5	0.5	Written exam	Writing of an academic essay	Essay	20	30
	1-5	0.25	Oral exam	Preparation for oral exam	Oral exam	5	10
	Total	**3**				**60**	**100**

Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)

Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	15	15	15

Course content / teaching units

- Didactics as an independent pedagogical discipline - theory of education: didactic theories, relations to other scientific disciplines, basic concepts
- Curriculum theory and practice: concept and structure of curriculum - objectives, principles, values, focus on competencies and learning outcomes, autonomy of school, autonomy of teachers, levels and application of curricula (National curricula, Curriculum areas, Cross-curricular themes, Subject-centred curricula)
- School curriculum
- Organisation of teaching (educational strategies, methods, procedures and techniques)
- Assessment and evaluation approaches
- Communication and learning environment
- Teaching and learning outside of school

Recommended reading

Bognar L., Matijević M. (2002) Didaktika. Školska knjiga, Zagreb.
Cindrić M., Miljković D., Strugar V. (2010) Didaktika i kurikulum. IEP d.o.o.
Desforges C. (2001) Uspješno učenje i poučavanje: psihologijski pristupi. Educa, Zagreb.
Vizek Vidović V., Rijevac M., Vlahović-Štetić V., Miljković D. (2014) Psihologija obrazovanja. IEP, Zagreb.

Optional reading	Jensen E. (2003) Super-nastava: nastavne strategije za kvalitetnu školu i uspješno učenje. Educa, d.o.o. Klippert H. (2001) Kako uspješno učiti u timu. Educa, Zagreb. Meyer H. (2002) Didaktika razredne kvake. Educa, Zagreb. Terhart E. (2001) Metode učenja i poučavanja. Educa, Zagreb.
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively and to fulfil all assignments within the course.
Exam passing procedure	During the course, the teacher monitors and evaluates the activities of students by awarding points according to determined criteria. The teacher thus provides continuous feedback, which students use to assess their learning progress and to create a portfolio to improve the learning process and their own professional development. At the end of the course, students write an essay with a critical review of theory and practice, after which they take oral exam. During the oral exam, the teacher asks questions that are related to learning outcomes. The final grade is determined according to the number of points collected for essay and oral exam and the number of points gained during lectures.
Main language of instruction; other languages	Croatian language
Method of monitoring the quality and efficiency of teaching	During the course, the teacher performs evaluation for learning by continuous monitoring of the learning process and student achievement, thus determining and adapting his/her teaching. After the course, the teacher conducts a survey among students to evaluate their subjective impression about the teaching quality, all with the aim to improve future teaching.

<table>
<tr><td>Course title</td><td>Didactics 2</td></tr>
<tr><td>Code</td><td>BP797-2</td></tr>
<tr><td>Study programme</td><td>Graduate University Study Programme in Biology and Chemistry Teacher Education</td></tr>
<tr><td>Semester</td><td>III semester</td></tr>
<tr><td>Workload/ECTS credits</td><td>3</td></tr>
<tr><td>Course status</td><td>Obligatory</td></tr>
<tr><td>Course teacher</td><td>Assist. Prof. Dr. Irena Labak</td></tr>
<tr><td>Associate teachers</td><td></td></tr>
<tr><td>Course entry requirements (Preceding courses)</td><td></td></tr>
<tr><td>Course objective</td><td>To teach students how to successfully and responsibly manage educational process within which each pupil achieves their learning and development potential.</td></tr>
<tr><td>Learning outcomes</td><td>1. Knowledge about creation of a stimulating and student-oriented learning environment in which each students can manage their learning, emotions and motivation.
2. Skills to predict the needs of each student in planning cognitively active learning with the aim of achieving knowledge at higher cognitive levels.
3. Skills required to support the development of creative thinking and other forms of thinking, as well as various types of literacy by selecting appropriate teaching strategies and approaches to evaluation.
4. Ability to support individualisation and differentiation of teaching for students with special needs.
5. Self-assessment of own needs and aspects for professional development to be able to successfully and responsibly manage educational work.</td></tr>
<tr><td>Link between learning outcomes, teaching and students' activities</td><td>
<table>
<tr><th rowspan="3">Learning outcome</th><th rowspan="3">Share of ECTS</th><th rowspan="3">Form of teaching</th><th rowspan="3">Activities of learning and teaching</th><th colspan="3">Assessment</th></tr>
<tr><th rowspan="2">Methods of monitoring and evaluation</th><th colspan="2">Grading Points</th></tr>
<tr><th>min</th><th>max</th></tr>
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</td></tr>
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	1-5	0.5	Lecture	Critical conversation and discussion; collaborative learning and reciprocal teaching within analysis of different types of information sources	Records related to active participation in discussions and analysis; portfolio	5	10
	1-5	1	Seminar	Flipped classroom: presentation and analysis of real-life situations; independent development of proposals for improvement of analysed real-life situations and for students' own teaching practices	Analysis of proposals of students' own teaching practices with provision of feedback; portfolio	20	30
	1-5	0.75	Practices	Independent work on tasks for learning process improvement	Analysis of completed tasks with provision of feedback, portfolio	10	20
	1-5	0.5	Written exam	Writing of an academic essay	Essay	20	30
	1-5	0.25	Oral exam	Preparation for oral exam	Oral exam	5	10
	Total	**3**				**60**	**100**

Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)

Consultation hours	By appointment.		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	15	15	15
Course content / teaching units	• Learning environment and self-regulated learning, emotions and motivation: ○ learning processes, self-evaluation and self-assessment of learning ○ metacognitive skills ○ motivation - types and ways of motivation ○ emotions and emotional regulation ○ competence to *learn how to learn* • Assessment of self-regulated managing of motivation and emotions • Active learning and teaching		

	• Educational development of students (taxonomies of cognitive, affective and psychomotor domains, dimensions of knowledge and development, individualised teaching) • Creative thinking: divergent and convergent processes, good practices in creative and critical thinking • Science, information and other types of literacy and development of students' literacy • Individualisation and differentiation of teaching for students with special needs • Learning and teaching focused on competence development, professional development and lifelong learning.
Recommended reading	Bognar L., Matijević M. (2002) Didaktika. Školska knjiga, Zagreb. Cindrić M., Miljković D., Strugar V. (2010) Didaktika i kurikulum. IEP d.o.o., Zagreb. Desforges C. (2001) Uspješno učenje i poučavanje: psihologijski pristupi. Educa, Zagreb. Vizek Vidović V., Rijevac M., Vlahović-Štetić V., Miljković D. (2014) Psihologija obrazovanja. IEP, Zagreb.
Optional reading	Sternberg R. J. (2005) Kognitivna psihologija. Naklada Slap, Jastrebarsko. Shunk D. H., Meece J. R., Pintrich P. R. (2020) Motivation in Education - Theory, Research and Application, 4th ed. Pearson. Miller M. (2020) Tech Like a PIRATE: Using Classroom Technology to Create an Experiance & making learning Memorable. Dave Burges Consulting, Inc., San Diego CA.
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively and to fulfil all assignments within the course.
Exam passing procedure	During the course, the teacher monitors and evaluates the activities of students by awarding points according to determined criteria. The teacher thus provides continuous feedback, which students use to assess their learning progress and to create a portfolio to improve the learning process and their own professional development. At the end of the course, students write an essay with a critical review of theory and practice, after which they take oral exam. During the oral exam, the teacher asks questions that are related to learning outcomes. The final grade is determined according to the number of points collected for essay and oral exam and the number of points gained during lectures.
Main language of instruction; other languages	Croatian language
Method of monitoring the quality and efficiency of teaching	During the course, the teacher performs evaluation for learning by continuous monitoring of the learning process and student achievement, thus determining and adapting his/her teaching. After the course, the teacher conducts a survey among students to evaluate their subjective impression about the teaching quality, all with the aim to improve future teaching.

Course title	**Plant Physiology 2**
Code	BP756
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	I semester
Workload/ECTS credits	3
Course status	Obligatory
Course teacher	Prof. Dr. Janja Horvatić
Associate teachers	Assist. Prof. Dr. Vesna Peršić Martina Varga, Ph.D. Vera Tikas, expert advisor
Course entry requirements (Preceding courses)	Cell Biology, Biochemistry 1, Plant Physiology 1
Course objective	To enable students to understand a cause-effect relationship of chemical and physiological changes in the plant organism. To enable students to interpret physiological changes by linking theoretical knowledge and the results of experimental research.
Learning outcomes	1. Ability to analyse metabolic processes in plants, such as photosynthesis, respiration, and the distribution of metabolites. 2. Ability to determine the mechanisms of plant growth regulators and to compare different types of regulation in plants. 3. Ability to analyse causes and levels of plant tissue differentiation and the aging process of plants. 4. Ability to examine the physiological processes of plant movements. 5. Development of natural science literacy by selecting research tasks related to interpretation of physiological changes in plants.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max

	1-4	1.0	Lecture	Lecture attendance and active participation	Records related to student performance with provision of feedback	6	10
	1,2,5	0.5	Practices	Practical classes attendance and active participation	Records related to student activity at practices with provision of feedback	12	20
	1-5	1.0	Written exam	Preparation for written exam	Written exam	24	40
	1-5	0.5	Oral exam	Preparation for oral exam	Oral exam	18	30
	Total	**3**				**60**	**100**
	Final grade: **60-69.9 points: grade 2 (sufficient)** **70-79.9 points: grade 3 (good)** **80-89.9 points: grade 4 (very good)** **90-100 points: grade 5 (excellent)**						

Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	30	0	15
Course content / teaching units	Lectures: • Photosynthesis (C3, C4 and CAM plants) • Photosynthesis and respiration • Cell exchange regulation: inner cell regulation (gene and enzyme activity regulations) • Intercellular regulations: plant growth regulators – auxins, gibberellins, cytokinins, ethylene and abscisic acid (chemical composition, biosynthesis, transport, physiological effects and their mechanism) • Growth, differentiation and development: levels of differentiation, cause of cell differentiation, plant aging • Regulations by ecological factors: effects of temperature and daylight on the growth and plant development • Physiology of the plant organelles and/or organ movements Practices: • Starch phosphorylase • Amylase • Influence of GA3 on starch hydrolysis during barley seed germination • Influence of kinetin on leaf senescence • Influence of auxin on growth		
Recommended reading	Pevalek-Kozlina B. (2003) Fiziologija bilja. Profil, Zagreb. Taiz L., Zeiger E., Moller I.M., Murphy A. (2015) Plant Physiology and Development, 6th ed. Sinauer Associates, Inc.		
Optional reading	Berg J.M., Tymoczko J.L., Stryer L. (2013) Biokemija. Školska knjiga, Zagreb.		
Conditions for obtaining teacher's signature	Regular attendance and active participation in lectures.		

Exam passing procedure	Before taking oral exam, students are obliged to pass written exam. The final grade is determined according to the number of points for student's performance and the points achieved in written and oral exams.
Main language of instruction; other languages	Croatian language
Method of monitoring the quality and efficiency of teaching	Student survey after the course; reviews during the course and possibility to give oral or written remarks after lectures; monitoring of student success at exams.

Course title	**Biological Collections**
Code	BP899
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	II semester
Workload/ECTS credits	2
Course status	Obligatory
Course teacher	Assist. Prof. Dr. Goran Vignjević
Associate teachers	
Course entry requirements (Preceding courses)	
Course objective	To develop students' skills in application of methods for preparation of various biological material, which shall be used in the teaching process.
Learning outcomes	1. Collection of different biological samples by using appropriate tools. 2. Preparation and stuffing of biological materials by using appropriate taxidermy methods. 3. Usage of knowledge and skills in assessment of the most suitable methods of preparing a certain group of living organisms for teaching process. 4. Making of student's own biological collection. 5. Making a proposal for a living corner in the classroom.
Link between learning outcomes, teaching and students' activities	

Learning outcome	**Share of ECTS**	**Form of teaching**	**Activities of learning and teaching**	**Assessment**		
				Methods of monitoring and evaluation	**Grading Points**	
					min	**max**

	1-5	0.25	Lecture	Critical conversation and discussion; collaborative learning within analysis of different taxidermy methods	Records related to active participation in discussions and analysis	5	10
	1-5	0.25	Field-based teaching	Practical application of methods in sampling of biological material, selection of suitable biological material within field classes	Records related to active engagement in the field-based learning	5	10
	1-5	0.5	Practices	Independent preparation of biological collection	Analysis of stuffed material with provision of feedback, preparation of a small collection	10	20
	1-5	1	Oral practice-based exam	Prepared student's own biological collection	Control of methods applied for taxidermy, determination and storage of collection	40	60
	Total	**2**				**60**	**100**

Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)

Consultation hours	By appointment.		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	15	0	30
Course content / teaching units	What is a biological collection and how it looks like? Overview of taxidermy methods - possibilities of creating a biological collection Taxidermy methods of living organisms: protozoa, plants, fungi and lichens, arthropods, vertebrates Production of permanent and semi-permanent microscopic preparations Making of aquariums, terrariums, and living corners Selection of suitable biological material for field teaching		

Recommended reading	Chinery M. (1989) 1000 ideja za prirodoslovca. Svjetlost, Sarajevo. Durrell G. (1990) Svijet prirode. GZH, Zagreb. Various authors (2015) Taxidermy Vol. 9 Bones and Skeletons - The Collection, Preparation and Mounting of Bones, Sigaud Press.
Optional reading	
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively and to fulfil all assignments within the course.
Exam passing procedure	During the course, the teacher monitors and evaluates the activities of students by awarding points according to determined criteria. In this way, the teacher provides continuous feedback, which students use to assess their learning progress and to create their own biological collection. After having prepared their biological collection, students take the oral exam. During the oral exam, the teacher checks the applied methods that are related to learning outcomes. The final grade is determined according to the number of points gained during the course and at the oral exam, as well as for preparation of biological collection.
Main language of instruction; other languages	Croatian language
Method of monitoring the quality and efficiency of teaching	During the course, the teacher performs evaluation for learning by continuous monitoring of the learning process and student achievement, thus determining and adapting his/her teaching. After the course, the teacher conducts a survey among students to evaluate their subjective impression about the teaching quality, all with the aim to improve future teaching.

Course title	**Conservation Biology**
Code	BP91006
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	3
Course status	Obligatory
Course teacher	Assist. Prof. Dr. Nataša Turić
Associate teachers	
Course entry requirements (Preceding courses)	
Course objective	To understand the basic concepts of conservation biology as an interdisciplinary science that connects the principles of biology and other social and economics sciences, and to develop students' skills in searching for referential scientific literature.
Learning outcomes	1. Ability to critically evaluate the basic principles and goals of conservation biology. 2. Ability to assess negative human influence on the biodiversity of ecological systems. 3. Ability to assess the role of key species and their importance in living communities. 4. Acquired knowledge about natural, socio-economic and cultural aspects of protected areas. 5. Awareness about the importance of biological diversity, its conservation and sustainable management of natural resources.

<table>
<tr><td>Link between learning outcomes, teaching and students' activities</td><td>
<table>
<tr><th rowspan="2">Learning outcome</th><th rowspan="2">Share of ECTS</th><th rowspan="2">Form of teaching</th><th rowspan="2">Activities of learning and teaching</th><th colspan="3">Assessment</th></tr>
<tr><th>Methods of monitoring and evaluation</th><th>Grading Points min</th><th>max</th></tr>
<tr><td>1-5</td><td>1</td><td>Lecture</td><td>Critical conversation and discussion</td><td>Records related to active participation in conversations and discussions</td><td>15</td><td>20</td></tr>
<tr><td>1-5</td><td>1.5</td><td>Written exam</td><td>Preparation for seminar</td><td>Seminar paper</td><td>25</td><td>50</td></tr>
<tr><td>1-5</td><td>0.5</td><td>Oral exam</td><td>Preparation for oral exam</td><td>Oral exam</td><td>20</td><td>30</td></tr>
<tr><td>Total</td><td>3</td><td></td><td></td><td></td><td>60</td><td>100</td></tr>
</table>
Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)
</td></tr>
<tr><td>Consultation hours</td><td>Wednesdays, from 10.00 - 12.00 a.m.</td></tr>
<tr><td>Teaching</td><td>
<table>
<tr><th>Lectures</th><th>Seminars</th><th>Practices</th></tr>
<tr><td>30</td><td>0</td><td>0</td></tr>
</table>
</td></tr>
<tr><td>Hours - total</td><td></td></tr>
<tr><td>Course content / teaching units</td><td>

Biodiversity - importance of species in conservation biology
Human influence: human population growth, current human influence, human influence on species extinction, habitat fragmentation
Habitat disorders: chemical pollution, introduction of exotic species and diseases, genetically modified organisms, disturbances in ecosystem dynamics
Unsustainable management: what is sustainable management, hunting of wild populations, overexploitation of resources
Scientific development of conservation biology
Selection of protected areas - historical overview, criteria for measuring the value of an area. Design and management of protected areas: management of semi-natural communities, monitoring of changes in protected areas
In situ conservation: rarity among species, threat assessment and categorisation, small population management, genetic management of small populations, sustainability of small populations
Ex situ conservation: ex situ conservation of plants and animals, reproduction in captivity, reintroduction of species
Landscape conservation: landscape ecology and conservation, improvement of species movement in the landscape, preservation of ecosystem function, ecosystem management
Practical application of knowledge in research

</td></tr>
<tr><td>Recommended reading</td><td>Groom J.M., Meffe K.G., Carroll R.C. (2006) Principles of Conservation Biology. Sinnauer Associates, Massachusetts.
Pullin S.A. (2007) Conservation Biology. CambridgeUniversity Press, New York.</td></tr>
<tr><td>Optional reading</td><td>DZZP (2008) Izvješće o stanju prirode i zaštite prirode u Republici Hrvatskoj. Zagreb.
Hunter M.L. JR., Gibbs J. (2007) Fundamentals of Conservation Biology. 3rd ed. Blackwell Publishing, UK.</td></tr>
</table>

	Maczulak A. (2010) Biodiversity. Conserving Endangered Species. Facts On File, USA. Magurran A.E. (2010) Measuring Biological Diversity. Blackwell Publishing, UK.
Conditions for obtaining teacher's signature	During the course, the teacher evaluates the activities of students. By regular attendance of lectures, students will be eligible to obtain teacher's signature.
Exam passing procedure	Before taking oral exam, students are obliged to complete the written assignment by preparing and presenting their seminar paper. Points achieved at written and oral exam are added to the points obtained up to the final exam, thus making a total number of points to be converted to final grade.
Main language of instruction; other languages	Croatian language
Method of monitoring the quality and efficiency of teaching	Survey on the subjective impression about the organisation of the course will be carried out after the course; during the course, students will be given an opportunity to make oral or written remarks; the teacher monitors students' success at exams.

Course title	**Terrestrial Ecosystems**
Code	
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	2
Course status	Obligatory
Course teacher	Prof. Dr. Stjepan Krčmar
Associate teachers	
Course entry requirements (Preceding courses)	
Course objective	To enable students to argue about the basic findings related to functioning of terrestrial ecosystems and terrestrial biomes and to teach them how to make a synthesized approach to understanding of terrestrial biomes while linking relevant information about their flora and fauna.
Learning outcomes	1. Knowledge about the basic concepts of ecological systems, and about distribution of terrestrial biomes on Earth. 2. Ability to review the role and importance of different terrestrial ecosystems. 3. Ability to compare similarities and differences between terrestrial biomes. 4. Developed writing skills within preparation of a seminar paper and review of relevant scientific literature.

Link between learning outcomes, teaching and	**Learning outcome**	**Share of ECTS**	**Form of teaching**	**Activities of learning and teaching**	**Assessment**	
						Grading Points

<table>
<tr><td>students' activities</td><td colspan="7"><table>
<tr><th></th><th></th><th></th><th></th><th>Methods of monitoring and evaluation</th><th>min</th><th>max</th></tr>
<tr><td>1-3</td><td>1</td><td>Lecture</td><td>Lecture attendance and active participation</td><td>Records, evaluation</td><td>25</td><td>45</td></tr>
<tr><td>1-4</td><td>0.5</td><td>Seminar</td><td>Independent search for and critical revision of scientific references used in preparation of a seminar paper, and presentation of a seminar paper</td><td>Records and assessment of presented seminar paper</td><td>15</td><td>25</td></tr>
<tr><td>1-4</td><td>0.25</td><td>Written exam</td><td>Preparation for written exam</td><td>Written exam</td><td>10</td><td>15</td></tr>
<tr><td>1-4</td><td>0.25</td><td>Oral exam</td><td>Preparation for oral exam</td><td>Oral exam</td><td>10</td><td>15</td></tr>
<tr><td>Total</td><td>2</td><td></td><td></td><td></td><td>60</td><td>100</td></tr>
</table>
Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)</td></tr>
<tr><td>Consultation hours</td><td colspan="7">According to announced schedule</td></tr>
<tr><td>Teaching</td><td colspan="2">Lectures</td><td colspan="2">Seminars</td><td colspan="2">Practices</td></tr>
<tr><td>Hours - total</td><td colspan="2">15</td><td colspan="2">5</td><td colspan="2">0</td></tr>
<tr><td>Course content / teaching units</td><td colspan="7">Lectures:
• Basic characteristics of an ecosystem
• Spatial distribution of terrestrial biomes on Earth
• Comparison of climatic and edaphic characteristics of terrestrial biomes on Earth
• Comparison of faunal and floristic similarities and differences of terrestrial biomes (tundra, coniferous woods, deciduous woods, grasslands, deserts, tropical rainforests and Mediterranean biome)
Seminars:
• Presentation of a seminar paper referring to biological diversity of selected components of terrestrial biomes</td></tr>
<tr><td>Recommended reading</td><td colspan="7">Aber J.D., Melillo J.M. (2001) Terrestrial ecosystems. Harcourt/Academic Press, San Diego.
Chapin S.F.III, Matson P.A., Mooney H.A. (2002) Principles of terrestrial ecosystem ecology. Springer, New York.</td></tr>
<tr><td>Optional reading</td><td colspan="7">Weigel M. (2009) Encyclopedia of biomes. Gale, Cengage Learning, Detroit.
Levin S.A. (2001) Encyclopedia of biodiversity. Academic Press, Cambridge.</td></tr>
<tr><td>Conditions for obtaining teacher's signature</td><td colspan="7">Active participation in lectures, preparation and presentation of a seminar paper.</td></tr>
</table>

Exam passing procedure	During lectures and seminars, the teachers monitor and evaluate performance of each student, which refers to 70% of the final grade. Passing of written exam refers to 15% of the final grade, and passing of oral exam refers to the remaining 15% of the final grade.
Main language of instruction; other languages	Croatian language
Method of monitoring the quality and efficiency of teaching	Evaluation form

Course title	**Teaching Practice in Biology**
Code	BP9107
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	3
Course status	Obligatory
Course teacher	Assist. Prof. Dr. Irena Labak
Associate teachers	
Course entry requirements (Preceding courses)	Attended courses: Didactics 1, Pedagogy 1, Pedagogy 2, Psychology in Education 1, Psychology in Education 2, Methodology of Teaching Biology.
Course objective	To enable students to develop knowledge and cognitive skills for independent teaching of biology and for self-assessment of their own professional development aspects.
Learning outcomes	1. Skills in preparing teaching material for classes. 2. Ability to deliver teaching independently. 3. Ability to critically evaluate the success of their practice classes by referring to learning and teaching management, evaluation, classroom management and provision of support to each student in their achievement of full personal potential and in achievement of inclusive school culture, based on which each individual can understand the importance of lifelong learning education.

Link between learning outcomes, teaching and students' activities	Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
					Methods of monitoring and evaluation	Grading Points	
						min	max
	1-3	1	Observations in schools	Observations of mentor's lessons and analysis of observed lessons, preparation of a teaching portfolio (reflection forms and professional development plan)	Work diary, Completed lesson observation forms, teaching portfolio	10	20
	1-3	1	Individually realised lecture	Writing of lesson plans and consultations with a mentor. Independent realisation of one teaching hour. (Self)evaluation of a realised teaching hour, creation of a teaching portfolio	Written lesson plan, Form for assessment of delivered lecture, teaching portfolio	25	40
	1-3	1	Public lecture	Writing of lesson plans and consultations with a mentor Independent realization of one teaching hour for public. (Self)evaluation of a realised teaching hour, creation of a teaching portfolio	Written lesson plan, Form for assessment of delivered lecture, teaching portfolio.	25	40
	Total	**3**				**60**	**100**
	Final grade: **60-70 points: grade 2 (sufficient)** **71-80 points: grade 3 (good)**						

	81-90 points: grade 4 (very good) **91-100 points: grade 5 (excellent)**		
Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	0	0	30
Course content / teaching units	Within this course, students are obliged to participation in direct educational work under supervision of a mentor: • observation of mentor's teaching and analysis of lessons with a mentor and colleagues • preparation of lesson plans and delivery of individual and public lectures • analysis of delivered lectures with a mentor, colleagues and a course teacher • creation of a portfolio - reflection forms and professional development plan (3rd outcome)		
Recommended reading	Reading lists as defined within all obligatory courses. Curriculum documents and textbooks. Selected scientific and professional papers dealing with Biology.		
Optional reading	Reading lists as defined within all obligatory courses, scientific and popular journals.		
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively and to fulfil all assignments within the course.		
Exam passing procedure	During the course, the teacher monitors and evaluates the activities of students by awarding points according to determined criteria. In this way, the teacher provides continuous feedback and supports the self-reflections of students that are required for creation of a teaching portfolio. Students pass the exam upon realisation of one teaching hour (lecture), the success of which is evaluated by a mentor according to defined assessment criteria. The final grade is determined according to the number of points awarded for public lecture and individual lecture delivery, as well as for observations.		
Main language of instruction; other languages	Croatian language		
Method of monitoring the quality and efficiency of teaching	During the course, the teacher performs evaluation for learning by continuous monitoring of the learning process and student achievement, thus determining and adapting his/her teaching. After the course, the teacher conducts a survey among students to evaluate their subjective impression about the teaching quality, all with the aim to improve future teaching.		

Course title	**Teaching Practice in Chemistry**
Code	K072
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	3
Course status	Obligatory
Course teacher	Assoc. Prof. Dr. Valentina Pavić
Associate teachers	
Course entry requirements (Preceding courses)	Attended courses: Didactics 1, Pedagogy 1, Pedagogy 2, Psychology in Education 1, Psychology in Education 2, Methodology of Teaching Chemistry, Practices in Methodology of Teaching Chemistry
Course objective	Application of knowledge and cognitive skills in independent realisation of teaching in Chemistry and ability to self-evaluate own professional development aspects.
Learning outcomes	1. Skills in preparing teaching material for classes. 2. Ability to deliver teaching independently. 3. Ability to critically evaluate the success of their practice classes from the aspect of learning and teaching management, evaluation, classroom management and provision of support to each student in their achievement of full personal potential and in achievement of inclusive school culture.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-3	1	Observations in schools	Observations of mentor's lessons and analysis of observed lessons, preparation of a teaching portfolio (reflection forms and professional development plan)	Work diary, Completed lesson observation forms, teaching portfolio	18	30
1-3	1	Individual lecture	Writing of lesson plans and consultations with a mentor. Independent realization of one teaching hour. (Self)evaluation of a realised teaching hour, creation of a teaching portfolio	Written lesson plan, Form for assessment of delivered lecture, teaching portfolio	21	35
1-3	1	Public lecture	Writing of lesson plans	Written lesson plan,	21	35

				and consultations with a mentor. Independent realization of one teaching hour for public. (Self)evaluation of a realised teaching hour, creation of a teaching portfolio	Form for assessment of delivered lecture, teaching portfolio.		
	Total	**3**				**60**	**100**
	Final grade: **60-70 points: grade 2 (sufficient)** **71-80 points: grade 3 (good)** **81-90 points: grade 4 (very good)** **91-100 points: grade 5 (excellent)**						

Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	0	0	30
Course content / teaching units	Within this course, students are obliged to participation in direct educational work under supervision of a mentor: • observation of mentor's teaching and analysis of lessons with a mentor and colleagues • preparation of lesson plans and delivery of individual and public lectures • analysis of delivered lectures with a mentor, colleagues and a course teacher • creation of a teaching portfolio - reflection forms and professional development plan		
Recommended reading	Reading lists as defined within all obligatory courses. Curriculum documents and textbooks. Selected scientific and professional papers dealing with Chemistry.		
Optional reading	Reading lists as defined within all obligatory courses, scientific and popular journals.		
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively and to fulfil all assignments within the course.		
Exam passing procedure	During the course, the teacher monitors and evaluates the activities of students by awarding points according to determined criteria. In this way, the teacher provides continuous feedback and supports the self-reflections of students that are required for creation of a teaching portfolio. Students pass the exam upon realisation of one teaching hour (lecture), the success of which is evaluated by a mentor according to defined assessment criteria. The final grade is determined according to the number of points awarded for public lecture and individual lecture delivery, as well as for observations.		
Main language of instruction; other languages	Croatian language		
Method of monitoring the quality and efficiency of teaching	During the course, the teacher performs evaluation for learning by continuous monitoring of the learning process and student achievement, thus determining and adapting his/her teaching. After the course, the teacher conducts a survey among students to evaluate their subjective impression about the teaching quality, all with the aim to improve future teaching.		

Course title	**Methodology of Teaching Biology**
Code	BP8102
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	II semester
Workload/ECTS credits	6
Course status	Obligatory
Course teacher	Assist. Prof. Dr. Irena Labak
Associate teachers	Nataša Bušić, assistant
Course entry requirements (Preceding courses)	
Course objective	To teach and guide students responsibly, independently and effectively through the learning process.
Learning outcomes	1. Ability to support fulfilment of each student's potential by direct planning of a teaching hour. 2. Ability to select appropriate learning and teaching strategies, methods, procedures and techniques in order to achieve curriculum outcomes. 3. Ability to predict approaches and strategies of evaluation in immediate planning. 4. Contribution to development of natural science literacy of students by developing their creative- and critical-thinking skills and all dimensions of knowledge. 5. Ability to make pedagogical and didactic adaptations in working with students with special needs. 6. Ability to make self-review of teaching and evaluation in order to boost student motivation their emotional regulation.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-6	1	Lecture	Critical conversation and discussion; collaborative learning and reciprocal teaching; knowledge-based tasks	Records related to active and independent participation in lecture activities; analysis of performed tasks with provision of feedback; portfolio	5	10
1-6	2	Seminar	Independent preparation of a lesson plan proposal, simulation of a teaching hour, and (self)evaluation	Analysis of a lesson plan and lesson simulation with provision of feedback; portfolio	20	30

				of a video record of simulation			
	2,4,5,6	2	Practices	Independent completion of an experiment, sections, demonstration of inquiry-based learning	Records related to active and independent participation in practical activities; Analysis of completed tasks with provision of feedback portfolio	10	20
	1-6	0.5	Written exam	Preparation for preliminary exam	Preliminary exam	20	30
	1-6	0.5	Oral exam	Preparation for oral exam	Oral exam	5	10
	Total	**6**				**60**	**100**

Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)

Consultation hours	By appointment.		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	30	15	60

Course content / teaching units

- Implementation of defined curricula in realisation of teaching
- Direct planning (curricular alignment in creation of lesson plans based on outcomes: planning of what is to be learned (content) and how it is taught and evaluated with the aim to develop knowledge at higher cognitive levels in factual, conceptual, procedural, epistemological and metacognitive contexts; implementation of defined curriculum of cross-curricular topics in teaching and direct planning
- Assessment in direct planning, issues related to higher cognitive levels, Crooks taxonomy, self-evaluation, creation of concepts – correlation between evaluation and teaching/learning
- Motivation and emotional regulation through teaching and evaluation
- Construction of exams and assessment of written knowledge tests
- Application of learning strategies, methods, procedures and techniques for development of natural science literacy of students and development of their creative- and critical-thinking skills
- Inquiry-based learning, the 5E learning model and out-of-classroom teaching in the development of natural science literacy and other types of literacy
- Forms of teaching, types of lessons and phases of a teaching hour
- Visualization of knowledge and understanding
- Basic adaptation of teaching to students with special needs during direct planning of a specific topic

Recommended reading

Bognar L., Matijević M. (2005) Didaktika. Školska knjiga, Zagreb.
Cindrić M., Miljković D., Strugar V. (2010) Didaktika i kurikulum. IEP d.o.o.
Matijević M., Radovanović D. (2011) Teaching usmjerena na učenika, Školske novine.

	Vizek Vidović V., Rijevac M., Vlahović-Štetić V., Miljković D. (2014) Psihologija obrazovanja. IEP, Zagreb.
Optional reading	Glasser W. (2005) Kvalitetna škola: škola bez prisile. Educa, Zagreb. Kyriacou (2001) Temeljna nastavna umijeća. Educa, Zagreb Matijević M. (2005) Grading u osnovnoj školi. Tipex, Zagreb. Sekulić Majurec A., Cvetković Lay J. (2008) Darovito je, što ću s njim? Alineja, Zagreb. Theobald M.A. (2006) Increasing student motivation. Strategies for Middle and High School Teachers. Corwing Press.
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively and to fulfill all assignments within the course.
Exam passing procedure	During the course, the teacher monitors and evaluates the activities of students by awarding points according to determined criteria. The teacher thus provides continuous feedback, which students use to assess their learning progress and to create a portfolio to improve the learning process and their own professional development. During the course, students take two preliminary exams and then they proceed with the oral exam. During the oral exam, the teacher asks questions that are related to learning outcomes. The final grade is determined according to the number of points awarded for preliminary and oral exam and the number of points gained during lectures.
Main language of instruction; other languages	Croatian language
Method of monitoring the quality and efficiency of teaching	During the course, the teacher performs evaluation for learning by continuous monitoring of the learning process and student achievement, thus determining and adapting his/her teaching. After the course, the teacher conducts a survey among students to evaluate their subjective impression about the teaching quality, all with the aim to improve future teaching.

Course title	**Methodology of Teaching Chemistry**
Code	K071
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	II semester
Workload/ECTS credits	3
Course status	Obligatory
Course teacher	Assist. Prof. Dr. Elvira Kovač-Andrić
Associate teachers	
Course entry requirements (Preceding courses)	Passed exams within undergraduate study courses and attended winter semester courses: Pedagogy 1, Psychology in Education 1, School Teaching Practice 1.
Course objective	Developed skills for successful and responsible teaching of chemistry based on the application of experimental, problem-based and inquiry-based learning in which each student achieves full personal and educational potential.
Learning outcomes	1. Realisation of teaching in accordance with the defined curriculum. 2. Ability to evaluate teaching strategies, methods, procedures, and learning techniques required for achievement of chemistry teaching objectives. 3. Ability to select chemical experiments within which students can develop their natural science literacy in classroom conditions and to apply safety and protection measures when working with chemicals. 4. Ability to self-assess own teaching and to review performed teaching activities. 5. Developed communication and cooperation skills for working with people outside the school by exchanging experiences and finding optimal solutions for teaching advancement. 6. Ability to assess the needs of individual students during their cognitive learning in order to enable them to acquire knowledge at higher cognitive levels.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-6	1	Lecture	Critical conversation and discussion, collaborative learning by analysing various written documents and electronic materials	Records related to student performance at discussions and analyses, portfolio	15	30
1-6	1	Seminar	Flipped classroom: case study analysis; independent selection and completion of an experiment, independent creation of a lesson plan in	Monitoring of students' performance at interpretations and tasks, analysis of created lesson plans with provision of	20	40

				direct educational process	feedback, portfolio		
	1-6	0.5	Written exam	Preparation for written exam	Written exam	10	20
		0.5	Oral exam	Preparation for oral exam	Oral exam	5	10
	Total	**3**				**50**	**100**
	Final grade: **50-70 points: grade 2 (sufficient)** **71-80 points: grade 3 (good)** **81-90 points: grade 4 (very good)** **91-100 points: grade 5 (excellent)**						
Consultation hours	By appointment						

Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	30	15	0

Course content / teaching units

Lectures

- Chemistry as a school subject (goals and tasks of teaching chemistry, chemistry as a science and as a school subject)
- Strategies of teaching (applying experiments in chemistry teaching, learning by discovery, group work, pair work, individual work, frontal work)
- Curriculum (specific tasks of chemistry teaching and the age of students, principles of curriculum development, principles of teaching units selection, defining learning outcomes for students, qualitative and quantitative analysis of chemistry curricula for primary and secondary school, evaluation of teaching content, methods, forms and results educational work, textbooks and other teaching materials)
- Interdisciplinary teaching
- Teaching in a classroom (chemistry classroom, laboratory equipment and chemicals, development and use of teaching aids, safety and protection measures when conducting experiments in the classroom, misinterpretations that occur as a consequence of the teaching process)
- Preparation of teachers for teaching (language and speech, psychological, material and technical preparations for: new school year, individual teaching unit and individual teaching hour, writing of a lesson plan, blackboard plan, evaluation of student achievements)
- Assessment of knowledge, abilities and skills (evaluation during the teaching process, social significance of assessment as a measure of value, internal and external evaluation, national exams, state graduation exam, the use and construction of questions, students' cognitive abilities and evaluation of achievements, self-assessment)
- Social and working environment of chemistry teachers (teachers' rights and duties, professional exams, school supervision, conditions for promotion, weekly assignments, professional development and training for teachers, pedagogical standards, regulations on assessment, approval and selection of textbooks, student competitions, work with students with special needs, extracurricular activities)
- Teaching objectives related to various terms (substance, aggregation state, chemical symbolism, chemical reaction equation, physical and chemical change, atom and structure of atoms, chemical bonding, molecule structures, crystalline structure of matter, basic chemical laws, chemical reactivity, chemical reaction rate , chemical equilibrium, reduction potential, classification of chemical reactions, structural characteristics of molecules of organic compounds,

	biologically significant molecules, medicines, addiction) Seminars • Delivery of demonstration lectures; development of teaching aids and models; preparation of a seminar paper related to current topics in chemistry teaching methodology, up-to-date achievements in chemistry and their application according to the original literature
Recommended reading	Bognar L., Matijević M. (1993) Didaktika. Školska knjiga, Zagreb. Sikirica M. (2003) Metodika nastave kemije. Školska knjiga, Zagreb.
Optional reading	Herak J. (1992) Što, kako i zašto – prilog metodici početne nastave kemije. Školske novine, Zagreb. Herak J. (1985) Uvođenje početnika u kemiju. Školske novine, Zagreb. Herron J.D. (1996) The Chemical Classroom: Formulas for Successful Teaching. American Chemical Society. Radonić F. (1997) Obrazovna tehnologija u nastavi učenja. Biotehnika, Zagreb. Raos P. (2004) Nove slike iz kemije. Školska knjiga, Zagreb.
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively and to fulfill all assignments within the course.
Exam passing procedure	Written and oral exams are taken after attended lectures.
Main language of instruction; other languages	Croatian language
Method of monitoring the quality and efficiency of teaching	Continuous monitoring of the learning process and of students' achievement, for the purpose of guiding and adjusting teaching process. Students provide feedback about the quality of teaching, which is used in improvements of future teaching.

Course title	**Basics of Horticulture**
Code	BM861
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	II semester
Workload/ECTS credits	3
Course status	Obligatory
Course teacher	Assoc. Prof. Dr. Ivna Štolfa Čamagajevac
Associate teachers	Ksenija Doboš, laboratory technician
Course entry requirements (Preceding courses)	Cormophyte (passed exam)
Course objective	To teach students about principles, theories and concepts in horticulture and to enable them to understand, apply and integrate those concepts in direct educational work.
Learning outcomes	1. Ability to incorporate basic concepts of horticulture (floriculture, vegetable growing, park landscaping, dendrology) into the teaching process in order to achieve concrete learning outcomes and curriculum expectations. 2. Ability to select appropriate methods of plant propagation depending on the plant species and to assess the importance of pedological and climatic conditions in plant breeding. 3. Ability to critically review the benefits of eco-schools in development of students' work habits and social skills. 4. Ability to create a computer image of a school garden and to select appropriate plant species by respecting soil characteristics and climatic conditions.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-3	1	Lecture	Critical conversation and discussion; collaborative learning and reciprocal teaching; knowledge-based tasks	Records related to active and independent participation in lecture activities	10	20
3,4	0.5	Practices	Independent performance of laboratory exercises	Records related to active and independent participation in practical activities	20	20
1-4	1	Written exam	Exam preparation	Exam	20	35
1-4	0.5	Oral exam	Preparation for oral exam	Oral exam	10	25
Total	**3**				**60**	**100**

Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)

	81-90 points: grade 4 (very good) **91-100 points: grade 5 (excellent)**		
Consultation hours	By appointment.		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	30	0	15
Course content / teaching units	Lectures: • Division and main characteristics of flower species (annuals, biennials, aquatic plants, creepers) • Basics of vegetable growing and the most important representatives of vegetables • Propagation of vegetables and flowers • *In vitro* cultivation • Woody plant species and park landscaping • Creating a school garden: spices and aromatic herbs, vegetable, ornamental plants, water garden • Eco-schools • Horticulture in teaching Practices: • Basic methods in plant propagation. *In vitro* cultivation methods • Creation of a school garden • Visit to eco-schools		
Recommended reading	Idžojtić M. (2013) Dendrologija-cvijet, češer, plod, sjeme. Sveučilište u Zagrebu, Šumarski fakultet, Zagreb. Idžojtić M. (2009) Dendrologija-list. Sveučilište u Zagrebu, Šumarski fakultet, Zagreb. Parađiković N., Tkalec M., Zeljković S., Kraljičak J., Vinković T. (2018) Osnove florikulture. Poljoprivredni fakultet, Osijek. Parađiković N. (2002) Opće i specijalno povrćarstvo. Poljoprivredni fakultet, Osijek. Parađiković N. (1994) Plastenici i staklenici. Nova zemlja, Osijek.		
Optional reading	Hartmann T.H., Kester D.E., Davies Jr. F.T., Geneve R.L. (2011) Hartmann and Kester's plant propagation : principles and practice. 8th ed. Prentice Hall, USA. Pittenger D.R. (2002) California Master Gardener Handbook. University of California, USA. Zdravi vrt - organski, prirodan i bez kemikalija (2010). Mozaik knjiga, Zagreb.		
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively and to fulfil all assignments within the course.		
Exam passing procedure	During the course, the teacher monitors and evaluates the activities of students by awarding points according to determined criteria. The teacher thus provides continuous feedback, which students use to assess their learning progress and to create a portfolio to improve the learning process and their own professional development. During the course, students take a written exam, and proceed to oral exam. During the oral exam, the teacher asks questions that are related to learning outcomes. The final grade is determined according to the number of points awarded for written and oral exam and the number of points gained during lectures.		
Main language of instruction; other languages	Croatian language		
Method of monitoring the quality and efficiency of teaching	During the course, the teacher performs evaluation for learning by continuous monitoring of the learning process and student achievement, thus determining and adapting his/her teaching. After the course, the teacher conducts a survey among students to evaluate their subjective impression about the teaching quality, all with the aim to improve future teaching.		

Course title	**Pedagogy 1**
Code	BP9100
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	I semester
Workload/ECTS credits	3
Course status	Obligatory
Course teacher	Assist. Prof. Dr. Irena Labak
Associate teachers	Nataša Bušić, assistant
Course entry requirements (Preceding courses)	
Course objective	To develop students' knowledge about pedagogical science and its role in the education system.
Learning outcomes	• Ability to critically evaluate pedagogical science, its foundation and terminology and alternative pedagogical concepts. • Contribution to achievement of goals and principles of education. • Ability to review contemporary pedagogical theory and its relation to school practice. • Ability to assess the effectiveness of educational strategies in the overall development of children, in the identification of problems and needs of students, as well as in self-reflection, and in commitment toward the change. • Ability to valorise scientific and professional literature dealing with the educational topics.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-5	0.5	Lecture	Critical conversation and discussion; collaborative learning within analysis of different types of information sources	Records related to active participation in discussions and analysis; portfolio	5	10
1-5	1	Seminar	Tasks related to professional development planning by active research and peer review*; Journal Club*	Analysis of completed tasks with provision of feedback; Records related to student activity in the *Journal Club*; portfolio	20	30
2,4	0.75	Practices	Creation and simulation of a	Analysis of a workshop with	10	20

				pedagogical workshop	provision of feedback, portfolio		
	1-5	0.5	Written exam	Writing of an academic essay	Essay	20	30
	1-5	0.25	Oral exam	Preparation for oral exam	Oral exam	5	10
	Total	**3**				**60**	**100**
	Final grade: **60-70 points: grade 2 (sufficient)** **71-80 points: grade 3 (good)** **81-90 points: grade 4 (very good)** **91-100 points: grade 5 (excellent)**						
Consultation hours	By appointment						

Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	15	15	15

Course content / teaching units	• System of pedagogical disciplines • Historical development of pedagogy • Theories of upbringing and educational practices in the world and in Croatia • Socialisation • Acculturation • Upbringing and education • Educational system • Philosophical and anthropological starting points of education, theories, process and factors of education • Student - an active participant in education • Teacher personality and teacher vocation • Educational strategies • Educational strategies in the education system • Assessment in the education system • Theory of school. Learning and teaching • Family upbringing • Home education • Education during free time • Education and modern information and communication technology • Educational and social work • Preventive work in education • Methodology of pedagogy • Types of pedagogical research • Quantitative and qualitative paradigm of pedagogical research
Recommended reading	Gudjons H. (1994) Pedagogija. Temeljna znanja. Educa, Zagreb. Mijatović A. (ed.) (1998) Osnove suvremene pedagogije. HKZ "MI" HPKZ, Zagreb. Vukasović A. (2001) Pedagogija. HKZ "MI", Zagreb.
Optional reading	Armstrong T. (2008) Najbolje škole. Educa, Zagreb. Cohen L., Manion L., Morrison K. (2007) Metode istraživanja u obrazovanju. Naklada Slap. König E., Zedler P. (2001) Znanosti o odgoju. Educa, Zagreb. Miljković D., Rijavec M. (2015) Pozitivna disciplina u razredu. IEP d.o.o., Zagreb. Rijavec M. (2000) Psihologija pozitivnog mišljenja. IEP, Zagreb.
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively and to fulfil all assignments within the course.

Exam passing procedure	During the course, the teacher monitors and evaluates the activities of students by awarding points according to determined criteria. The teacher thus provides continuous feedback, which students use to assess their learning progress and to create a portfolio to improve the learning process and their own professional development. At the end of the course, students write an essay with a critical review of theory and practice, after which they take oral exam. During the oral exam, the teacher asks questions that are related to learning outcomes. The final grade is determined according to the number of points collected for essay and oral exam and the number of points gained during lectures.
Main language of instruction; other languages	Croatian language
Method of monitoring the quality and efficiency of teaching	During the course, the teacher performs evaluation for learning by continuous monitoring of the learning process and student achievement, thus determining and adapting his/her teaching. After the course, the teacher conducts a survey among students to evaluate their subjective impression about the teaching quality, all with the aim to improve future teaching.

Course title	**Pedagogy 2**
Code	BP9101
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	II semester
Workload/ECTS credits	3
Course status	Obligatory
Course teacher	Assist. Prof. Dr. Irena Labak
Associate teachers	Nataša Bušić, assistant
Course entry requirements (Preceding courses)	
Course objective	To teach students how to cherish teaching philosophy that ensures school and classroom culture and an environment in which each student gets support for their personal development and success in learning. To teach students how to achieve pleasant and stimulating communication with students, parents, professional associates and community.
Learning outcomes	1. Ability to create a school environment in which all students respect themselves and others and fulfil their personal potential. 2. Ability to establish communication with students within which all ethical principles are respected and which is stimulating for building of positive relationships towards oneself, others, and learning. 3. Skills in performing evaluation in a way to support creation of a positive image of oneself and of others. 4. Ability to evaluate examples of practical problem solving related to issues of educating children with behavioural disorders, as well as examples of adapting work to students with disabilities and of encouraging development of gifted students. 5. Ability to establish cooperation and communication with parents and professional associates in school who can contribute to students' development.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-5	0.5	Lecture	Critical conversation and discussion; collaborative learning and reciprocal teaching within analysis of different types of information sources	Records related to active participation in discussions and analysis; portfolio	5	10
1-5	0.75	Seminar	Flipped classroom: presentation and analysis of a lesson plan and related examples	Analysis of a lesson plan and related examples; portfolio	10	20

	1-5	1	Practices	Independent preparation of proposals for teaching by respecting the learning outcomes and preparation of proposals for improvement of analysed practice	Analysis of created lesson plans and their improvements with provision of feedback; portfolio	20	30
	1-5	0.5	Written exam	Writing of an academic essay	Essay	20	30
	1-5	0.25	Oral exam	Preparation for oral exam	Oral exam	5	10
	Total	**3**				**60**	**100**
	Final grade: **60-70 points: grade 2 (sufficient)** **71-80 points: grade 3 (good)** **81-90 points: grade 4 (very good)** **91-100 points: grade 5 (excellent)**						
Consultation hours	By appointment						

Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	15	15	15

Course content / teaching units

- General characteristics, pedagogical requirements and problems of children with special needs
- Definitions and terminology of special needs
- Classification and etiology of special needs
- Historical position and attitudes towards people with special needs
- Legal provisions and importance of early detection and early professional treatment of children with
- developmental difficulties
- Teamwork in the process of diagnosis, upbringing, education and rehabilitation
- Education and rehabilitation system
- Stereotypical attitudes
- Philosophy of inclusion
- Integrated upbringing and education of children and youth with disabilities
- Marginalized groups, contemporary tendencies and civic education
- Social and legal care for children with disabilities
- Practical problems of including children with disabilities in regular educational program
- Giftedness, personality, creativity
- Gifted child in family and in school
- Enriched programs for monitoring and guiding of gifted children and youth
- Elements of a comprehensive support system for gifted children
- The concept of marginal groups, processes and dimensions of marginality
- Competences of the modern teacher
- Communication with students, parents, professional associates, community and other members involved in education
- Assessment in the education system
- School management and classroom management
- Rules and discipline

	• Cooperation within school, with parents and the community • Lifelong learning and professional development
Recommended reading	Bouillet D. (2010) Izazovi integriranog odgoja i obrazovanja. Školska knjiga, Zagreb. Bouillet D., Uzelac S. (2007) Osnove socijalne pedagogije. Školska knjiga, Zagreb. Jensen E. (2004) Različiti mozgovi, različiti učenici - Kako doprijeti do onih do kojih se teško dopire. Educa, Zagreb.
Optional reading	Čudina Obradović M. (1991) Nadarenost: razumijevanje, prepoznavanje, razvijanje. Školska knjiga, Zagreb. Miljković D., Rijavec M. (2015) Pozitivna disciplina u razredu. IEP d.o.o., Zagreb. Rijavec M. (2000) Psihologija pozitivnog mišljenja. IEP, Zagreb.
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively and to fulfil all assignments within the course.
Exam passing procedure	During the course, the teacher monitors and evaluates the activities of students by awarding points according to determined criteria. The teacher thus provides continuous feedback, which students use to assess their learning progress and to create a portfolio to improve the learning process and their own professional development. At the end of the course, students write an essay with a critical review of theory and practice, after which they take oral exam. During the oral exam, the teacher asks questions that are related to learning outcomes. The final grade is determined according to the number of points collected for essay and oral exam and the number of points gained during lectures.
Main language of instruction; other languages	Croatian language
Method of monitoring the quality and efficiency of teaching	During the course, the teacher performs evaluation for learning by continuous monitoring of the learning process and student achievement, thus determining and adapting his/her teaching. After the course, the teacher conducts a survey among students to evaluate their subjective impression about the teaching quality, all with the aim to improve future teaching.

Course title	**Practices in Physical Chemistry**
Code	K053
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	I semester
Workload/ECTS credits	5
Course status	Obligatory
Course teacher	Assist. Prof. Dr. Martina Medvidović-Kosanović
Associate teachers	Matej Šag, professional associate
Course entry requirements (Preceding courses)	Practices in General Chemistry, Analytical Chemistry Laboratory Practice
Course objective	To develop students' knowledge about some concepts and laws of physical chemistry and to train students for independent practical work related to designing and performing an experiment by reviewing scientific literature.
Learning outcomes	1. Ability to assess the design and realisation of experiments performed during the course 2. Ability to critically evaluate the obtained and processed experimental data and to compare the obtained values with the published referential data. 3. Ability to make conclusions about the examined physical process and to present the report about the analysed topic.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-3	2	Laboratory practices	Attendance of classes; Participation in classes by asking questions or giving suggestions; Experimental work	Records related to attendance, control of workbooks, commenting the obtained results	5	10
1-3	3	Periodical exams (preliminary oral exams)	Preparation for laboratory practices, participation in oral exams prior to or during practical classes	Preliminary oral exams, Records related to practical assignments performance	55	90
Total	**5**				**60**	**100**

Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)
Final exam: achieved minimum number of points refers to the lowest grade (sufficient), and maximum number of points refers to the highest grade (excellent).

Consultation hours	Consultation hours are held during the laboratory practices.		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	0	0	60
Course content / teaching units	• Calorimetry (enthalpy of neutralisation) • Equilibrium constant (Nernst's division law) • Potentiometry 1 (pH measurement) • Potentiometry 2 (potentiometric titration of NaOH with HCl) • Conductometry (conductivity of electrolytes) • Conductometric titration • Transference number (the Hittorf method) • Chemical kinetics (hydrogen peroxide decomposition) • Spectrophotometry (the Lambert-Beer law) • Physical properties of liquids 1 (viscosity) • Physical properties of liquids 2 (surface tension)		
Recommended reading	Medvidović-Kosanović M. (2012) Praktikum fizikalne kemije / Maja Dutour Sikirić (ed.). Osijek: Sveučilište J.J. Strossmayera u Osijeku, Odjel za biologiju.		
Optional reading	Atkins P.W., Atkins J.de P. (2002) Physical Chemistry. Oxford University Press, Oxford. Atkins P.W., Clugston M.J. (1989) Načela fizikalne kemije. Školska knjiga, Zagreb. Cvitaš T., Kallay N. (1980) Fizičke veličine i jedinice Međunarodnog sustava. Školska knjiga, Zagreb. Sikirica M. (1985) Stehiometrija. Školska knjiga, Zagreb.		
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively and to fulfil all assignments within the course (practices, keeping notes by using forms for practices).		
Exam passing procedure	Preliminary oral exams are taken before each practice. The final grade refers to average grades achieved at individual practical classes (including results of preliminary exams, performance of practices and completed forms for practices). Final exam has to be taken if students did not achieve the minimum number of points during practical classes and preliminary exams.		
Main language of instruction; other languages	Croatian language, English language		
Method of monitoring the quality and efficiency of teaching	Continuous communication between teacher and students and anonymous student survey.		

Course title	**Practices in Methodology of Teaching Chemistry**
Code	K073
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	II semester
Workload/ECTS credits	3
Course status	Obligatory
Course teacher	Assist. Prof. Dr. Elvira Kovač-Andrić
Associate teachers	Nataša Bušić, assistant
Course entry requirements (Preceding courses)	Passed exams within undergraduate study courses and attended winter semester courses: Psychology in Education 1, Pedagogy 1, School Teaching Practice 1
Course objective	To develop students' knowledge and skills that are required for independent and responsible performance of experiments for the purpose of natural science literacy development and more effective learning and teaching.
Learning outcomes	1. Knowledge about basic rules of laboratory work, safety and protection measures in the chemical laboratory and the basic rules of handling chemicals and reagents. 2. Ability to direct research-based learning and teaching to develop critical- and creative-thinking skills. 3. Ability to understand basic chemical concepts by using models. 4. Ability to choose appropriate experiments to develop students' natural science literacy. 5. Ability to achieve learning outcomes prescribed by the curriculum through strategies, methods and procedures of teaching and evaluation. 6. Skills in integration of professional, methodological and pedagogical knowledge in the planning of direct teaching process.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-6	2	Practices	Independent completion of an experiment, demonstration of inquiry-based learning, preparation of models	Records related to performance of laboratory practices and other activities, analysis with provision of feedback, critical review – evaluation as learning	35	60
1-6	0.5	Written exam	Preparation for preliminary exam	Preliminary exam	20	30
1-6	0.5	Oral exam	Preparation for oral exam	Oral exam	5	10
Total	**3**				**60**	**100**

Final grade:
60-70 points: grade 2 (sufficient)

	71-80 points: grade 3 (good) **81-90 points: grade 4 (very good)** **91-100 points: grade 5 (excellent)**		
Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	0	0	60
Course content / teaching units	• Introduction to laboratory work in school: Basic rules of laboratory work; safety and protection measures in chemical laboratory; Basic rules for handling chemicals and reagents; First aid in chemical laboratory; Use of household chemicals in chemistry teaching; Preparation of solutions and reagents in classes • Experiments related to teaching units; Introduction to school experiment; Types of substances; Separation of mixtures; Metals and their compounds; Salts; Non-metals and their compounds; Water and hydrogen; Oxygen and air; Chemical kinetics; Carbon and organic compounds; Hydrocarbons; Organic compounds with oxygen; Biologically important compounds; Synthetically important compounds • Creation and usage of models in teaching chemistry		
Recommended reading	Sikirica M. (2011) Zbirka kemijskih pokusa za osnovnu i srednju školu. Školska knjiga, Zagreb.		
Optional reading	Farley R.F. (2001) School Chemistry Experiments. Association for Science Education. Journal of Chemical Education, Division of Chemical Education of the American Chemical Society, New York. Kostović-Vranješ V. (2015) Metodika nastave predmeta prirodoslovnog područja. Školska knjiga, Zagreb. Marin G., Ruić R., Cindrić M. (2009) Projektna nastava prirode, biologije, fizike i kemije. Školska knjiga, Zagreb. Sikirica M. (2004) Metodika nastave kemije. Školska knjiga, Zagreb.		
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively, to pass preliminary exams and to keep records on performed practices.		
Exam passing procedure	Monitoring and evaluation of students' performance by awarding points according to determined criteria. Students receive continuous feedback from the teacher after each practice class. Students can assess their learning progress within preparation of papers. Preliminary exams are taken prior to each practice class, and oral exam is taken after completion of practices. The final grade is determined according to the number of points awarded for preliminary and oral exam and the number of points obtained during lectures.		
Main language of instruction; other languages	Croatian language		
Method of monitoring the quality and efficiency of teaching	Continuous monitoring of the learning process and of students' achievement, for the purpose of guiding and adjusting teaching process. Students provide feedback about the quality of teaching, which is used in improvements of future teaching.		

Course title	**Psychology in Education 1**
Code	BP798
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	I semester
Workload/ECTS credits	3
Course status	Obligatory
Course teacher	Assoc. Prof. Dr. Daniela Šincek
Associate teachers	Marija Milić, Ph.D.
Course entry requirements (Preceding courses)	Completed undergraduate study
Course objective	To introduce students to the practical aspects of psychology of education.
Learning outcomes	1. Ability to critically review the relevant scientific literature referring to psychology of education. 2. Ability to assess the importance of a scientific approach to the research into mental processes, characteristics and behaviours of students in learning and teaching. 3. Knowledge about correlation between biological basis of behaviour and theories about learning and their application in the process of learning and teaching. 4. Ability to compare and differentiate between the development stages of an individual. 5. Ability to analyse the relations among teaching process, memory process and learning outcomes. 6. Ability to explain relations among the cognitive development, personality traits and the educational process. 7. Ability to critically determine the appropriate teaching methods and the specifics of teaching students with learning disabilities, students with developmental disabilities and students with behavioural disorders. 8. Ability to predict possible difficulties in working with students with disabilities and skills in finding possible solutions.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-8	0.5	Lecture	Critical conversation and discussion	Records	-	-
1-8	0.75	Seminars	Interpretation of scientific papers and application of obtained results in concepts learned within lectures	Monitoring of students' performance at interpretations and tasks	12	20
1-8	0.5	Practices	Work on practical assignment	Monitoring of student performance	0	5

	1-8	0.75	Written exam	Preparation for written exam	Written exam	36	55
	1-8	0.5	Oral exam	Preparation for oral exam	Oral exam	12	20
	Total	**3**				**60**	**100**

Final grade:
All above-mentioned elements of monitoring of students' performance are evaluated and graded according to the publicly available evaluation criteria that students are familiar with.
The final grade refers to continuous monitoring and testing of knowledge (preliminary exams are taken in written and practical form) and to the success at final exam. Activity of students during lectures is not part of the final grade, but it is added to the total number of points achieved within other elements of monitoring students' progress. Records on student activity are taken during each lecture.

Final grade:
From 60-69.9 points: grade 2 (sufficient)
From 70-79.9 points: grade 3 (good)
From 80-89.9 points: grade 4 (very good)
From 90-100 points: grade 5 (excellent)

Consultation hours	According to defined schedule and by individual appointment; written and oral consultations.		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	15	15	15
Course content / teaching units	• Introduction to scientific psychology • Definition of educational psychology fields • Biological basis of behaviour • Development of an individual • Cognitive abilities and creativity • Personality and individual differences • Memory • Learning • Students with learning disabilities and special educational needs.		
Recommended reading	Vizek-Vidović V., Vlahović-Štetić V., Rijavec M., Miljković, D. (2003) Psihologija obrazovanja. IEP- VERN, Zagreb. Zarevski P. (2007) Psihologija učenja i pamćenja (5th edition). Naklada Slap, Jastrebarsko.		
Optional reading	Atkinson R.L., Hilgard E. (2007) Uvod u psihologiju. Naklada Slap, Jastrebarsko. Beck M. (2004) Motivacija. Naklada Slap, Jastrebarsko. Čorkalo Biruški D. (2009) Primijenjena psihologija: pitanja i odgovori. Školska knjiga, Zagreb. Čudina-Obradović M. (1991) Nadarenost: razumijevanje, prepoznavanje, razvijanje. Školska knjiga, Zagreb. Gardner H., Kornhaber M.L., Wake W.K. (1999) Inteligencija. Naklada Slap, Jastrebarsko. Grgin T. (2004) Edukacijska psihologija (2nd edition). Naklada Slap, Jastrebarsko. Grgin T. (2001) Školsko ocjenjivanje znanja (4th edition). Naklada Slap, Jastrebarsko. Hock R.R. (2004) Četrdeset znanstvenih studija koje su promijenile psihologiju. Naklada Slap, Jastrebarsko. Rathus S.A. (2001) Temelji psihologije. Naklada Slap, Jastrebarsko. Ribić K. (1991) Psihofizičke razvojne poteškoće. ITP Forum, Zadar. Slavin R.E. (2012) Educational psychology: Theory and practice (10th ed.). Pearson, New York. Vasta R., Haith M.M., Miller S.A. (2004) Dječja psihologija (3rd edition). Naklada Slap, Jastrebarsko. Articles published in periodicals.		

Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively and to fulfil all assignments within the course.
Exam passing procedure	Preliminary exams during the course (assignments, homework). Final exam consists of written exam, of problem-solving task and of final oral exam.
Main language of instruction; other languages	Croatian language
Method of monitoring the quality and efficiency of teaching	Continuous communication between teacher and students and anonymous student survey.

Course title	**Psychology in Education 2**
Code	BP798-2
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	II semester
Workload/ECTS credits	3
Course status	Obligatory
Course teacher	Assoc. Prof. Dr. Daniela Šincek
Associate teachers	Ivana Duvnjak, assistant
Course entry requirements (Preceding courses)	Completed undergraduate study; attended course Psychology in Education 1 (or equivalent)
Course objective	To introduce students to the practical aspects of psychology of education.
Learning outcomes	1. Ability to determine the correlation between different theories of motivation and emotions and theories of learning and their application in the process of learning and teaching. 2. Skills required in analysis of teaching procedures that are directed to students' motivation. 3. Ability to critically analyse various factors of success and failure. 4. Ability to critically analyse processes related to classroom and discipline management. 5. Knowledge about importance of different group processes and group dynamics for successful classroom and discipline management. 6. Skills in planning different methods of knowledge assessment in individual academic domains. 7. Ability to predict possible difficulties in achieving classroom discipline and skills in creating possible solutions. 8. Ability to critically evaluate and compare alternative approaches to education.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-8	0.5	Lecture	Critical conversation and discussion	Records	-	-
1-8	0.75	Seminars	Interpretation of scientific papers and application of obtained results in concepts learned within lectures	Monitoring of students' performance at interpretations and tasks	12	20
1-8	0.5	Practices	Work on practical assignment	Monitoring of student performance	0	5
1-8	0.75	Written exam	Preparation for written exam	Written exam	36	55
1-8	0.5	Oral exam	Preparation for oral exam	Oral exam	12	20
Total	**3**				**60**	**100**

	All above-mentioned elements of monitoring of students' performance are evaluated and graded according to the publicly available evaluation criteria that students are familiar with. The final grade refers to continuous monitoring and testing of knowledge (preliminary exams are taken in written and practical form) and to the success at final exam. Activity of students during lectures is not part of the final grade, but it is added to the total number of points achieved within other elements of monitoring students' progress. Records on student activity are taken during each lecture. **Final grade:** **Od 60-69.9 points: grade 2 (sufficient)** **Od 70-79.9 points: grade 3 (good)** **Od 80-89.9 points: grade 4 (very good)** **Od 90-100 points: grade 5 (excellent)**		
Consultation hours	According to defined schedule and by individual appointment; written and oral consultations.		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	15	15	15
Course content / teaching units	• Motivation • Understanding of emotions - the role of emotions in the learning process • Teaching • Planning of lessons • Assessment and evaluation of knowledge • Evaluation of teacher's performance • Group processes and group dynamics • Classroom management and discipline • Inappropriate behaviour • Alternative approaches to education.		
Recommended reading	Vizek-Vidović V., Vlahović-Štetić V., Rijavec M., Miljković D. (2003) Psihologija obrazovanja. IEP- VERN, Zagreb.		
Optional reading	Barth B.M. (2004) Razumjeti što djeca razumiju. Profil International, Zagreb. Beck M. (2000) Motivacija. Naklada Slap, Jastrebarsko. Čudina-Obradović M. (1991) Nadarenost: razumijevanje, prepoznavanje, razvijanje. Školska knjiga, Zagreb. Gossen D.C. (2011) Restitucija - preobrazba školske discipline (2nd edition). Alineja, Zagreb. Grgin T. (2004) Edukacijska psihologija (2nd edition). Naklada Slap, Jastrebarsko. Grgin T. (2001) Školsko ocjenjivanje znanja (4th edition). Naklada Slap, Jastrebarsko. Matijević M. (2004) Grading u osnovnoj školi. Tipex, Zagreb. Woolfolk A. (2012) Educational psychology (12th ed.). Allyn and Bacon (poglavlje 10, 11, 12), New York. Vlahović-Štetić V. (ed.), Vizek Vidović V., Arambašić L., Vojnović N. (2005) Daroviti učenici: Teorijski pristup i primjena u školi. Institut za društvena istraživanja, Zagreb. Articles published in periodicals.		
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively and to fulfil all assignments within the course.		
Exam passing procedure	Preliminary exams during the course (assignments, homework). Final exam consists of written exam, of problem-solving task and of final oral exam.		
Main language of instruction; other languages	Croatian language		

Method of monitoring the quality and efficiency of teaching	Continuous communication between teacher and students and anonymous student survey.

<table>
<tr><td>Course title</td><td colspan="4">Study Visit</td></tr>
<tr><td>Code</td><td colspan="4">BP9112</td></tr>
<tr><td>Study programme</td><td colspan="4">Graduate University Study Programme in Biology and Chemistry Teacher Education</td></tr>
<tr><td>Semester</td><td colspan="4">III semester</td></tr>
<tr><td>Workload/ECTS credits</td><td colspan="4"></td></tr>
<tr><td>Course status</td><td colspan="4">Obligatory</td></tr>
<tr><td>Course teacher</td><td colspan="4">Assist. Prof. Dr. Selma Mlinarić
Assist. Prof. Dr. Anita Galir Balkić</td></tr>
<tr><td>Associate teachers</td><td colspan="4"></td></tr>
<tr><td>Course entry requirements (Preceding courses)</td><td colspan="4"></td></tr>
<tr><td>Course objective</td><td colspan="4">To introduce students to the organisation and implementation of teaching and to facilitate their direct observation and study of the surrounding occurrences and phenomena, so that they develop skills to correlate observed occurrences with those not available for observation, but taught in school.</td></tr>
<tr><td>Learning outcomes</td><td colspan="4">1. Acquired knowledge in biology by performing practices on field.
2. Implemented study visit within the field study and excursion in form of visits to a natural or cultural monument or a certain natural phenomenon.
3. Exchange of experiences related to organisation and realisation of excursions with experts.
4. Raised awareness about the importance of school cooperatives.</td></tr>
<tr><td>Link between learning outcomes, teaching and students' activities</td><td colspan="4">
<table>
<tr><th rowspan="2">Learning outcome</th><th rowspan="2">Share of ECTS</th><th rowspan="2">Form of teaching</th><th rowspan="2">Activities of learning and teaching</th><th colspan="3">Assessment</th></tr>
<tr><th>Methods of monitoring and evaluation</th><th colspan="2">Grading Points</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td>min</td><td>max</td></tr>
<tr><td>1-4</td><td></td><td>Practices</td><td>Organisation of a study visit</td><td>Records</td><td>-</td><td>-</td></tr>
</table>
Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)
</td></tr>
<tr><td>Consultation hours</td><td colspan="4">By appointment.</td></tr>
<tr><td>Teaching</td><td>Lectures</td><td>Seminars</td><td colspan="2">Practices</td></tr>
<tr><td>Hours - total</td><td>0</td><td>0</td><td colspan="2">30</td></tr>
<tr><td>Course content / teaching units</td><td colspan="4">Field teaching with the purpose of acquiring knowledge about different plant and animal species in the surrounding area
Observation of spatial distribution of plants and animals in the environment
Introduction to the principles of field work and excursion teaching as a form of out-of-classroom teaching
Learning about organisation of field excursions by participating in preparation, planning and realization of the excursion, and by transferring learned concepts to the classroom after the excursion
Team work, task division, analysis and synthesis of study visits
Study visit to the nature park, zoo, park, meadow, river
Study visit to the school cooperative.</td></tr>
</table>

	Using a study visit concept to obtain theoretical knowledge in biology and to implement it in teaching content that will be taught out of classroom.
Recommended reading	Desforges C. (2001) Učenje izvan škole. Educa, Zagreb.
Optional reading	Eko škole u Hrvatskoj, http://www.hr/wwwhr/education/elementary/index.hr.html. Moja škola - Eko škola, http://skole.posluh.hr/cabar/eko-skola.htm.
Conditions for obtaining teacher's signature	Students are obliged to participate actively in the study visit / excursion.
Exam passing procedure	
Main language of instruction; other languages	Croatian language
Method of monitoring the quality and efficiency of teaching	After the course, an anonymous survey will be carried out among students to evaluate their subjective impression about the organisation and quality of teaching; during the lectures, students will have opportunity to make written or oral remarks; monitoring of students' success.

Course title	**School Teaching Practice 1**
Code	BP7108
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	I semester
Workload/ECTS credits	2
Course status	Obligatory
Course teacher	Assist. Prof. Dr. Irena Labak
Associate teachers	
Course entry requirements (Preceding courses)	
Course objective	To introduce students to the organisation of schools within their observation period spent in schools and to make them familiar with duties and obligations of teachers, professional associates and other school staff.
Learning outcomes	1. Knowledge about pedagogical documentation used in schools. 2. Knowledge about all relevant curricula and regulations necessary for successful educational work and fulfilment of work obligations. 3. Knowledge about organisation of school jobs and division of work responsibilities of teachers and of professional associates.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-3	2	Observations in schools	Work with a mentor in school, analysis of school jobs, responsibilities and documents used in direct educational work. Creation of a teaching portfolio (reflection forms and professional development plan)	Work diary, teaching portfolio		
Total	**2**					

Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	0	0	30
Course content / teaching units	• Within this course, students will be guided by a school mentor with the aim to learn about: division of school jobs and duties, pedagogical documentation, curricula and other documents and regulations applicable in educational work (regular classes, elective classes, additional classes and additional work,		

	extracurricular activities and duties of a class teacher); teachers' obligations, curriculum-related obligations, annual executive curriculum, school curriculum and other documents, special obligations arising from the school organisation; duties of professional associates and other school employees; the role and tasks of school principal.
Recommended reading	Reading lists defined within all obligatory courses. Curriculum documents, applicable regulations and textbooks. Selected scientific and professional papers dealing with Biology.
Optional reading	
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively and to fulfil all assignments.
Exam passing procedure	
Main language of instruction; other languages	Croatian language
Method of monitoring the quality and efficiency of teaching	A survey carried out among students and school mentors to evaluate their subjective impression about the teaching quality, in order to improve future teaching.

Course title	**School Teaching Practice 2**
Code	BP8109
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	II semester
Workload/ECTS credits	2
Course status	Obligatory
Course teacher	Assist. Prof. Dr. Irena Labak
Associate teachers	
Course entry requirements (Preceding courses)	
Course objective	To teach students about the importance of communication and cooperation to be established between a school, parents and other people outside the school system, who can contribute with their expertise to the overall development of pupils and to professional development and lifelong learning of students.
Learning outcomes	1. Ability to determine the role and responsibilities of a class teacher in the direct educational work and to become familiar with duties arising from the class teacher's work. 2. Knowledge about roles and tasks related to school board, teachers' council, class council, parents' council and pupils' council. 3. Raised awareness on the importance of professional training as a way of professional development of teachers.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-3	2	Observations in schools	Work with a mentor in school, analysis of duties and responsibilities of class teacher and of school boards and councils. Creation of a teaching portfolio (reflection forms and professional development plan)	Work diary, teaching portfolio		
Total	**2**					

Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	0	0	30
Course content / teaching units	• Within this course, students will be introduced to educational work and to learn about duties of a class teacher, such as organisation of a homeroom class and other activities, organisation of information sessions for parents, other forms of cooperation with parents, organisation of parent meetings, planning and implementation of classroom work, keeping records on students in electronic registers (e-Records, e-Diary, etc.), keeping of class documentation, tasks related to the enrolment of children in the first grade of secondary school, transition from lower primary to upper primary grade, organisation of class council sessions, other tasks related to the implementation of executive curriculum and school curriculum, procedure for appointing and assigning tasks to school boards, teachers' councils, class councils, parents' councils and pupils' councils, realising the importance of professional trainings and professional development of teachers.		
Recommended reading	Curriculum documents, applicable regulations and textbooks. Selected scientific and professional papers dealing with Biology.		
Optional reading			
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively and to fulfil all assignments.		
Exam passing procedure			
Main language of instruction; other languages	Croatian language		
Method of monitoring the quality and efficiency of teaching	A survey carried out among students and school mentors to evaluate their subjective impression about the teaching quality, in order to improve future teaching.		

Course title	**School Teaching Practice 3**
Code	BP9110
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	2
Course status	Obligatory
Course teacher	Assist. Prof. Dr. Irena Labak
Associate teachers	
Course entry requirements (Preceding courses)	
Course objective	To enable students to develop their professional teaching skills within working with school mentors in direct educational environment.
Learning outcomes	1. Ability to identify the starting points for managing of learning and teaching process. 2. Ability to critically review the observed educational strategies and observed classroom management procedures. 3. Developed knowledge and skills necessary for working with students with special needs by cooperating with the professional school services. 4. Skills required for self-assessment of students' own positive aspects and areas for improvement of their work in direct educational environment.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-4	2	Observations in schools	Observations of school mentor's work in direct educational environment and continuous (self)analysis of the observed work. Creation of a teaching portfolio (reflection forms and professional development plan)	Work diary, teaching portfolio		
Total	**2**					

Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	0	0	30
Course content / teaching units	• Within this course, students will be observing the school mentor's work in direct educational environment, which includes: analysis and preparation for regular classes, elective classes, additional classes and additional teaching, extracurricular activities, cooperation with professional school service that work with children with special needs.		
Recommended reading	Reading lists defined within all obligatory courses. Curriculum documents, legal acts, regulations and applicable textbooks. Selected scientific and professional papers dealing with Biology.		
Optional reading			
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively and to fulfil all assignments within the course.		
Exam passing procedure			
Main language of instruction; other languages	Croatian language		
Method of monitoring the quality and efficiency of teaching	A survey carried out among students and school mentors to evaluate their subjective impression about the teaching quality, in order to improve future teaching.		

Course title	**Fundamentals of Physical Chemistry 1**
Code	K058
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	I semester
Workload/ECTS credits	5
Course status	Obligatory
Course teacher	Assoc. Prof. Dr. Maja Dutour Sikirić
Associate teachers	General Chemistry
Course entry requirements (Preceding courses)	
Course objective	To teach students about basic principles of thermodynamics and quantum chemistry; to enable students to solve complex problems by linking theoretical knowledge with experimental results, and by using scientific literature; to train students to apply concepts of thermodynamics in biology.
Learning outcomes	1. Ability to critically evaluate the applicability of state equations of real and ideal gases in industrial conditions and in the environment. 2. Ability to determine the relations between basic thermodynamic quantities: heat, operation, heat capacity, internal energy, enthalpy, entropy and Gibbs energy. 3. Ability to analyse physical and chemical reactions by using thermochemical laws. 4. Ability to analyse phase diagrams of pure substances and binary mixtures. 5. Knowledge about applicability of chemical equilibrium concepts to biological and environmental processes. 6. Ability to make comparison between electrochemical processes in biological systems and chemical parts. 7. Ability to determine the connection between quantum theory and the structure of atoms.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-7	1.5	Lecture	Critical discussion	Records related to active participation in lectures	5	10
1-7	1.5	Seminar	Usage of theoretical knowledge in problem-solving tasks	Monitoring of students' performance at solving of tasks	5	10
1-7	1	Written exam	Preparation for written exam	Results of written exam	20	40
1-7	1	Oral exam	Preparation for oral exam	Results of oral exam	20	40
Total	**5**				**50**	**100**

	Final grade: **50.0-62.5 points: grade 2 (sufficient)** **62.6-75 points: grade 3 (good)** **75.1-87.5 points: grade 4 (very good)** **87.6-100 points: grade 5 (excellent)**		
Consultation hours			
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	45	15	0
Course content / teaching units	Lectures refer to topics of thermodynamics and quantum chemistry: • Properties of gases, the first and the second law of thermodynamics, physical changes of pure substances, phase diagrams, properties of solutions, simple mixtures, mixing thermodynamics, activity, chemical equilibrium, equilibrium electrochemistry, electrochemical cells, standard potentials • Quantum theory, Schrödinger equation, atomic structure and atomic spectrum Each teaching unit is accompanied by seminar assignments, which are requiring students to apply basic concepts of thermodynamics to solving problems in chemistry, biology and environmental protection.		
Recommended reading	Atkins P., de Paula J. (2017) Elements of Physical Chemistry. 7th ed. Oxford University Press. Atkins P., de Paula J., Keeler J. (2018) Atkins' Physical Chemistry. 11th ed. Oxford University Press.		
Optional reading	Simeon V. (1980) Termodinamika. Školska knjiga, Zagreb.		
Conditions for obtaining teacher's signature	Obligatory active participation in lectures and performance of all assignments.		
Exam passing procedure	Students are obliged to pass the written exam in order to proceed with the oral exam. The final grade is determined according to the number of points achieved at written and oral exams, and of points obtained during the course.		
Main language of instruction; other languages	Croatian language		
Method of monitoring the quality and efficiency of teaching	After the course, an anonymous survey will be carried out among students to evaluate their subjective impression about the organisation of teaching; during the lectures, students will have opportunity to make written or oral remarks; monitoring of students' success at exams.		

Course title	**Fundamentals of Physical Chemistry 2**
Code	K059
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	II semester
Workload/ECTS credits	5
Course status	Obligatory
Course teacher	Assoc. Prof. Dr. Maja Dutour Sikirić
Associate teachers	Fundamentals of Physical Chemistry 1 (attended)
Course entry requirements (Preceding courses)	
Course objective	To teach students about the basics of quantum theory and to develop their skills required for application of the quantum theory to molecular spectroscopy. To develop students' knowledge about the basics of chemical kinetics and its application in biologically and environmentally important processes.
Learning outcomes	1. Ability to determine the connection between quantum theory and the structure of molecules. 2. Knowledge about the theoretical basis of molecular spectra (IR, UV-VIS, NMR). 3. Ability to review physical quantities that describe the kinetics of chemical reactions. 4. Ability to predict the influence of experimental conditions on chemical reaction rates. 5. Ability to apply knowledge about simple chemical reaction rate on complex reaction rates. 6. Ability to analyse the characteristics of adsorption that are important for heterogeneous catalysis.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-6	1.5	Lecture	Critical discussion	Records related to active participation in lectures	5	10
1-6	1.5	Seminar	Usage of theoretical knowledge in problem-solving tasks	Monitoring of students' performance at tasks	5	10
1-6	1	Written exam	Preparation for written exam	Results of written exam	20	40
1-6	1	Oral exam	Preparation for oral exam	Results of oral exam	20	40
Total	**5**				**50**	**100**

Final grade:
50.0-62.5 points: grade 2 (sufficient)
62.6-75 points: grade 3 (good)
75.1-87.5 points: grade 4 (very good)
87.6-100 points: grade 5 (excellent)

Consultation hours			
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	30	15	0
Course content / teaching units	Lectures refer to topics of quantum chemistry and chemical kinetics: • Molecular structures, Born-Oppenheimer approximation, molecular symmetry • Spectroscopy: rotational and vibrational spectra, electron transitions, lasers, nuclear magnetic resonance • Substance changes: kinetic theory of gases, diffusion, electrolyte solutions, order of chemical reactions, kinetics of complex reactions, catalysis - homogeneous, autocatalysis and heterogeneous, photochemistry, dynamics of molecular interactions, surface reactions, adsorption Each teaching unit is accompanied by seminar assignments within which students apply the basic concepts of quantum chemistry and chemical kinetics into solving of problems in chemistry, biology and environmental protection.		
Recommended reading	Atkins P., de Paula J. (2017) Elements of Physical Chemistry. 7th ed. Oxford University Press. Atkins P., de Paula J., Keeler J. (2018) Atkins' Physical Chemistry. 11th ed. Oxford University Press.		
Optional reading			
Conditions for obtaining teacher's signature	Obligatory active participation in lectures and performance of all assignments.		
Exam passing procedure	Students are obliged to pass the written exam in order to proceed with the oral exam. The final grade is determined according to the number of points achieved at written and oral exams, and of points obtained during the course.		
Main language of instruction; other languages	Croatian language, English language		
Method of monitoring the quality and efficiency of teaching	After the course, an anonymous survey will be carried out among students to evaluate their subjective impression about the organisation of teaching; during the lectures, students will have opportunity to make written or oral remarks; monitoring of students' success at exams.		

Course title	**Aquatic Ecosystems**
Code	
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	3
Course status	Obligatory
Course teacher	Assoc. Prof. Dr. Melita Mihaljević
Associate teachers	Assist. Prof. Dr. Anita Galir Balkić
Course entry requirements (Preceding courses)	
Course objective	To enable students to develop an argument-based opinion about functioning of freshwater ecosystems and marine biome. To teach students how to make a synthesized approach to understanding of aquatic biomes by linking relevant information about their flora and fauna.
Learning outcomes	1. Knowledge about the basic concepts of aquatic ecosystems and their distribution on Earth. 2. Ability to review the role and importance of aquatic ecosystems. 3. Ability to compare similarities and differences of various ecosystems. 4. Presentation of a seminar paper, which is written by using relevant scientific literature.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-3	0.5	Lecture	Lecture attendance and active participation	Records, evaluation	10	20
1-4	1	Seminar	Independent search for and critical revision of scientific references used in preparation of a seminar paper, and presentation of a seminar paper	Records and assessment of presented seminar paper	30	50
1-4	0.5	Written exam	Preparation for written exam	Written exam	10	15
1-4	1	Oral exam	Preparation for oral exam	Oral exam	10	15
Total	**3**				**60**	**100**

Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)

Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	30	10	0
Course content / teaching units	Lectures: • Freshwater ecosystems – classification, water as a living medium, ecological classification of freshwater organisms; Basic biological and ecological characteristics of lentic systems; Lotic systems - longitudinal zonation; Littoral zone; Sediment; Eutrophication; Water pollution and water protection. • Abiotic and biotic factors of marine ecosystems; Plankton and planktonic communities; Benthic population of phytal system; Seaweed communities; Ecology of the intertidal zone; Coasts; Estuaries; Tropical communities. Seminars: • Presentation related to biological diversity of selected aquatic ecosystems • Eutrophication and protection of freshwater ecosystems • Human influence on marine ecosystems.		
Recommended reading	Nybakken J.W. (2001) Marine biology: An ecological approach. San Francisco: Benjamin Cummings. Wetzel R.G. (2001) Limnology - Lake and River Ecosystems. 3rd ed. Academic Press, San Diego.		
Optional reading	Engelhardt W. (2003) Was lebt in Tümpel, Bach und Weiher? Kosmos, Stuttgart. Levinton J.S. (2017) Marine Biology: Function, Biodiversity, Ecology. Oxford University Press. Weigel M. (2009) Encyclopedia of biomes. Gale, Cengage Learning, Detroit.		
Conditions for obtaining teacher's signature	Active participation in lectures, preparation and presentation of seminar paper.		
Exam passing procedure	During lectures and seminars, the teachers monitor and evaluate performance of each student, which refers to 60% of the final grade. Achieved success at the written exam contributes to the final grade with 20%, while the remaining 20% of the final grade refers to success achieved at oral exam.		
Main language of instruction; other languages	Croatian language / English language		
Method of monitoring the quality and efficiency of teaching	Evaluation form		

Elective Courses

<table>
<tr><td>Course title</td><td colspan="7">Algae as Biological Indicators</td></tr>
<tr><td>Code</td><td colspan="7"></td></tr>
<tr><td>Study programme</td><td colspan="7">Graduate University Study Programme in Biology and Chemistry Teacher Education</td></tr>
<tr><td>Semester</td><td colspan="7">III semester</td></tr>
<tr><td>Workload/ECTS credits</td><td colspan="7">2</td></tr>
<tr><td>Course status</td><td colspan="7">Elective</td></tr>
<tr><td>Course teacher</td><td colspan="7">Assist. Prof. Dr. Dubravka Špoljarić Maronić</td></tr>
<tr><td>Associate teachers</td><td colspan="7">Assist. Prof. Dr. Filip Stević
Assoc. Prof. Dr. Tanja Žuna Pfeiffer
Nikolina Bek, assistant</td></tr>
<tr><td>Course entry requirements (Preceding courses)</td><td colspan="7">Algae, Fungi and Lichens (attended)</td></tr>
<tr><td>Course objective</td><td colspan="7">To teach students about the role and importance of algae as indicators of environmental change and about their application in assessment of ecosystem conditions.</td></tr>
<tr><td>Learning outcomes</td><td colspan="7">1. Ability to assess the role of algae as biological indicators of environmental changes.
2. Skills in sampling and analysing different algae in order to determine their structure, differences and adjustments to particular ecological conditions.
3. Ability to use professional literature and keys for determination of algae.
4. Ability to assess ecological conditions of an aquatic biotope by using defined methodology and regulations.
5. Ability to critically analyse various approaches and methodologies to assessment of aquatic ecosystem status.
6. Skills in designing of an experiment related to using of algae as biological indicators in assessment of environment and nature status.</td></tr>
<tr><td>Link between learning outcomes, teaching and students' activities</td><td colspan="7">
<table>
<tr><th rowspan="2">Learning outcome</th><th rowspan="2">Share of ECTS</th><th rowspan="2">Form of teaching</th><th rowspan="2">Activities of learning and teaching</th><th colspan="3">Assessment</th></tr>
<tr><th>Methods of monitoring and evaluation</th><th>Grading Points min</th><th>Grading Points max</th></tr>
<tr><td>1 , 4-6</td><td>0.5</td><td>Lecture</td><td>Critical conversation and discussion</td><td>Records related to active participation in conversations and discussions</td><td>5</td><td>10</td></tr>
<tr><td>1-6</td><td>1</td><td>Practices</td><td>Field research, designing and simulation of field research task</td><td>Field work report, analysis of simulation with provision of feedback</td><td>25</td><td>40</td></tr>
<tr><td>1-6</td><td>0.25</td><td>Written exam</td><td>Preparation for written exam</td><td>Written exam</td><td>15</td><td>25</td></tr>
<tr><td>1-6</td><td>0.25</td><td>Oral exam</td><td>Preparation for oral exam</td><td>Oral exam</td><td>15</td><td>25</td></tr>
<tr><td>Total</td><td>2</td><td></td><td></td><td></td><td>60</td><td>100</td></tr>
</table>
Final grade:
60-70 points: grade 2 (sufficient)
</td></tr>
</table>

	71-80 points: grade 3 (good) **81-90 points: grade 4 (very good)** **91-100 points: grade 5 (excellent)**		
Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	15	0	15
Course content / teaching units	Lectures: • Algae within the monitoring of water, soil and air quality • Algal biomarkers - biomolecular, biochemical, physiological • Monitoring of the community composition and metabolism - indicators and methods • Analysis of population - indicator species, invasive species, growth potential, indices • Algae as indicators of ecological status of waters - comparison of taxonomic approach and functional classifications • Algae - indicators in paleolimnological research and forensic limnology Practices: • Methods of sampling of algae (water, sediment, aerophytic communities) and monitoring of basic physical and chemical indicators • Taxonomic analysis and functional classifications • Designing and simulation of a research task - planning • Implementation, evaluation and connection with educational content in teaching		
Recommended reading	Bellinger E.G., Sigee D.C. (2010) Freshwater algae: Identification and use as bioindicators. John Wiley & Sons, Ltd, Chichester, West Sussex, UK. Hrvatske vode (2016) Metodologija uzorkovanja, laboratorijskih analiza i određivanja omjera ekološke kakvoće bioloških elemenata kakvoće (https://www.voda.hr/hr/metodologije).		
Optional reading	Stoermer E.F., Smol J.P. (2004) The Diatoms: Applications for the Environmental and Earth Sciences. Cambridge University Press, Cambridge, UK. Keys for determination of algae, recent scientific publications (scientific papers and review articles) and legal acts related to course topics.		
Conditions for obtaining teacher's signature	Active participation in lectures and fulfilment of all assignments within the course.		
Exam passing procedure	During the course, the teacher monitors and evaluates the activities of students by awarding points according to determined criteria. After lectures and practices, students shall pass the written exam, as well as oral exam. The final grade is determined according to the number of points gained during lectures and practices and the number of points achieved at written and oral exam.		
Main language of instruction; other languages	Croatian language, English language		
Method of monitoring the quality and efficiency of teaching	Making reviews during lectures; Carrying out of a student survey to obtain remarks and comments referring to organisation and realisation of teaching after the course; monitoring of students' success at exams.		

Course title	**Atmosphere and Environment**
Code	K082
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	2
Course status	Elective
Course teacher	Assist. Prof. Dr. Elvira Kovač-Andrić
Associate teachers	
Course entry requirements (Preceding courses)	
Course objective	To introduce students to the atmosphere and the environment in our surroundings and to teach them about possible pollution and its consequences.
Learning outcomes	1. Integrated knowledge about concepts of development and properties of the atmosphere. 2. Ability to assess the importance of micro-constituents present in the air and their interdependence. 3. Ability to predict the mechanisms that affect the level of micro-constituents present in the atmosphere. 4. Ability to assess the causes of atmospheric pollution and their consequences for the environment. 5. Ability to critically assess the human influence on the atmosphere and the environment.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-5	0.5	Lecture	Critical conversation and discussion	Records related to student performance at discussions and analyses	15	30
1-5	0.5	Seminar	Interpretation of scientific papers	Monitoring of students' performance at interpretations and tasks	20	40
1-5	0.5	Written exam	Preparation for written exam	Written exam	10	20
1-5	0.5	Oral exam	Preparation for oral exam	Oral exam	5	10
Total	**2**				**50**	**100**

Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)

	Final exam: minimum number of points refers to the lowest grade (sufficient), and maximum number of points refers to the highest grade (excellent).		
Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	15	15	0
Course content / teaching units	• Evolution of Earth atmosphere, climate • Layers of the atmosphere • atmospheric micro-constituents, cycles: sulphur, nitrogen and carbon-halogen compounds; atmospheric ozone; particulate matter; aerosols • Photochemical reactions; chemistry of the stratosphere and troposphere • Air pollution; pollution sources, types of pollutants and their influence (climate, environment, health) • Influence of meteorological parameters on atmospheric micro-constituents • Ozone holes; global warming; acid rain; human influence on atmospheric pollution, consequences and prevention		
Recommended reading	Hewit C.N., Jackson A.V. (2009) Atmospheric Science for Environmental Scientists. Wiley & Blackwel. Jacob D.J. (1999) Intoducttion of Atmospheric Chemisty. Prenston University Press, Prenston, New Jersey. Seinfeld J.H., Pandis S.N. (2006) Atmospheric Chemistry and Phisics. John Wiley and Sons, Inc., New Jersey.		
Optional reading	Finlayson-Pitts B.J., Pitts J.N.Jr. (1986) Atmospheric Chemistry. John Wiley, New York. Seinfeld J.H. (1986) Atmospheric Chemistry and Physics of Air Pollution. John Wiley and Sons, Inc., New York.		
Conditions for obtaining teacher's signature	Attendance of lectures with minimum 5 points obtained, oral presentation (seminar paper) with minimum 5 points obtained; minimum 10 points required.		
Exam passing procedure	During the course, the teacher monitors and evaluates performance of each student (preparation of a seminar paper), which refers to 20% of the final grade. Passing of written exam refers to 30% of the final grade and passing of oral exam refers to the remaining 50% of the final grade.		
Main language of instruction; other languages	Croatian language		
Method of monitoring the quality and efficiency of teaching	Student survey after the course; reviews during the course and possibility to give oral or written remarks after lectures; monitoring of student success at exams.		

Course title	**Plant Microtechnique and Microscopy**
Code	BMZ82
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	2
Course status	Elective
Course teacher	Prof. Dr. Vera Cesar
Associate teachers	Assist. Prof. Dr. Jasenka Antunović Dunić Assist. Prof. Dr. Lidija Begović Assist. Prof. Dr. Selma Mlinarić
Course entry requirements (Preceding courses)	Physical Foundations of Instrumental Methods in Biology, Cell Biology, Plant Anatomy
Course objective	To develop students' knowledge and skills required for the preparation of cytological and histological specimens and for usage of light and fluorescence microscope.
Learning outcomes	1. Skills required for application of methods of fixation and tissue preparation as appropriate to the plant material structure. 2. Skills to prepare materials that are suitable for planned experiment and to make photographic documentation. 3. Ability to evaluate the quality of prepared material. 4. Ability to interpret tissues structure of available preparations by applying previously acquired knowledge about the structure of cells and tissues. 5. Contribution to the development of professional knowledge by making critical interpretation of scientific research results.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1, 3, 4, 5	1	Lecture	Critical conversation and discussion	Records related to active participation in conversations and discussions	12	20
2, 3	0.5	Practices	Independent preparation and microscopic examination of material	Records related to students' performance at preparing and examining of materials	21	35
1 - 5	0.25	Written exam	Preparation for written exam	Assessment of practical work, written exam and/or delivered presentation	18	30
1 - 5	0.25	Oral exam	Preparation for oral exam	Oral exam	9	15
Total	**2**				**60**	**100**
Final grade:						

<table>
<tr><td></td><td colspan="3">60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)</td></tr>
<tr><td>Consultation hours</td><td colspan="3">By appointment</td></tr>
<tr><td>Teaching</td><td>Lectures</td><td>Seminars</td><td>Practices</td></tr>
<tr><td>Hours - total</td><td>30</td><td>0</td><td>15</td></tr>
<tr><td>Course content / teaching units</td><td colspan="3">Lectures:
Introduction to plant microtechniques
Sampling of plant material
Fixation
Dehydration
Infiltration and fitting
Histochemical and cytochemical reactions: fresh sections, sections in paraffin, methacrylate and epoxy resins
Usage of rotating microtome and cryostat
Immunolocalisation
In situ hybridisation of nucleic acids
Light microscopy: microscope with phase and differential-interference contrast, fluorescence microscope, confocal microscope
Electron microscopy: TEM and SEM (ESEM)
Practices:
Preparation of cytological and histological material, staining and microscopy
Application of some microscopy methods to analyse permanent preparations</td></tr>
<tr><td>Recommended reading</td><td colspan="3">Ambriović Ristov A. (2007) Metode u molekularnoj biologiji. Institut Ruđer Bošković, Zagreb.
Ruzin S.E. (1999) Plant Microtechnique and Microscopy. Oxford University Press, New York, Oxford.</td></tr>
<tr><td>Optional reading</td><td colspan="3">Bowes B.G. (1996) A Colour Atlas of Plant Structure. Manson Publishing Ltd, London.
Maliga P., Klessig D.F., Cashmore A.R., Gruissem W., Varner J.E. (1995) Methods in Plant Molecular Biology. A Laboratory Course Manual. Cold Spring Harbor Laboratory Press, New York.
O'Brien T.P., McCully M.E. (1981) The Study of Plant Structure. Princples and Selected Methods. Termercarphi Pty. Ltd., Melbourne, Australia.
Van De Graaf K.M., Rushforth S.R., Crawely, J.L. (1998) A Photographic Atlas for the Botany Laboratory. 3rd ed. Morton Publishing Company, Colorado.
Relevant scientific papers referring to the subject area.</td></tr>
<tr><td>Conditions for obtaining teacher's signature</td><td colspan="3">Students are obliged to attend lectures and practices, to participate in lectures actively and to fulfil all assignments within the course.</td></tr>
<tr><td>Exam passing procedure</td><td colspan="3">During the course, the teacher monitors and evaluates the activities of students by awarding points according to determined criteria. The final grade is determined according to the number of points collected during the lectures and the points achieved in written and oral exams.</td></tr>
<tr><td>Main language of instruction; other languages</td><td colspan="3">Croatian language, English language</td></tr>
<tr><td>Method of monitoring the quality and efficiency of teaching</td><td colspan="3">Survey carried out during the course, opportunity given to students to make written remarks and/or suggestions after the lectures.
Monitoring of students' success at exams.
Carrying out a uniform University Student Survey.</td></tr>
</table>

Course title	**Plant Pathoanatomy**
Code	BMZ80
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	2
Course status	Elective
Course teacher	Assoc. Prof. Dr. Ljiljana Krstin
Associate teachers	Assoc. Prof. Dr. Tanja Žuna Pfeiffer
Course entry requirements (Preceding courses)	Plant Anatomy, Plant Morphology with Field Work (attended)
Course objective	To teach students how to recognise changes in the anatomical structure of plant organs caused by pathogens.
Learning outcomes	1. Knowledge about the most common causes of plant diseases and ability to assess the impact of environmental factors on their occurrence and development of diseases. 2. Ability to predict changes in the anatomical structure of plant organs caused by diseases. 3. Ability to determine pathological changes in plant cells and tissues on freshly prepared microscopic preparations. 4. Ability to compare plant defence mechanisms against pathogen attack and disease development. 5. Developed natural science literacy of students by choosing simpler research tasks related to monitoring of pathological changes in plant tissues.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-5	0.5	Lecture	Critical conversation and discussion	Records related to active and independent participation in conversations and discussions	5	10
1-4	0.5	Practices	Independent preparation of microscopic samples, comparison of structures of healthy and diseased plant tissues	Records related to students' activities within practices with provision of feedback	25	40
1-5	0.5	Written exam	Preparation for written exam	Written exam	15	25

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<tr><td></td><td>
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<tr><td>1-5</td><td>0.5</td><td>Oral exam</td><td>Preparation for oral exam</td><td>Oral exam</td><td>15</td><td>25</td></tr>
<tr><td>Total</td><td>2</td><td></td><td></td><td></td><td>60</td><td>100</td></tr>
</table>
Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)</td></tr>
<tr><td>Consultation hours</td><td>By appointment</td></tr>
<tr><td>Teaching</td><td>
<table>
<tr><th>Lectures</th><th>Seminars</th><th>Practices</th></tr>
<tr><td>15</td><td>0</td><td>15</td></tr>
</table>
</td></tr>
<tr><td>Hours - total</td><td></td></tr>
<tr><td>Course content / teaching units</td><td>Lectures:
Anatomical structure of plants
Abiotic and biotic factors as causes of pathogenic changes in cellular structures and plant tissues
Pathological changes of cellular structures and organelles
Pathological changes of plant tissues
Practices:
Preparation of fresh microscopic samples of healthy and diseased plant tissues
Analysis and comparison of healthy and diseased plant tissues</td></tr>
<tr><td>Recommended reading</td><td>Agrios G.N. (2005) Plant Pathology, 5th ed. Academic Press, New York.
Trigiano R.N., Windham M.T., Windham A.S. (eds). 2006 Plant Pathology: Concepts and Laboratory Exercises, Taylor & Francis.</td></tr>
<tr><td>Optional reading</td><td>Bačić T. (2003) Morfologija i anatomija bilja, Sveučilište Josipa Jurja Strossmayera u Osijeku, Pedagoški fakultet, Osijek.
Lepeduš H., Cesar V. (2010) Osnove biljne histologije i anatomije vegetativnih organa. Sveučilište Josipa Jurja Strossmayera u Osijeku, Odjel za biologiju, Osijek.
Žuna Pfeiffer T., Krstin Lj., Štolfa I., Lovaković T., Tikas,V., Lepeduš,H. (2014) Praktikum iz anatomije biljaka, Sveučilište Josipa Jurja Strossmayera u Osijeku, Odjel za biologiju, Osijek.
Original scientific papers referring to the subject area.</td></tr>
<tr><td>Conditions for obtaining teacher's signature</td><td>Students are obliged to participate in lectures actively and to fulfil all assignments within the course.</td></tr>
<tr><td>Exam passing procedure</td><td>During the course, the teacher monitors and evaluates performance of each student, which refers to 40% of the final grade. Passing of written exam refers to 30% of the final grade, and passing of oral exam refers to the remaining 30% of the final grade.</td></tr>
<tr><td>Main language of instruction; other languages</td><td>Croatian language, English language</td></tr>
<tr><td>Method of monitoring the quality and efficiency of teaching</td><td>Periodic evaluation of students and teachers is planned to be carried out in order to assure and continuously improve the quality of teaching and of the study programme. During the last week of lectures, an anonymous student survey will be carried out to evaluate the overall quality of the course. Student success at exams will be also monitored.</td></tr>
</table>

Course title	**Biofilms**
Code	
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	2
Course status	Elective
Course teacher	Assist. Prof. Dr. Goran Palijan
Associate teachers	
Course entry requirements (Preceding courses)	Microbiology
Course objective	To teach students about the structure and function of biofilms.
Learning outcomes	1. Obtained knowledge about the role of biofilms in the environment. 2. Ability to valorise the interaction of biofilms and environment. 3. Ability to predict the changes in biofilm populations in the environment depending on environmental effects and species interactions. 4. Skills in reviewing professional literature.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-3	0.5	Lecture	Critical conversation and discussion	Records related to active participation in conversations and discussions	5	10
1-4	0.5	Seminar	Interpretation of scientific papers and application of obtained results at concepts learned within lectures	Monitoring of students' performance at interpretations and tasks	10	15
1-4	1	Written exam	Preparation for written exam	Written exam	20	32,5
	1	Oral exam	Preparation for oral exam	Oral exam	25	42,5
Total	**3**				**60**	**100**

Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)

Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**

Hours - total	15	15	0
Course content / teaching units	Lectures: Physical and chemical factors that influence the biofilm microorganisms Competitive strategies of microorganisms in biofilms Interactions between microorganisms in biofilm Soil biofilms Biofilms of the sea and ocean Inland water biofilms Extreme habitats Practices: • Within seminars, students will present and discuss the topics related to individual teaching units • Students shall independently prepare and present the seminar paper		
Recommended reading	Costerton JW. (2007) The Biofilm Primer. Springer, Berlin. Ghannoum M, Parsek M, Whiteley M, Mukherjee PK. (2015) Microbial Biofilms. ASM Press, Washington DC.		
Optional reading	Brown AE. (2009) Benson's Microbiological Applications – Laboratory Manual in General Microbiology. McGraw-Hill, Boston. Barton LL, Northup DE. (2011) Microbial Ecology. Wiley-Blackwell, New Jersey.		
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively and to fulfil all assignments within the course.		
Exam passing procedure	Before taking oral exam, students are obliged to pass written exam.		
Main language of instruction; other languages	Croatian language		
Method of monitoring the quality and efficiency of teaching	Survey on the subjective impression about the organisation of the course will be carried out after the course; during the course, students will be given an opportunity to make oral or written remarks; the teacher monitors students' success at exams.		

Course title	**Biomolecules in Food**
Code	BMZ77
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	2
Course status	Elective
Course teacher	Assoc. Prof. Dr. Valentina Pavić
Associate teachers	
Course entry requirements (Preceding courses)	
Course objective	To teach students about the structure and properties of food biomolecules, about chemical and energy transformations that are crucial for the function of biomolecules and to introduce students to the principles of modulation of metabolic reactions as a basis of biological processes in physiological and pathophysiological conditions of the organism.
Learning outcomes	1. Knowledge about the chemical structure of natural and synthetic compounds and their potential antioxidant activity. 2. Ability to evaluate the coordination of catabolic and anabolic processes. 3. Ability to understand the concept of deficient nutrient utilization in everyday life. 4. Ability to classify the bioavailability of biomolecules from food, and to determine the factors that affect the bioavailability of particular groups of compounds. 5. Knowledge about effects of nutrition on the development and prevention of specific diseases and conditions.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-5	0.5	Lecture	Critical conversation and discussion	Records related to active participation in conversations and discussions	10	15
1-5	1	Seminar	Interpretation of scientific papers and application of obtained results at concepts learned within lectures	Monitoring of students' performance at interpretations and tasks	40	60
1-5	0.5	Final exam	Preparation for oral exam	Oral exam	10	20
Total	**2**				**60**	**100**

Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)

Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	15	15	0
Course content / teaching units	Lecture: • Biological role of active molecules in food • Biomolecular interactions • Secondary metabolites of plants • Damages caused by free radicals • Antioxidant properties of natural metabolites • Assessment of the protective role of phytochemicals • Oxidative stress and diseases • The role of nutrition in the prevention of various diseases • The role of nutrition in gene expression Seminar: • Membrane lipids of skeletal muscle and insulin resistance • Natural isothiocyanate sulforaphane in cancer cell apoptosis • Function of soy lecithin phospholipids in emulsions • Recovery of biomolecules from food residues • Influence of food on medicine absorption • Phytosterols • Nonspecific interactions between food additives and biomolecules		
Recommended reading	Belitz H.D., Grosch W., Schieberle P. (2004) Food Chemistry. Springer-Verlag, Berlin. Fennema O.R. (1996) Food Chemistry. Marcel Dekker, Inc, New York.		
Optional reading	Watson D. (1998) Natural Toxicants in Food. Sheffield Academic Press, Sheffield. Rice-Evans C.A., Packer L. (2003) Flavonoids in Health and Disease. Marcel Dekker, Inc, New York.		
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively and to fulfil all assignments within the course.		
Exam passing procedure	Prior to taking oral exam, students are obliged to prepare and present the seminar paper. The final grade consists of points achieved at oral exam and of points obtained during the course.		
Main language of instruction; other languages	Croatian language		
Method of monitoring the quality and efficiency of teaching	Survey on the subjective impression about the organisation of the course will be carried out after the course; during the course, students will be given an opportunity to make oral or written remarks; the teacher monitors students' success at exams.		

Course title	**Socially Useful Learning**
Code	
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	2
Course status	Elective
Course teacher	Assist. Prof. Dr. Anita Galir Balkić
Associate teachers	Assoc. Prof. Dr. Tanja Žuna Pfeiffer Assist. Prof. Dr. Dubravka Špoljarić Maronić Nikolina Bek, assistant
Course entry requirements (Preceding courses)	
Course objective	To enable students to acquire knowledge and develop skills that are useful in solving of issues related to biology and chemistry in the local community. Within the selected project, students will be engaged in an association or school cooperative in order to find solutions to current problems.
Learning outcomes	1. Supported cooperation of students and the local community with the aim to identify needs, find solutions and contribution to the community. 2. Skills in dealing with current social issues and challenges among schoolchildren. 3. Developed skills in applying appropriate problem-solving methods. 4. Ability to self-assess one's own professional progress towards becoming a responsible member of the local community.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-4	0,2	Lectures	Active participation in critical discussion and in teaching	Records, evaluation	5	10
1-3	0,8	Seminars	Active participation in all project activities	Records, assessment of participation in project activities	25	35
1-4	0.5	Written exam	Keeping a work diary about the socially useful learning experience	Assessment of work diary	15	25
3-4	0.5	Oral exam	Final oral presentation	Oral exam	15	25
Total	**2**				**60**	**95**

Final grade:
60-68 points: grade 2 (sufficient)
69-77 points: grade 3 (good)
78-86 points: grade 4 (very good)
87-95 points: grade 5 (excellent)

Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	3	27	0
Course content / teaching units	Lectures: • Socially useful learning in higher education - definition and purpose • Forms of socially useful learning • Socially useful learning procedure - project planning (project goal, project duration, distribution of activities, end-user function), determination of project teams, project management and implementation of project activities) • Assessment of achieved project results and experiences. Seminars: • Examples of good practice • Developing a project with a local community partner in order to solve specific problems of a local community target group • Project report - activities, sustainability, knowledge transfer, description of measurable and objective indicators of success of certain activities		
Recommended reading	Mikelić Preradović N. (2009) Učenjem do društva znanja. Zavod za informacijske studije Odsjeka za informacijske znanosti Filozofskog fakulteta Sveučilišta u Zagrebu, Zagreb.		
Optional reading	Begić J., Berbić K.E., Brajković L., Matanović D., Mileusnić M., Paraga S., Tomasić I., Zec K. (2019) Od realizacije do promjene: Vodič za pokretanje programa društveno korisnog učenja. Institut za razvoj obrazovanja, Zagreb. Brubaker D.C., Ostraff J.H. (eds.) (2006) Life, learning, and community: Concepts and models for service-learning in biology. Sterling, VA: Stylus Publishing, LLC. Kazmer M.M. (2005) Community-Embedded Learning. The Library Quarterly, 75: 190-212. Original scientific and professional papers related to course subject area.		
Conditions for obtaining teacher's signature	Regular attendance of lectures and active participation in project-related tasks.		
Exam passing procedure	The teacher evaluates the activities of students during the course and their achievements at final exam. Active participation in lectures refers to 10% of the final grade, and active participation in project activities and keeping of work diary refers to 70% of the final grade. Final oral presentation refers to 20% of the final grade.		
Main language of instruction; other languages	Croatian language, English language		
Method of monitoring the quality and efficiency of teaching	Communication with students during lectures, continuous guidance, giving possibility to students to make oral or written remarks, monitoring of the implementation of all project phases, evaluation of the final project report.		

Course title	**Ecology in Education**
Code	BBZ50
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	2
Course status	Elective
Course teacher	Assist. Prof. Dr. Irena Labak
Associate teachers	
Course entry requirements (Preceding courses)	
Course objective	To enable students to independently and effectively manage the educational process dealing with ecology and environment issues.
Learning outcomes	1. Skills in teaching that cherish the natural and cultural heritage. 2. Knowledge about the functioning of eco-schools for the purpose of managing such a school. 3. Ability to review the ways of integrating environmental education into direct educational work. 4. Ability to self-assess aspects and opportunities to improve the knowledge and skills needed for environmental education.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-4	0.5	Lecture	Critical conversation and discussion Flipped classroom: analysis of relevant curricula; collaborative learning and a debate within analysis of different types of information sources	Records related to active participation in discussions, analysis and in collaborative learning; portfolio	10	20
1-5	1	Practices	Visit to an eco-school, workshop	Analysis of a proposal referring to active engagement in a workshop; portfolio	25	40
1-5	0.5	Written exam	Preparation of a workshop	Simulation of a workshop	25	40
Total	**2**				**60**	**100**

	Final grade: **60-70 points: grade 2 (sufficient)** **71-80 points: grade 3 (good)** **81-90 points: grade 4 (very good)** **91-100 points: grade 5 (excellent)**		
Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	15	0	15
Course content / teaching units	• Ecological education in Croatian curriculum • Ecological education in the teaching of biology • Raising awareness on environmental issues through the curriculum • Raising consciousness of children and youth toward a complex experience of the environment • Activities in the development of ecological sensitivity of children • Nature and cultural heritage in different subject curricula in primary and secondary school • The importance of developing ecological and creative abilities in the process of education • Integration and correlation of environmental education through the curriculum • The importance of student activities in preserving the environment • Projects that contribute to preservation of school environment in subject teaching • Cooperation in environmental education programs that involves: children/pupils - teacher - school - family - experts - scientists - professional and cultural institutions • Learning, teaching and the role of teachers in education for sustainable development • Introduction to eco-schools, classes, eco-projects • Simulation of various activities and situations related to environmental protection		
Recommended reading	Glavač (2000) Uvod u globalnu ekologiju. Hrvatska sveučilišna naklada i Ministarstvo zaštite i prostornog uređenja, Zagreb. Uzelac V. (2002) Stanje i vizija obrazovanja studenata učiteljskih škola/nastavničkih fakulteta za okoliš. Hrvatski pedagoško-književni zbor, Zagreb.		
Optional reading	Cifrić I. (1996) Ekološki izazovi obrazovnom kurikulumu. Društvena istraživanja 5(1):135-153. Uzelac V., Starčević I. (1999) Djeca i okoliš. Adamić, Rijeka. http://www.ekologija.net - website containing articles related to ecology.		
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively.		
Exam passing procedure	During the course, the teacher monitors and evaluates the activities of students by awarding points according to determined criteria. The teacher thus provides continuous feedback, which students use to assess their learning progress with the aim to improve their learning process and professional development. At the end of the course, students are obliged to perform a simulation of a developed workshop. The final grade refers to achieved points for the workshop and to points obtained during the course.		
Main language of instruction; other languages	Croatian language		

Method of monitoring the quality and efficiency of teaching	During the course, the teacher performs evaluation for learning by continuous monitoring of the learning process and student achievement, thus determining and adapting his/her teaching. After the course, the teacher conducts a survey among students to evaluate their subjective impression about the teaching quality, all with the aim to improve future teaching.

Course title	**Ecological Immunology**
Code	
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	2
Course status	Elective
Course teacher	Assist. Prof. Dr. Senka Blažetić Assist. Prof. Dr. Irena Labak
Associate teachers	
Course entry requirements (Preceding courses)	Ecology (attended), Biochemistry 3 (attended)
Course objective	To enable students to understand the natural variations in the body's immune response, by putting emphasis on the influence of biotic and abiotic factors and their consequences.
Learning outcomes	1. Ability to compare the diversity and complexity of the immune system of different groups of organisms. 2. Knowledge about the causes and consequences of the immune system diversity in the context of evolution and ecology. 3. Ability to analyse the relations between environmental factors and the immune response. 4. Ability to determine the consequences that ecosystem disorders have on the immune response.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-4	0.5	Lecture	Critical conversation and discussion	Records related to student performance during lectures	10	20
1-4	0.75	Seminar	Working on a case study	Assessment of presentation and interpretation of obtained results with provision of feedback	35	50
1-4	0.25	Written exam	Preparation for written exam	Written exam	5	10
1-4	0.5	Oral exam	Preparation for oral exam	Oral exam	10	20
Total	**2**				**60**	**100**

Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)

Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	15	15	0
Course content / teaching units	• Evolutionary development of the immune response • Mechanisms of interaction between the host and the pathogen • Intraspecific selective limitations • Influence of environmental factors on the diversity of the immune response • Integration of the immune response and collective immunity within community • Mechanisms for development of tolerance and resistance		
Recommended reading	Demas G., Nelson R. (2011) Ecoimmunology 1st ed. Oxford University Press. Malagol D., Ottaviani E. (2014) Eco-immunology: Evolutive Aspects and Future. Springer, Dordrecht		
Optional reading	Ulvestad E. (2007) Defending Life: The Nature of Host-Parasite Relations. Springer.		
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively and to fulfil all assignments within the course.		
Exam passing procedure	During the course, the teacher monitors and evaluates the activities of students by awarding points according to determined criteria. After the course, students take a written exam and then oral exam.		
Main language of instruction; other languages	Croatian language		
Method of monitoring the quality and efficiency of teaching	During the course, the teacher continuously evaluates student achievement, and gives students the opportunity to make oral or written comments. After the course, students are given a survey in which they give their subjective opinion about quality and organisation of teaching, all with the aim to improve future teaching.		

Course title	**Ecological Projects**
Code	
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	3
Course status	Elective
Course teacher	Assoc. Prof. Dr. Melita Mihaljević
Associate teachers	
Course entry requirements (Preceding courses)	
Course objective	To enable students to develop, implement and manage scientific and professional projects related to the nature and environment protection.
Learning outcomes	1. Skills needed for project management, from its preparation, through implementation and final evaluation. 2. Ability to assess environmental studies and projects. 3. Ability to determine environmental protection issues, to find solutions for problems, and to prepare a project proposal independently.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-3	0.5	Lectures	Lecture attendance and active participation	Records, evaluation	10	15
1-3	0.5	Seminar	Attendance at the seminar, prepared seminar paper containing results and conclusions of the performed analyses	Records, evaluation of seminar paper	15	20
1-3	1	Written exam	Preparation for written preliminary exam	Written exam	15	20
	1	Final exam	Exam preparation	Oral exam	20	**45**
Total	**2**				**60**	**100**

Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)

Consultation hours	As agreed with students.		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	15	15	0
Course content / teaching units	• Scientific research projects, development projects - planning, specifics, application procedure, project management and implementation. • European Union funds, financial programs and calls for proposals • Application of projects for financial support from European Union and national funds • Preparation of project documentation and project application process • Proposal evaluation procedure • The role of individuals, non-governmental organisations, scientific community and authorised institutions in the application and implementation of projects • Legal framework. • Independent preparation of project documentation		
Recommended reading	Kerzner H. (2003) Project management, A systems Approach to Planning, Scheduling and Controlling. John Wiley & Sons, Inc. Martinić I. (2010) Upravljanje zaštićenim područjima prirode - planiranje, razvoj i održivost. Šumarski fakultet, Sveučilište u Zagrebu.		
Optional reading	McCarthy S. (2013) How to Write a Competitive Proposal for Horizon 2020. Seán McCarthy Hyperion Ltd. McCarthy S. (2008) How to Write a Competitive Proposal for Framework 7. Seán McCarthy Hyperion Ltd.		
Conditions for obtaining teacher's signature	Attendance at lectures and seminars by obtaining minimum 25 points and by achieving at least 40% of the total number of points at the preliminary exam. A report written in the form of a scientific project application is a prerequisite for proceeding with the written exam.		
Exam passing procedure	The teacher evaluates the activities of students during the course and their achievements at final exam. The final grade consists of preparation of a written report by a share of 30%, of written exam by a share of 40%, and of oral exam by a share of 30%.		
Main language of instruction; other languages	Croatian language		
Method of monitoring the quality and efficiency of teaching	Periodic evaluation of students and teachers is planned to be carried out in order to assure and continuously improve the quality of teaching and of the study programme. During the last week of lectures, an anonymous student survey will be carried out to evaluate the overall quality of the course. The analysis of students' success at exams will be carried out.		

Course title	**Genome Evolution**
Code	BMZ79
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	2
Course status	Elective
Course teacher	Assist. Prof. Dr. Zorana Katanić
Associate teachers	
Course entry requirements (Preceding courses)	Genetics, Molecular Biology, Evolution
Course objective	To enable students to understand the basic concepts of genome evolution and to make them familiar with the research methodology used in this scientific discipline.
Learning outcomes	1. Skills in reviewing the basics of genome organisation and function in different organisms. 2. Ability to predict the action and significance of different mechanisms of genome evolution. 3. Skills in applying research methods related to the size, organisation, function, and evolution of the genome. 4. Ability to critically review relevant scientific literature.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-4	0.5	Lecture	Critical conversation and discussion	Records related to active participation in conversations and discussions	10	20
1-4	1	Seminar	Critical interpretation and presentation of scientific research; preparation and presentation of a seminar paper	Monitoring of students' interpretations and presentation of scientific research; analysis of a seminar paper	30	50
1-4	0.5	Final exam	Preparation for oral exam	Oral exam	20	30
Total	**2**				**60**	**100**

Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)

Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	15	15	0
Course content / teaching units	Lectures: • Size and organisation of genomes in different organisms • Genetic control of cell size • Mechanisms of genome evolution • Evolution of gene structure and gene expression • Basic differences of mitochondrial DNA • Evolution of plastid DNA • B-chromosomes • Sex chromosomes • Mechanism and significance of chromatin reduction and chromosome elimination • Methods for investigating the size, structure, function and evolution of the genome Seminars: • Working on assignments: review of literature and selection of a seminar paper topic; presentation of a seminar paper		
Recommended reading	Cooper G.M., Hausman R.E. (2010) Stanica: Molekularni pristup. Medicinska naklada, Zagreb Scientific papers referring to the subject area. Gregory T.R. (2005) The Evolution of the Genome. Elsevier Academic Press.		
Optional reading	Alberts B., Bray D., Lewis J., Raff M., Roberts K., Watson J.D. (2007) Molecular biology of the cell. 5th ed. Garland Publishing, Inc., New York – London. Ambriović Ristov A. et al. (2007) Metode u molekularnoj biologiji. IRB, Zagreb. Saitou N. (2017) Evolution of the Human Genome I. Springer, Japan		
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively and to fulfil all assignments within the course.		
Exam passing procedure	During the course, the teacher monitors and evaluates the activities of students by awarding points according to determined criteria. After the lectures, students proceed with the oral exam. The final grade consists of points achieved at the oral exam and of points obtained during the course.		
Main language of instruction; other languages	Croatian language		
Method of monitoring the quality and efficiency of teaching	After the course, an anonymous survey will be carried out among students to evaluate their subjective impression about the organisation and quality of teaching; during the lectures, students will have opportunity to make written or oral remarks; monitoring of students' success at exams.		

Course title	**Fauna Diversity of Croatia**
Code	BBZ52
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	3
Course status	Elective
Course teacher	Assist. Prof. Dr. Alma Mikuška
Associate teachers	Assist. Prof. Dr. Mirta Sudarić Bogojević
Course entry requirements (Preceding courses)	
Course objective	To educate students as responsible members of the local, national, European and global community by strengthening their knowledge and skills about biological diversity of animal species living in Croatia and by raising their awareness of Croatian fauna value at the international level.
Learning outcomes	1. Self-assessment of knowledge and skills needed for responsible behaviour in preservation of biodiversity in Croatia. 2. Ability to determine the relation between anthropogenic influence and the preservation of the fauna diversity of Croatia. 3. Ability to design a protocol for independent research of certain groups of animals living in Croatia. 4. Ability to valorise scientific and professional research of Croatian fauna. 5. Knowledge about calculations of biodiversity indexes for different groups of animals and areas in Croatia.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-4	0.5	Lecture	Critical conversation and discussion, Flipped classroom	Monitoring of students' activity during lectures	15	20
1-4	0.5	Seminars	Independent writing of an essay	Analysis of the essay by provision of feedback on student's progress in the learning process	10	20
1-5	1	Practices	Calculation of biodiversity indexes	Analysis of completed tasks by provision of feedback on student's progress in the learning process	10	20

	1-5	0.5	Written exam	Preparation for written exam	Seminar	15	20
	1-5	0.5	Oral exam	Preparation for oral exam	Oral exam	10	20
	Total	**3**				**60**	**100**

Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)

Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	15	15	15

Course content / teaching units

Lectures:

- Introductory lecture – course content, reading list and student obligations
- What is biodiversity?
- Fauna - why we need to explore fauna?
- Factors that influence the composition of fauna, the ratio of evaluated and confirmed taxa of animals in the world, Europe and Croatia
- Characteristics of European fauna
- Factors that influence the great diversity of Mediterranean fauna
- Regional division of Croatian fauna
- Habitat diversity in Croatia and the national classification of Croatian habitats
- Natura 2000 species in Croatia
- Research into Croatian fauna
- Endangerment and protection of Croatian fauna
- Overview of individual groups of vertebrates and invertebrates in Croatia

Seminar:

- Methods of inventory and monitoring of fauna in Croatia
- Introduction to literature and databases on fauna
- Biodiversity indexes
- Indexes of fauna similarity
- Using of the Primer software to calculate the indexes of diversity and similarity of fauna in various habitats

Recommended reading

Clarke K.R., Gorely R.N. (2020) Primer 7. User Manual/ Tutoral. Primer-E Ltd. Plymouth.
Holcer D., Pavlinić I. (2008) Fauna, Priručnik za inventarizaciju i praćenje stanja. Ministarstvo kulture, Državni zavod za zaštitu prirode, Zagreb.
Purger J. (2007) Priručnik za istraživanje biološke raznolikosti duž rijeke Drave. Sveučilište u Pečuhu, Pečuh.
Izvješće o stanju okoliša u RH za razdoblje 2013-2016
http://www.haop.hr/sites/default/files/uploads/dokumenti/06_integrirane/dokumenti/niso/IZVJ_OKOLIS_2013-2016.pdf

Optional reading

Antolović J., Frković A., Grubešić M., Holcer D., Vuković M., Flajšman E., Grgurev M., Hamidović D., Pavlinić I., Tvrtković N. (2006) Crvena knjiga sisavaca Hrvatske. Ministarstvo kulture, Državni zavod za zaštitu prirode, Zagreb.
Belančić A., Bogdanović T., Franković M., Ljuština M., Mihoković N., Vitas B. (2008) Crvena knjiga vretenaca Hrvatske. Ministarstvo kulture, Državni zavod za zaštitu prirode, Zagreb
Jardas I., Pallaoro A., Vrgoč N., Jukić-Peladić S., Dadić V. (2008) Crvena knjiga morskih riba Hrvatske. Ministarstvo kulture, Državni zavod za zaštitu prirode, Zagreb.
Jelić D., Kuljerić M., Koren T., Treer D., Šalamon D., Lončar M., Podnar-Lešić M., Janev-Hutinec Lj., Bogdanović T., Mekinić S., Jelić K. (2013) Crvena knjiga vodozemaca i gmazova Hrvatska. Ministarstvo zaštite prirode i okoliša i Državni zavod za zaštitu prirode, Zagreb.

	Mrakovčić M., Brigić A., Buj I., Ćaleta M., Mustafić P., Zanella D. (2006) Crvena knjiga slatkovodnih riba Hrvatske. Ministarstvo kulture, Državni zavod za zaštitu prirode, Zagreb. Ozimec R., Bedek J., Gottstein S., Jalžić B., Slapnik R., Štamol V., Bilandžija H., Dražina T., Kletečki E. Komerički A., Lukić M., Pavlek M. (2009) Crvena knjiga špiljske faune Hrvatske. Ministarstvo kulture, Državni zavod za zaštitu prirode, Zagreb. Tutiš V, Kralj J, Čiković D, Barišić S (2013) Crvena knjiga ptica Hrvatske. Ministarstvo zaštite prirode i okoliša i Državni zavod za zaštitu prirode, Zagreb.
Conditions for obtaining teacher's signature	Active participation in the teaching process and fulfilment of all assignments.
Exam passing procedure	The teacher evaluates the activities of students by awarding points according to determined criteria (points are awarded for solving of practical tasks and for seminar paper presentation). In this way, students can assess and improve their learning progress and advance their own professional development. At the end of the course, students prepare the seminar paper. During the oral exam, the teacher asks questions that are related to learning outcomes. The final grade is determined according to the number of points that students obtain at practices, for the seminar paper and at the oral exam.
Main language of instruction; other languages	Croatian language
Method of monitoring the quality and efficiency of teaching	The teacher continuously monitors the learning process and student achievements, thus determining and adapting his/her teaching. After the course, the teacher and students analyse the efficiency of the teaching process and carry out a survey to evaluate students' subjective impression about the teaching quality, all with the aim to improve future teaching.

Course title	**Herpetology**
Code	
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	2
Course status	Elective
Course teacher	Assist. Prof. Dr. Olga Jovanović Glavaš
Associate teachers	
Course entry requirements (Preceding courses)	
Course objective	To teach students about the biology of amphibians and reptiles and their systematics, anatomy, morphology, distribution and causes of endangerment.
Learning outcomes	1. Knowledge about the anatomy and morphology of amphibians and reptiles and different ways of their reproduction. 2. Ability to predict distribution of amphibians and reptiles based on the acquired knowledge. 3. Ability to define the reasons for the endangerment of amphibians and reptiles. 4. Ability to select appropriate methods for researching amphibians and reptiles. 5. Knowledge about the fauna of amphibians and reptiles of Croatia. 6. Skills in searching databases of amphibians and reptiles.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-5	0.5	Lectures	Lecture attendance and active participation	Student attendance	5	10
1-6	0.5	Practices	Practical classes attendance and active participation, written report containing obtained results	Records, evaluation	10	15
1-6	0.5	Knowledge assessment (written exam)	Preparation for written exam	Written exam	20	40
1-6	0.5	Final exam	Preparation for oral exam	Oral exam	25	35
Total	**2**				**60**	**100**

Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)

Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	15	0	15
Course content / teaching units	Lectures: • Introduction to herpetology • Taxonomy of amphibians • Anatomy and morphology of amphibians • Reproduction of amphibians • Distribution of amphibians • Systematics of reptiles • Anatomy and morphology of reptiles • Reproduction of reptiles • Distribution of reptiles • Endangerment of herpetofauna • Methods of researching herpetofauna • Herpetofauna of Croatia Practices: • Introduction to keys for identification of amphibian and reptile species • Anatomy and morphology of amphibians • Sounds of the Anura order • Identification of Croatian amphibians • Anatomy and morphology of reptiles • Identification of Croatian reptiles • Methods of researching herpetofauna • Collection and processing of data on the distribution of certain species of amphibians and reptiles • International databases of amphibians and reptiles		
Recommended reading	Arnold N., Ovenden D. (2002) Reptiles and Amphibians of Britain and Europe. Collins.Vitt L.J., Caldwell J.P. (2013) Herpetology: An Introductory Biology of Amphibians and Reptiles 4th ed. Academic Press.		
Optional reading	Duellman W.E., Trueb L. (1994) Biology of Amphibians. Johns Hopkins University Press.		
Conditions for obtaining teacher's signature	Regular attendance at lectures, successfully completed practices.		
Exam passing procedure	During the course, the teacher monitors and evaluates the performance of each student, which makes up to 30% of the final grade. Written exam contributes with 40% to the final grade, while oral exam takes up to 30% of the final grade.		
Main language of instruction; other languages	Croatian language, English language		
Method of monitoring the quality and efficiency of teaching	Student survey to evaluate the overall quality of the course. Analysis of student success at the exams.		

Course title	**Immunocompetence and Transplantation**
Code	BMZ84
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	2
Course status	Elective
Course teacher	Assist. Prof. Dr. Lidija Begović
Associate teachers	
Course entry requirements (Preceding courses)	Biochemistry 3, Immunology
Course objective	To enable students to understand the concepts and importance of transplantation and immune system reaction during transplantation, the role and importance of tissue tolerance, and to assess the problems associated with transplantation of tissues and organs.
Learning outcomes	1. Improved theoretical knowledge and insights into the basic modern techniques for determining immunocompetence during organ transplantation. 2. Ability to determine methods of isolation of individual cell populations from peripheral blood, spleen and lymph nodes, and methods of cell storage from peripheral and umbilical blood. 3. Ability to determine the class I HLA antigen, the panel of reactive antibodies in serum, the cross-match test, the HLA class II gene and HLA phenotype and genotype, and to conduct genealogical research. 4. Ability to analyse and evaluate problems related to tissue and organ transplantation.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-4	0.5	Lecture	Critical conversation and discussion	Records related to active participation in conversations and discussions	5	10
2-3	0.5	Practices	Work on experimental assignment	Monitoring of student performance within experimental assignment	25	30
1-4	0.5	Written exam	Preparation for written exam	Written exam	15	30
1-4	0.5	Oral exam	Preparation for oral exam	Oral exam	15	30
Total	**2**				**60**	**100**

Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)

Consultation hours	By appointment

Teaching	Lectures	Seminars	Practices
Hours - total	15	0	15
Course content / teaching units	Lectures: • Transplantation of cells, tissues and organs: history, application, types of transplantation, problems (immunobiological, surgical, ethical, legal) • Immune system: the role, organs (primary, secondary), cells (lymphocytes, granulocytes, mediators), immunity (congenital, acquired, active, passive), immune response (cellular, humoral) • Main tissue matching system (HLA system): basic characteristics, role, location, polymorphism, imbalance of matching, products, tissue representation, crossing-over, terminology, application • Molecular structure of the HLA region (HLA class I region, central region, HLA class II region), HLA class I and class II genes (structure, role), HLA class I and class II molecules (structure, role) • Minor systems of tissue tolerance (system H-Y, HA-2) • Transplant reaction, recipient reaction against transplant, transplant reaction against recipient, criteria of recipient selection for transplantation of solid organs (kidney, liver, heart, pancreas), tissues and hematopoietic cells, waiting lists • Chimerism: application, importance, prognostic value, methods of determination Practices: • Isolation of individual cell populations from peripheral blood, spleen, lymph nodes • Methods of storing cells from peripheral and umbilical cord blood • Determination of HLA class I antigen (Microlymphocytotoxicity test: MLCT) • Determination of a panel of reactive HLA antibodies in serum (% P RA) • Cross-match test (CM) • Class II HLA gene determination (Polymerase Chain Reaction -Sequence Specific Primers: PCR-SSP) • Determination of HLA phenotype, HLA genotype, genealogy		
Recommended reading	Andreis I., Batinić D., Čulo F., Grčević D., Marušić M., Taradi M., Višnjić D. (2004) Imunologija. Medicinska naklada, Zagreb. Marsh S.G.E., Parham P., Barber L.D. (2000) The HLA facts book. Academic Press, London.		
Optional reading	Bader P., Neithammer D., Willasch A., Kreyenberg H., Klingebiel T. (2005) How and when we monitor chimerism after allogeneic stem cell transplantation?. Bone Marrow Transplantation, 35, 107-119. Janeway C.A., Travers P., Walport M., Shlomchik M.J. (2001) Immunobiology 5, The Immune system in health and disease. Garland Publishing, New York. Starzl T.E. (2004) Chimerism and tolerance in transplantation. Colloquium of the National Academy of Science, 101 (2), 607-614.		
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively and to fulfil all assignments within the course.		
Exam passing procedure	During the course, the teacher monitors and evaluates the activities of students by awarding points according to determined criteria. After lectures and practices, students take a written exam and then an oral exam. Points achieved at written and oral exam are added to the points obtained up to the final exam, thus making a total number of points to be converted to final grade.		
Main language of instruction; other languages	Croatian language		

Method of monitoring the quality and efficiency of teaching	Survey on the subjective impression about the organisation of the course will be carried out after the course; during the course, students will be given an opportunity to make oral or written remarks; the teacher monitors students' success at exams.

Course title	**Inquiry-based Teaching of Biology**
Code	BBZ49
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	2
Course status	Elective
Course teacher	Assist. Prof. Dr. Irena Labak
Associate teachers	
Course entry requirements (Preceding courses)	
Course objective	To develop students' skills required to apply the method of inquiry-based learning in their teaching, and to enable them to use scientific methodology for improvement of their teaching skills.
Learning outcomes	1. Adopted knowledge on natural science concepts by applying the inquiry-based learning method. 2. Ability to adjust the inquiry-based learning method to pupils' age. 3. Developed skills for assessment of the inquiry-based learning process and achievements by applying evaluation approaches. 4. Skills to manage self-regulated professional development by applying scientific methodology. 5. Ability to review scientific and professional literature dealing with research in the field of education.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-5	0.75	Lecture	Critical conversation and discussion; inquiry-based learning	Records related to active and independent participation in conversations and discussions; monitoring of student performance at inquiry-based learning with provision of feedback; portfolio	20	30
1-5	1	Practices	Independent simulation of inquiry-based learning and assessment; *journal club*	Analysis of simulation with provision of feedback; Records related to student activity in the journal club; portfolio	30	50

	1-5	0.25	Written exam	Planning of professional development	Professional development plan	10	20
	Total	**2**				**60**	**100**

Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)

Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	15	0	15
Course content / teaching units	• Natural science literacy, scientific approach and biological literacy - changing the paradigm of learning and teaching of the science subjects • Learning by discovering, experiential learning, inquiry-based learning of biological macro-concepts and the development of natural science literacy • Natural science competence (analysis, interpretation, observation, explanation, argumentation, conclusion drawing based on observation and measurement), causal conclusion drawing and epistemological knowledge • Research questions - characteristics, conditions, variables, hypotheses and statistical methods • 5E learning model for the development of natural science literacy • Degrees of students' independence in learning by using the method of scientific research • Evaluation approaches to inquiry-based learning • Curriculum of interdisciplinary topics for the development of natural science literacy • Information literacy and learning of a scientific language • The relationship of science, technology and social progress, one's own responsibility for the progress of society • Research methods in education • Management of learning: metacognitive skills and self-regulated learning • Competence-based learning and teaching • The importance of lifelong learning		
Recommended reading	Cohen L., Manion, L., Morrison, K. (2007) Metode istraživanja u obrazovanju. Naklada Slap. Klipert H. (2001) Kako učiti u timu. EDUCA, Zagreb. Mužić V. (2001) Metodologija pedagoškog istraživanja. Zavod za izdavanje udžbenika, Sarajevo. Littleton K., Scanlon E., Sharples M. (2012) Orchestrating Inquiry Learning. Abingdon: Routledge.		
Optional reading	Chu S.K.W., Reynolds R.B., Tavares N.J., Notari M., Lee C.W.Y. (2017) 21st Century Skills Development Through Inquiry-Based Learning From Theory to Practice. Springer. Ristić Dedić Z. (2013) Metodike u suvremenom odgojno-obrazovnom sustavu: Istraživačko učenje kao sredstvo i cilj prirodoznanstvenog obrazovanja: psihologijska perspektiva. Akademija odgojno-obrazovnih znanosti Hrvatske, Zagreb, 258-275 pp.		
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively and to fulfil all assignments within the course.		
Exam passing procedure	During the course, the teacher monitors and evaluates the activities of students by awarding points according to determined criteria. The teacher thus provides continuous feedback, which students use to assess their learning progress and to create a portfolio to improve the learning process and their own professional development. At the end of the course, students are required to develop a professional development plan. The final grade is determined according to the number of points gained during the course and at the written exam.		

Main language of instruction; other languages	Croatian language
Method of monitoring the quality and efficiency of teaching	During the course, the teacher performs evaluation for learning by continuous monitoring of the learning process and student achievement, thus determining and adapting his/her teaching. After the course, the teacher conducts a survey among students to evaluate their subjective impression about the teaching quality, all with the aim to improve future teaching.

Course title	**Research Work in Teaching Chemistry**
Code	K075
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	2
Course status	Elective
Course teacher	Assoc. Prof. Dr. Valentina Pavić
Associate teachers	
Course entry requirements (Preceding courses)	
Course objective	To develop students' skills required to apply the method of inquiry-based learning in their teaching, and to enable them to integrate scientific methodology into improvement of their teaching skills. To develop students' creativity and teamwork skills.
Learning outcomes	1. Adopted knowledge on natural science concepts by using scientific methodology. 2. Ability to adjust the inquiry-based learning method to pupils' age. 3. Ability to search for information about European projects and international cooperation opportunities. 4. Skills in managing team groups for the purpose of project realisation.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-2	0.25	Lecture	Critical conversation and discussion; inquiry-based learning	Records related to active and independent participation in conversations and discussions; monitoring of student performance at inquiry-based learning with provision of feedback	20	30
1-4	1.5	Practices	Independent simulation of inquiry-based learning and assessment	Analysis of simulation with provision of feedback; Records related to student activity	30	50

		0.25	Written exam	Planning of professional development	Professional development plan	10	20
	Total	**2**				**60**	**100**
	Final grade: **60-70 points: grade 2 (sufficient)** **71-80 points: grade 3 (good)** **81-90 points: grade 4 (very good)** **91-100 points: grade 5 (excellent)**						
Consultation hours	By appointment						
Teaching	**Lectures**		**Seminars**		**Practices**		
Hours - total	15		0		45		
Course content / teaching units	• Learning by discovering, experiential learning, inquiry-based learning • Natural science competence • Curriculum of interdisciplinary topics for the development of natural science literacy • Research methods in education • Scientific methods in teaching of the science subjects • The importance of lifelong learning • Simulation of inquiry-based learning • Assessment of inquiry-based learning						
Recommended reading	Cohen L., Manion L., Morrison K. (2007) Metode istraživanja u obrazovanju. Naklada Slap. Klipert H. (2001) Kako učiti u timu. EDUCA, Zagreb. Mužić V. (2001) Metodologija pedagoškog istraživanja. Zavod za izdavanje udžbenika, Sarajevo. Sikirica M. (2003) Metodika nastave kemije. Školska knjiga, Zagreb. Sikirica M. (2011) Zbirka kemijskih pokusa za OŠ i SŠ. Školska knjiga, Zagreb.						
Optional reading	Raos N. (2004) Nove slike iz kemije. Školska knjiga. www.scinetix.eu Ristić Dedić Z. (2013) Metodike u suvremenom odgojno-obrazovnom sustavu: Istraživačko učenje kao sredstvo i cilj prirodoznanstvenog obrazovanja: psihologijska perspektiva. Akademija odgojno obrazovnih znanosti Hrvatske, Zagreb, 258-275 pp.						
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively and to fulfil all assignments within the course.						
Exam passing procedure	During the course, the teacher monitors and evaluates the activities of students by awarding points according to determined criteria. The teacher thus provides continuous feedback, which students use to assess their learning progress with the aim to improve their learning process and professional development. At the end of the course, students are required to develop a professional development plan. The final grade is determined according to the number of points gained during the course and at the written exam.						
Main language of instruction; other languages	Croatian language						
Method of monitoring the quality and efficiency of teaching	During the course, the teacher performs evaluation for learning by continuous monitoring of the learning process and student achievement, thus determining and adapting his/her teaching. After the course, the teacher conducts a survey among students to evaluate their subjective impression about the teaching quality, all with the aim to improve future teaching.						

Course title	**Chemistry in Everyday Life**
Code	K083
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	2
Course status	Elective
Course teacher	Assist. Prof. Dr. Olivera Galović
Associate teachers	
Course entry requirements (Preceding courses)	Obligatory courses related to chemistry
Course objective	To enable students to understand basic concepts in chemistry that are applicable to everyday situations.
Learning outcomes	1. Ability to compare the daily activities of humans and chemical processes that take place in their environment. 2. Ability to assess positive and negative impact of humans on nature and natural processes. 3. Ability to analyse the relevant scientific literature. 4. Ability to apply knowledge in solving of simpler problem-based tasks.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-3	1	Lecture	Discussion	Records related to students' engagement in discussions	6	10
1-4	0.5	Practices	Working on tasks by applying knowledge acquired during lectures	Records related to performance at solving of tasks	6	10
1-4	0.5	Written exam	Preparation for written exam	Written exam	48	80
Total	**2**				**60**	**100**

Final grade:
60-70.9 points: grade 2 (sufficient)
71-80.9 points: grade 3 (good)
81-90.9 points: grade 4 (very good)
91-100 points: grade 5 (excellent)

Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	15	0	15
Course content / teaching units	• By using examples from everyday life (medications, detergents, plastics, food additives, cosmetic products, fertilisers), as well as by elaborating selected		

	issues and solutions, students will be introduced to the role of chemistry in criminology, ecology, technology, transport, waste management, food production and other industries. • Better understanding of chemistry and chemistry laws for better control of chemicals in everyday life situations and for achievement of maximum benefit and minimum risk of their usage.
Recommended reading	American Chemical Society (2018) Chemistry in context - Applying Chemistry to Society, 9th ed. Hill J. W., McCreary T.W., Kolb D.K. (2016) Chemistry for Changing Time (Global Edition). Pearson Higher Ed.
Optional reading	Lee H.C., Gaensslen R.E. (2013) Advances in Fingerprint Technology, 3rd ed. CRC Press, New York. Journal of Chemical Education
Conditions for obtaining teacher's signature	Active participation in classes and completion of all assignments within the course.
Exam passing procedure	Passed two preliminary exams during the course or final written exam after the attended lectures. The final grade also includes the points obtained for active participation in lectures and seminars.
Main language of instruction; other languages	Croatian language
Method of monitoring the quality and efficiency of teaching	Conversation with students during lectures, student survey after the course.

Course title	**Colloid and Interfacial Chemistry**
Code	K054
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	2
Course status	Elective
Course teacher	Assoc. Prof. Dr. Berislav Marković
Associate teachers	
Course entry requirements (Preceding courses)	Passed exams within the courses Fundamentals of Physical Chemistry 1 and 2
Course objective	To teach students about properties and wide application of various colloidal systems and about the basics of surface reactions.
Learning outcomes	1. Knowledge about classification of colloidal systems. 2. Ability to plan the usage of colloidal systems within different applications. 3. Ability to evaluate specific properties of different colloidal systems in different applications. 4. Ability to analyse the role of surface thermodynamics: surface tension, surface energy, adsorption on surfaces. 5. Skills in applying appropriate methods for determination of colloid characteristics. 6. Developed skills in oral and written presentation of scientific work.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-6	0.5	Lecture	Critical conversation and discussion	Records	7	10
1-6	0.5	Seminars	Independent analysis and interpretation of scientific papers by applying knowledge acquired within lectures	Presentation	10	20
1-6	0.5	Exam (preliminary exam)	Preparation for written exam	Written exam	20	30
1-6	0.5	Oral exam	Preparation for oral exam	Oral exam	23	40
Total	**2**				**60**	**100**

Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)

	Final exam: achieved minimum number of points refers to the lowest grade (sufficient), and maximum number of points refers to the highest grade (excellent).		
Consultation hours	One hour a week during a semester, according to schedule announced in advance.		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	15	15	0
Course content / teaching units	• Colloid systems: systematic review of colloids, diffusion, the Brown's motion, technological and biological significance of colloids • Thermodynamics of surfaces: surface energy, the Gibbs equation, nucleation, contact angle and surface tension; • Sedimentation and viscosity of suspensions • Particles and their characterisation: particle size and shape determination methods • Adsorption at interfaces: adsorption isotherms, polymer adsorption • Surface charge: development of surface potential, electrical double-layer, electrokinetics and zeta-potential • Association colloids: micelles, liquid crystals, membranes • Interaction of colloid particles: coagulation kinetics, effects of polymers on colloidal stability • Modern methods for investigating colloidal dispersions • Colloid chemistry today and tomorrow – nanochemistry and nanotechnology		
Recommended reading	Cosgrove T. (2010) Colloid Science: Principles, Methods and Applications. Willey-Blackwell, Chichester. Hunter R.J. (2001) Foundations of Colloid Science, 2nd ed. Oxford University Press, New York.		
Optional reading	Hunter R.J. (1994) Introduction to Modern Colloid Science, 2nd ed. Oxford University Press, Oxford. Hiemenz P.C., Rajagopalan R. (1997) Principles of Colloid and Surface Chemistry, 3rd ed. Marcel Dekker, New York. Selected articles on colloid chemistry applications in modern technologies.		
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively and to fulfil all assignments within the course (practices, seminar tasks).		
Exam passing procedure	Students' knowledge is evaluated within one preliminary exam taken in the middle of semester. Final exam is taken in form of oral exam.		
Main language of instruction; other languages	Croatian language, English language		
Method of monitoring the quality and efficiency of teaching	Continuous communication between teacher and students and anonymous student survey.		

Course title	**Medicinal Plants**
Code	BBZ51
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	3
Course status	Elective
Course teacher	Assoc. Prof. Dr. Ljiljana Krstin
Associate teachers	Assist. Prof. Dr. Zorana Katanić
Course entry requirements (Preceding courses)	
Course objective	To teach students about the most important medicinal plants and the ways of making and using medicinal preparations.
Learning outcomes	1. Ability to compare morphological and anatomical characteristics and phytochemical properties of some medicinal plants. 2. Ability to select and use professional and scientific literature in the determination of medicinal plants. 3. Ability to select appropriate method for collecting and storing of medicinal plants. 4. Ability to determine phytochemical content of medicinal plants and its effect on human health. 5. Ability to use scientific literature for critical evaluation of using medicinal plants.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-5	0.5	Lecture	Critical conversation and discussion	Records related to active participation in conversations and discussions	10	20
1-5	1	Seminar	Interpretation of scientific papers and application of obtained results in concepts learned within lectures	Monitoring of student's interpretations and performance at tasks	20	30
1-3	0.5	Practices	Work on experimental task	Monitoring of student performance	10	20
1-5	0.5	Written exam	Preparation for written exam	Written exam	10	15
1-5	0.5	Oral exam	Preparation for oral exam	Oral exam	10	15
Total	**3**				**60**	**100**

Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)

	81-90 points: grade 4 (very good) **91-100 points: grade 5 (excellent)**		
Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	15	15	15
Course content / teaching units	Lectures: • The history of healing with medicinal plants • The most common medicinal plants of the Croatian flora • Calendar of harvesting medicinal plants • Processing and storage of medicinal plants • Bioactive substances in medicinal plants • Phytochemical content of medicinal plants and their modes of action Seminars: • Each teaching unit will be accompanied by appropriate scientific and professional literature, based on which students will prepare seminar papers Practices: • Recognition and collection of some medicinal plants • Preparation of herbal products		
Recommended reading	Bowden J. (2014) Najučinkovitiji prirodni lijekovi. Selman d.o.o. Zagreb. Chevallier A. (2016) Encyclopedia of Herbal Medicine: 550 Herbs and Remedies for Common Ailments. Penguin Random House, DK. Galle Toplak K. (2015) Domaće ljekovito bilje. Mozaik knjiga, Zagreb. Glavaš M. (2019) Enciklopedija domaćeg ljekovitog bilja. Ceres, Zagreb.		
Optional reading	Simmonds M., Howes M.J., Irving J. (2017) Gardener s Companion to Medicinal Plants. Frances Lincoln in association with RBG Kew Wyk B.E., Wink M. (2017) Medicinal Plants of the World - An Illustrated Scientific Guide to Important Medicinal Plants and Their Uses. Revised Edition, CABI.		
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively and to fulfil all assignments within the course.		
Exam passing procedure	During the course, the teacher monitors and evaluates the activities of students by awarding points according to determined criteria. Students can take written and oral exam after they have attended lectures, practices and seminars. Points achieved at written and oral exam are added to the points obtained up to the final exam, thus making a total number of points to be converted to final grade.		
Main language of instruction; other languages	Croatian language		
Method of monitoring the quality and efficiency of teaching	Students have the opportunity to express their opinion about the organisation and quality of delivered lectures within an anonymous survey, and to make oral or written comments after lectures or exams; Monitoring of students' success at exams.		

Course title	**Materials of the 21st Century – Technology and Environment**
Code	K026
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	2
Course status	Elective
Course teacher	Assoc. Prof. Dr. Berislav Marković
Associate teachers	
Course entry requirements (Preceding courses)	
Course objective	To enable students to understand the relation between structure and properties of new materials used in modern technologies and to assess the impact of such materials on the environment.
Learning outcomes	1. Ability to identify the relationship between material structure and properties. 2. Ability to examine the correlation between modern materials, their production processes and the environment. 3. Ability to formulate the concept of renewable raw materials on Earth. 4. Ability to identify new, modern materials that will influence "the change of the 21st century life". 5. Skills in using new knowledge and modern aids within the presentation of seminar paper.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-6	0.5	Lecture	Critical conversation and discussion	Records, evaluation	5	10
5-6	0.5	Seminars	Preparation of presentation	Evaluation	20	40
1-6	1	Oral exam	Preparation for oral exam	Oral exam	30	50
Total	**2**				**55**	**100**

Final grade:
55-65 points: grade 2 (sufficient)
66-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)
Final exam: achieved minimum number of points refers to the lowest grade (sufficient), and maximum number of points refers to the highest grade (excellent).

Consultation hours	By appointment

Teaching	Lectures	Seminars	Practices
Hours - total	15	15	0
Course content / teaching units	• Materials in modern technology: basic concepts and methods of modern materials science and engineering • Determination and role of mechanical, electrical, magnetic, and optical properties of materials • Correlation between materials and environment in manufacturing, processing, recycling and waste disposal • Usage of primary and secondary raw materials and their impact on environment • Renewable resources of raw materials on Earth • Modern materials that will transform the life in the 21st century: new polymers, photonic materials, materials for information storage, smart materials, biomaterials, biomedical materials, porous materials, hard materials, materials for clean energy, renewable materials • Within the seminars, students will select a topic of their interest and present it in a written and oral form		
Recommended reading	Ball P. (1999) Made to Measure: New Materials for the 21st Century. Princeton University Press, Princeton. Ball P. (1996) Designing the Molecular World. Princeton University Press, Princeton.		
Optional reading	Ashby M.F., Jones D.R.H. (1996) Engineering Materials Volume 1, 2nd ed. Butterworth-Heinemann, Oxford. Callister W.D. (2002) Materials Science and Engineering: An Introduction, 6th ed. Wiley, New York.		
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively and to fulfil all assignments within the course (practices, seminar tasks).		
Exam passing procedure	Written and oral exams are taken after the attended lectures. The final grade refers to: regular attendance and active participation in lectures – 10 %, written seminar paper and its presentation – 40 % and success at the final exam – 50 %.		
Main language of instruction; other languages	Croatian language, English language		
Method of monitoring the quality and efficiency of teaching	Student survey after the course; reviews during the course and possibility to give oral or written remarks after lectures; monitoring of student success at exams.		

Course title	**Neuroimmunology**
Code	
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	2
Course status	Elective
Course teacher	Assist. Prof. Dr. Senka Blažetić Assist. Prof. Dr. Irena Labak
Associate teachers	
Course entry requirements (Preceding courses)	Human Anatomy (attended), Animal Physiology (attended), Biochemistry 1, 2 and 3 (attended)
Course objective	To teach students how to correlate the mechanisms of the immune and the nervous systems as a basis for maintaining the organism homeostasis and for disease development.
Learning outcomes	1. Knowledge about the concept and importance of neuroimmunology. 2. Ability to correlate the basic immune responses in the brain and their influence on the rest of the body. 3. Ability to evaluate the influence of the immune system on the preservation of normal brain function. 4. Ability to compare the mechanisms of the immune response in the brain between the healthy and the diseased organism.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-4	0.5	Lecture	Critical conversation and discussion	Records related to student performance during lectures	10	20
1-4	0.75	Seminar	Working on a case study	Assessment of presentation and interpretation of obtained results with provision of feedback	35	50
1-4	0.25	Written exam	Preparation for written exam	Written exam	5	10
1-4	0.5	Oral exam	Preparation for oral exam	Oral exam	10	20
Total	**2**				**60**	**100**

Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)

	81-90 points: grade 4 (very good) **91-100 points: grade 5 (excellent)**		
Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	15	15	0
Course content / teaching units	• Introduction to neuroimmunology • Anatomical characteristics and cell components of the immune and the nervous systems • Biochemical mechanisms of the neuroinflammation process • Regulation of inflammatory processes in brain and spinal cord • Neuroimmune mechanisms during brain development • Inflammation and regeneration of axons • Stem cells and neuroinflammation • Inflammatory process in neurodegenerative and autoimmune diseases		
Recommended reading	Bačić-Kes V. et al. (2015) Neuroimunologija. Medicinska naklada, Zagreb. Kuby Immunology W. H. Freeman and Company, New York. Phillips M. I., Dwight E. (1995) Neuroimmunology, Volume 24, 1st ed. Academic Press.		
Optional reading	Szentivanyi A, Berczi I (2003). The Immune-Neuroendocrine Circuitry, Volume 3: History and Progress (NeuroImmune Biology). Amsterdam: Elsevier Science. ISBN 0-444-50851-1.		
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively and to fulfil all assignments within the course.		
Exam passing procedure	During the course, the teacher monitors and evaluates the activities of students by awarding points according to determined criteria. After the course, students take a written exam and then oral exam.		
Main language of instruction; other languages	Croatian language		
Method of monitoring the quality and efficiency of teaching	During the course, the teacher continuously evaluates student achievement, and gives students the opportunity to make oral or written comments. After the course, students are given a survey in which they give their subjective opinion about quality and organisation of teaching, all with the aim to improve future teaching.		

Course title	**Areas of Importance for Croatian Flora**
Code	
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	2
Course status	Elective
Course teacher	Assoc. Prof. Dr. Tanja Žuna Pfeiffer
Associate teachers	Nikolina Bek, assistant
Course entry requirements (Preceding courses)	
Course objective	To raise awareness of students about the importance of preserving natural and/or semi-natural habitats that are characterised by unique and diverse flora.
Learning outcomes	1. Ability to review legal documents that define botanically important areas in Croatia. 2. Ability to compare characteristics and diversity of flora and the management models of botanically important areas in Croatia and in the world. 3. Ability to apply references for flora determination and to valorise professional and scientific papers. 4. Ability to assess the importance of protection and the possibilities of preservation of botanically valuable areas in Croatia. 5. Development of students' science literacy by choosing simpler research tasks related to preservation of plant species and sustainable management of botanically valuable areas.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-5	0.5	Lecture	Critical conversation and discussion	Records related to active and independent participation in conversations and discussions	5	10
1-5	1	Seminars	Independent preparation of seminar paper	Records related to active and independent preparation of seminar paper with provision of feedback	25	40
1-5	0.25	Written exam	Preparation for written exam	Written exam	15	25

	1-5	0.25	Oral exam	Preparation for oral exam	Oral exam	15	25
	Total	**2**				**60**	**100**

Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)

Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	15	15	0

Course content / teaching units

Lectures:
- Botanically important areas - definition, selection criteria, importance
- Overview of botanically important areas in Croatia - habitats and taxa
- Management of botanically important areas in Croatia
- Causes of endangerment of botanically important areas in Croatia

Seminars:
- Monitoring and study of botanically important areas in Croatia
- Management and protection of botanically important areas in Croatia and in the world - comparison
- Endangered and endemic plant species in botanically important areas
- Botanically important areas and the local community - sustainable development of the area

Recommended reading

Alegro A., Bogdanović S., Brana S., Jasprica N., Katalinić A., Kovačić S., Nikolić T., Milović M., Pandža M., Posavec-Vukelić V., Randić M., Ruščić M., Šegota V., Šincek D., Topić J., Vrbek M., Vuković N. (2010) Botanički važna područja Hrvatske. Školska knjiga, Zagreb.
Anonymus (2001) European Strategy for Plant Conservation adopted at the 3rd Conference Planta Europa (translated and commented by Nikolić, T. 2006).

Optional reading

Anderson S. (2010) Identifying Important Plant Areas. Priručnik za odabir lokaliteta u Europi i osnova za razvoj smjernica za ostala područja svijeta (original translated by Nikolić T. (2004) – supported by the Regional Environmental Center)
The Nature Protection Strategy and Action Plan of the Republic of Croatia for the period 2017-2025 (Official Journal 72/2017)

Conditions for obtaining teacher's signature

Students are obliged to attend and actively participate in lectures and seminars.

Exam passing procedure

During the course, the teacher monitors and evaluates the activities of students by awarding points according to determined criteria. After the lectures and seminars, students take the written exam, and proceed to the oral exam. The final grade is determined according to the number of points achieved at written and oral exam and the number of points gained during lectures and seminars.

Main language of instruction; other languages

Croatian language

Method of monitoring the quality and efficiency of teaching

During the course, the teacher continuously monitors the learning process and student achievement, thus determining and adapting his/her teaching. After each lecture, students have the opportunity to make oral or written remarks. During the last week of lectures, students are given an anonymous survey to evaluate the overall quality of the course. The teacher monitors the success of students at the exams.

Course title	**Animal Behaviour**
Code	BM969
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	2
Course status	Elective
Course teacher	Assist. Prof. Dr. Mirta Sudarić Bogojević
Associate teachers	
Course entry requirements (Preceding courses)	
Course objective	To introduce students to the basic principles of animal behaviour and to support development of their natural science literacy.
Learning outcomes	1. Ability to identify the main causes and motives for a certain form of animal behaviour. 2. Ability to predict interactions between animals and environment through behavioural adaptation. 3. Ability to compare the behaviour of animals and humans. 4. Development of natural science literacy by learning how to critically interpret live or recorded animal behaviour, or those presented in scientific and professional literature.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-4	0.5	Lectures	Lecture attendance and active participation	Records related to student activity during lectures	10	20
1-4	1	Seminars	Attendance of lectures, Independent preparation of seminar paper	Records, evaluation of presented seminar paper	30	50
1-4	0.5	Oral exam	Preparation for oral exam	Oral exam	20	30
Total	**2**				**60**	**100**

Final grade:
Od 60-70 points: grade 2 (sufficient)
Od 71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
Od 91-100 points: grade 5 (excellent)

Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	15	15	0

Course content / teaching units	• Introduction to the animal behaviour • Mechanisms of behaviour • motivation and organisation of behaviour • Development of behaviour • Communication • Foraging behaviour • Avoiding of predators • Reproductive behaviour • Analysis of video materials and papers related to course topics • Presentation of one form of animal behaviour
Recommended reading	Alcock J. (2009) Animal Behavior: An Evolutionary Approach. 9th ed. Sinauer Associates, Sunderland. Goodenough J., McGuire B., Wallace R.A. (2001) Perspectives of Animal Behavior. John Wiley and sons, Inc. New York, Brisbane, Toronto. McFarland D. (1996) Animal behaviour. Addison Wesley Longman Limited, Edinbourgh.
Optional reading	Halliday T. (1994) Animal Behavior. A Blanford book, London. Miller S., Harley J.P. (1996) Zoology. WCB Mc. Graw – Hill Companiec Inc. Boston. Wilson E.O. (2000) Sociobiology, The new synthesis. 25th ed. The President and Fellows of Harvard College. Scientific journals, popular articles and videos
Conditions for obtaining teacher's signature	Attendance of lectures and seminars, and completion of all course assignments.
Exam passing procedure	Performance of students is assessed during lectures, as well as within the written and oral exam. Preparation and presentation of seminar paper is awarded by certain number of points according to determined criteria.
Main language of instruction; other languages	Croatian language
Method of monitoring the quality and efficiency of teaching	During the course, the teacher continuously monitors the learning process and student achievements, thus determining and adapting his/her teaching. After the course, the teacher conducts an anonymous survey among students to evaluate their subjective impression about the teaching quality.

Course title	**History of Plant Physiology Research**
Code	
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	2
Course status	Elective
Course teacher	Assist. Prof. Dr. Vesna Peršić Assist. Prof. Dr. Jasenka Antunović Dunić
Associate teachers	
Course entry requirements (Preceding courses)	
Course objective	To teach students about developments of plant physiology science from a historical perspective by elaborating the most important achievements in civilisation.
Learning outcomes	1. Knowledge about facts and events related to the development of plant physiology and about prominent scientists throughout history. 2. Ability to generate a timeline of scientists/events/facts. 3. Ability to explain important achievements and its significance in understanding of physiological processes. 4. Ability to critically analyse the literature on scientific findings and concepts that contributed to development of science. 5. Knowledge about the history of research and the preconditions for correct reasoning, thus enabling the development of natural science literacy.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-5	0.5	Lecture	Active learning; critical discussion	Records related to student activity in discussions	12	20
2, 4	0.75	Seminar	Supervised research into the development of scientific concepts within the history of scientific research; presentation of research and critical review of the relations between science and society	Analysis of seminar paper presentation and provision of feedback	24	40

	5	0.25	Laboratory practices	Laboratory work; demonstration of experiments	Records related to student activity during practical work and provision of feedback	6	10
	1-5	0.5	Oral exam	Preparation for oral exam	Oral exam	18	30
	Total	**2**				**60**	**100**

Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)

Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	15	5	10

Course content / teaching units

Lectures and seminars:

- Historical development of plant physiology science until 1895 (Aristotle's humus theory of plant nutrition, Theophrastus - the father of botany and systematics, van Helmont's willow tree experiment in the 17th century, the first hydroponic experiments with treatment repetition performed by J. Woodward and S. Hales)
- Carl Sprengel and J. von Liebig - the theory of mineral nutrition of plants
- Assimilation of carbon dioxide (de Sassure, Sachs)
- Respiration – the research performed until 1921 (de Vries, Pfeffer, Traube, Schwann, Buchner) and the research after 1921 (Warburg, Blackmann)
- Water and plants (Molisch, Priestly, Atkins)
- Photosynthesis (discoveries of Emmerson, Arnold, Warburg, Engelmann, Boysen-Jensen, Robert Hill, Ruben, Randall and Kamen, Calvin)
- Nitrogen assimilation
- Translocation of organic matter in plants - research before and after 1895
- Growth, elongation and phototropism (researches until 1927 by Darwin, Boysen Jensen, Paal, Went; researches after 1927)
- The last 60 years of photosynthesis research

Laboratory and experimental practices:

- Osmometer and the Pfeffer cell, Traube cell, willow tree experiment, Liebig's law of the minimum, starch images, Hill reaction, plant movements

Recommended reading

Taiz L., Zeiger E. (2010) Plant Physiology. 5th ed. Sinauer Associates Inc., Sunderland.
Antonkievicz J., Łabetowicz J. (2016) Chemical innovation in plant nutrition in a historical continuum from ancient Greece and Rome until modern times. Chem didact ecol metrol. 21(1-2):29-43.
Govindjee (2018) A sixty-year tryst with photosynthesis and related processes: an informal personal perspective. Photosynthesis Research 139: 15-43.
Darwin F., Hamilton Acton E. (1895) Practical Physiology of Plants. Cambridge University Press.

Optional reading

Kutschera U. (2015) 150 Years of an integrative plant physiology. Nature Plants.
Kutschera U., Niklas K.J. (2018) Julius Sachs (1868): The father of plant physiology. American Journal of Botany 105(4): 1–11.

Conditions for obtaining

Attendance of lectures is obligatory, as defined by the Regulations on Studies and Studying at Josip Juraj Strossmayer University of Osijek. If a student misses more than 30% of the

teacher's signature	teaching hours, he/she shall not be entitled to obtain the teacher's signature for the course attendance.
Exam passing procedure	During the course, the teacher monitors and evaluates the activities of students by awarding points according to determined criteria. After attending lectures, seminars and practices, students proceed with the oral exam. The final grade is determined according to the number of points collected during the lectures, seminars and practices and the points achieved at the oral exam.
Main language of instruction; other languages	Croatian language
Method of monitoring the quality and efficiency of teaching	During the course, the teacher continuously monitors the learning process and student achievement, thus determining and adapting his/her teaching. After each lecture, students have the opportunity to make oral or written remarks. During the last week of lectures, students are given an anonymous survey to evaluate the overall quality of the course. The teacher monitors the success of students at the exams.

Course title	**Application of Algae and Cyanobacteria**
Code	
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	2
Course status	Elective
Course teacher	Assist. Prof. Dr. Filip Stević
Associate teachers	Assist. Prof. Dr. Dubravka Špoljarić Maronić Assoc. Prof. Dr. Tanja Žuna Pfeiffer
Course entry requirements (Preceding courses)	
Course objective	To teach students about the importance and multiple possibilities of using algae and cyanobacteria in various areas of human activities.
Learning outcomes	1. Knowledge about general characteristics of algae and cyanobacteria. 2. Ability to understand how lifestyle affects algal and cyanobacterial adaptations. 3. Ability to assess the importance of algae and cyanobacteria in the context of global climate change. 4. Ability to estimate the success of algae and cyanobacteria application in various areas of human activities.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-4	0.25	Lecture	Critical conversation and discussion	Records related to active and independent participation in conversations and discussions	10	20
3-4	0.5	Seminar	Independent preparation of seminar paper	Records related to active and independent preparation of seminar paper with provision of feedback	15	25
1-4	0.5	Written exam	Preparation for written exam	Written exam	15	25
1-4	0.75	Oral exam	Preparation for oral exam	Oral exam	20	30
Total	**2**				**60**	**100**

Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)

Consultation hours	By appointment

Teaching	Lectures	Seminars	Practices
Hours - total	15	15	0
Course content / teaching units	• Habitats of algae and cyanobacteria • Lifestyle • Significance of algae and cyanobacteria • Adaptations to different environmental conditions • Primary producers, heterotrophs and mixotrophs • Bioactive substances • Biotechnology • Application of algae and cyanobacteria: basic indicators of water quality, medical and pharmaceutical industry, water purifiers, energy sources (photobioreactors, biofuels), paleolimnology, cosmetic industry (cosmetics, cosmeceutics), nutrition - primitive food, macro and microelements, sources of vitamins, proteins, minerals and fatty acids • The most common types of algae and cyanobacteria in wide application • UV protection • Connection to global climate change		
Recommended reading	Lee R.E. (2008) Phycology. Cambridge University Press, New York. Reynolds C.S. (2006) The Ecology of Phytoplankton. Cambridge University Press, Cambridge. Relevant scientific papers referring to the subject area.		
Optional reading	Cardozo K.H.M, Guaratini T., Barros M.P., Falcão V.R., Tonon A.P., Lopes N.P., Campos S., Torres M.A., Souza A.O., Colepicolo P., Pinto E. (2007) Metabolites from algae with economical impact. Comp Biochem Physiol 146: 60-78. Goswami G. (2015) Diverse apllications of algae. Int J Adv Res Sci Eng Technol 4: 1102-1109.		
Conditions for obtaining teacher's signature	Students are obliged to attend and actively participate in lectures and practices.		
Exam passing procedure	Student's performance within the course is evaluated during lectures, and at the written and oral exam. Each student prepares and presents a seminar paper, for which there are certain number of points awarded according to determined criteria.		
Main language of instruction; other languages	Croatian language		
Method of monitoring the quality and efficiency of teaching	An anonymous student survey will be carried out to evaluate the overall quality of the course. Analysis of student success at the exams.		

Course title	**Sexuality of Living Creatures**
Code	BBZ53
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	3
Course status	Elective
Course teacher	Prof. Dr. Enrih Merdić
Associate teachers	
Course entry requirements (Preceding courses)	
Course objective	The aim of the course is to provide an overview of sexuality of living creatures, to raise awareness of the meaning of sexes, and to define similarities and differences of sexuality in plants, animals and humans.
Learning outcomes	1. Knowledge about the importance of bisexual reproduction. 2. Ability to define the behavioural patterns of some animals during reproduction. 3. Ability to compare the differences in sexuality between men and women. 4. Ability to critically estimate the quality of sexual life in humans. 5. Knowledge about different forms of sexual behaviour of humans.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-5	1	Lecture	Attendance of lectures; discussions and conversations	Records related to active participation in conversations and discussions	18	30
1-5	1	Seminar	Independent research work on a seminar paper topic	Assessment of seminar paper	24	40
1-5	1	Oral exam	Preparation for oral exam	Oral exam	18	30
Total	**3**				**60**	**100**

Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)

Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	30	15	0

Course content / teaching units	Lectures: • Two sexes vs. one sex • Patterns of sexual breeding in plants • Animals: copulation as a start of a new life and/or a great pleasure, searching for a partner, physiology of sexual receptors, fight for a female, courting, patterns of copulation, birth, care for the offspring • Life in a partnership • Homosexuality in animals • Humans: love and sexuality, biology of sexuality, sexual selection, sociological moments (in the past and today). • Infatuation, types of love, attractiveness, chemistry of attraction, pheromones • Man as a partner, woman as a partner, technics of sexual love • Birth control • Difficulties in sexual life • Homosexuality Seminar: • Within the seminar, each student prepares and presents one topic related to the teaching units, while being supervised by the teacher • Within the seminar, there will be course-related video materials shown
Recommended reading	Holroyd S., Holroyd S. (1989) The complete book of sexual love. Aldus Books Limited, London Klein M. (2009) Seks odgovori na sva pitanja. Mozaik knjiga, Zagreb.
Optional reading	http://www.intimatemedicine.com.hr/enciklopedija-seksualnosti https://www.animaledu.com/
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively.
Exam passing procedure	Students shall deliver an oral presentation about the topic of their choice. Presentations are evaluated according to criteria valid for the assessment of seminar papers. Students performance during the course contributes to the final grade with a share of 60%, while success at final exam contributes to the final grade with 40%.
Main language of instruction; other languages	Croatian language, English language
Method of monitoring the quality and efficiency of teaching	Evaluation form

Course title	**Modern Spectroscopic Methods in Chemistry**
Code	K056
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	2
Course status	Elective
Course teacher	Assoc. Prof. Dr. Berislav Marković
Associate teachers	
Course entry requirements (Preceding courses)	Passed exams within the courses Fundamentals of Physical Chemistry 1 and 2
Course objective	To acquaint students with the properties of electromagnetic radiation, the basics of spectrum formation, the main parts of spectroscopic instruments and some of the modern spectroscopic methods and information obtained by these methods.
Learning outcomes	1. Upgraded previous knowledge about different areas of the electromagnetic radiation spectrum. 2. Ability to use different wavelength radiation to obtain different information about materials. 3. Knowledge about experimental techniques that are the most suitable for testing of a particular material. 4. Ability to make correlation between surface chemistry and its influence on the properties of nanomaterials. 5. Ability to plan appropriate methods for determination of characteristic properties. 6. Skills necessary for oral and written presentation of scientific work.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading points	
					min	max
1-6	0.5	Lecture	Critical conversation and discussion	Records	7	10
1-6	1	Practices	Preparation and presentation of a seminar paper	Oral presentation, evaluation	10	20
1-6	0.25	Exam (preliminary exam)	Preparation for written exam	Written exam	20	30
1-6	0.25	Final exam	Preparation for oral exam	Oral exam	23	40
Total	**2**				**60**	**100**

Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)

	Final exam: minimum number of points refers to the lowest grade (sufficient), and maximum number of points refers to the highest grade (excellent).		
Consultation hours	One hour a week during a semester according to schedule announced in advance.		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	15	0	15
Course content / teaching units	• Electromagnetic radiation; Electromagnetic spectrum • Absorption and emission of electromagnetic radiation • Interaction of radiation with materials • Spectroscopic instruments: the main and auxiliary instrumental parts • Modern methods of data collection - FT instruments • NMR spectroscopy (nuclear magnetic resonance); ESR spectroscopy (electron spin resonance) • Raman spectroscopy; Infrared spectroscopy (IR, FTIR) • Ultraviolet and visible spectroscopy (UV-VIS); Ultraviolet photoelectron spectroscopy (UPS) • X-ray photoelectron spectroscopy (XPS) • The Mössbauer spectroscopy		
Recommended reading	Skoog D.A., Holler F.J., Crouch S.R. (2006) Principles of Instrumental Analysis. Cengage Learning, 6th ed. Andover. Skoog D.A., West D.M., Holler F.J. (1999) Osnove analitičke kemije. Školska knjiga, Zagreb. Rouessac F., Rouessac A. (2007) Chemical Analysis: Modern Instrumentation Methods and Techniques. 2nd ed. Wiley, Chichester.		
Optional reading	Harris D.C. (2010) Quantitative Chemical Analysis. W.H. Freeman, 8th ed., New York. Selected papers on the application of new spectroscopic methods.		
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively and to fulfil all assignments within the course (practices, seminars).		
Exam passing procedure	Students' knowledge is evaluated within one preliminary exam taken in the middle of semester. Final exam is taken in form of oral exam.		
Main language of instruction; other languages	Croatian language, English language		
Method of monitoring the quality and efficiency of teaching	Continuous communication between teacher and students and anonymous student survey.		

Course title	**Introduction to Chemical Sensors and Biosensors**
Code	K066
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	3
Course status	Elective
Course teacher	Assist. Prof. Dr. Marija Jozanović
Associate teachers	
Course entry requirements (Preceding courses)	Attended obligatory courses related to chemistry, basics of physics
Course objective	To enable students to acquire basic knowledge of chemical sensors and biosensors, and to learn about theoretical principles, and their application in the process of quality monitoring and environmental protection. To explain to students the interdisciplinary approach to development and usage of chemical sensors and biosensors.
Learning outcomes	1. Knowledge about the basic principles of chemical sensors and biosensors. 2. Ability to analyse the difference between chemical sensors and biosensors. 3. Ability to determine the basic characteristics of the sensory element. 4. Ability to critically evaluate the performance of chemical sensors and biosensors. 5. Knowledge about the types of chemical sensors with respect to the transducer. 6. Ability to assess the new technologies and approaches in the production and application of chemical sensors and biosensors in physiological processes and environmental protection. 7. Developed opinion on solutions referring to application of sensors in practice.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-3	1	Lecture	Critical conversation and discussion, collaborative learning	Records related to active participation in conversations and discussions	10	20
2-7	1	Seminar	Interpretation of scientific papers, case study analysis. Independent preparation of practice proposals	Monitoring of student performance at interpreting and solving of exercises. Analysis of created lesson plans	10	20
1-7	0.5	Written exam	Preparation for written exam	Written exam	15	30
1-7	0.5	Oral exam	Preparation for oral exam	Oral exam	15	30
Total	**3**				**50**	**100**

	Final grade: **50.1-62.5 points: grade 2 (sufficient)** **62.6-75 points: grade 3 (good)** **75.1-87.5 points: grade 4 (very good)** **87.6-100 points: grade 5 (excellent)**		
Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	30	15	0
Course content / teaching units	• Chemical sensors and biosensors - definitions, theoretical background, parts of the sensor system. Transducer elements: electrochemical, optical, thermal and mass converters • Sensing elements: mechanisms of chemical and biological recognition, biomimetic systems, chemical and biological active ingredients in the sensory systems, methods of chemical and biological reagents immobilisation, the role of materials in the sensory systems - polymers • Measuring of sensor performance: selectivity, sensitivity, precision, accuracy, repeatability, reversibility • Electrochemical sensors and biosensors, optical sensors and biosensors, mass and thermal sensors • Applications of chemical sensors: industrial processes, environmental protection, medicine • Manufacturing and design of sensors, new materials and technologies: high-degree integration of sensors, microfluidics, micro-electromechanical systems (MEMS and BioMEMS, Micro-Total-Analytical-Systems (μTAS), Lab-on-a-chip systems, nanosensors, biochips		
Recommended reading	Banic F.G. (2012) Chemical Sensors and Biosensors: Fundamentals and Applications, Wiley. Fraden J. (2010) Handbook of Modern Sensors: Physics, Designs, and Applications, 4th ed., Springer. Karvinen T., Karvinen K., Valtokar V. (2014) Make: Sensors, 1st ed., Maker Media, Inc. Yurish S. (2016) Advances in Sensors: Reviews, Vol. 3, Ifsa Publishing.		
Optional reading	Pandey C.M., Malhotra B.D. (2019) Biosensors: Fundamentals and Application, 1st ed. De Gruyter. Janata J. (2009) Principles of chemical sensors, 2nd ed. Springer.		
Conditions for obtaining teacher's signature	Active participation in lectures and seminars, with an absence of up to 30% of the total number of teaching hours.		
Exam passing procedure	During the course, the teacher monitors and evaluates the work of each student, which makes up to 20% of the final grade. During the course, students will be taking written preliminary exams, which can be considered as a substitute for the written final exam if they achieve at least 50% of total points. Preliminary exams or final written exam make up to 30% of the final grade, while oral exam makes up to 50% of the final grade.		
Main language of instruction; other languages	Croatian language, English language		
Method of monitoring the quality and efficiency of teaching	Survey on the subjective impression about the organisation of the course will be carried out after the course; during the course, students will be given an opportunity to make oral or written remarks; the teacher monitors students' success at exams.		

Course title	**Introduction to Scientific Research Methodology**
Code	
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	2
Course status	Elective
Course teacher	Assist. Prof. Dr. Lidija Begović
Associate teachers	Assist. Prof. Dr. Selma Mlinarić
Course entry requirements (Preceding courses)	
Course objective	To enable students to understand the basic concepts of scientific research work and to develop their skills required for independent preparation of a research paper.
Learning outcomes	1. Ability to determine the relation between research methodology and research results. 2. Ability to critically evaluate the importance of experimental design and application of statistical methods. 3. Ability to select appropriate methods and techniques to research a selected problem and to test the hypotheses. 4. Ability to assess and critically analyse scientific articles. 5. Skills in searching the bibliographic databases and in using reference management software.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-5	0.5	Lecture	Critical conversation and discussion	Records related to active participation in conversations and discussions	15	20
2-5	0.5	Practices	Work on an experimental assignment	Monitoring of student performance within experimental assignment	20	30
1-5	0.5	Written exam	Preparation for written exam	Written exam	10	20
1-5	0.5	Oral exam	Preparation for oral exam	Oral exam	15	30
Total	**2**				**60**	**100**

Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)

Consultation hours	By appointment.

Teaching	Lectures	Seminars	Practices
Hours - total	15	0	15
Course content / teaching units	Lectures: • What is a hypothesis? The role of hypothesis in scientific research • How to design an experiment: what is a replica (technical, biological), experiment replication, control, variability • Experiments in controlled conditions, field experiments, field research. • Ethics and codes of ethics in research on humans and animals • Types of publications, bibliographic databases of scientific and professional papers, WoS, SCImago (SJR), JCR • Citation, reference management software Practices: • Experiment design • Rules for preparation of master theses • Writing of scientific articles: styles, grammar • Presentation of research results: tables, graphs, figures • Working with reference management software (EndNote, Ref Manager, Mendeley), creating citation databases, searching of databases • Presentation of research at scientific conferences: oral presentation, poster		
Recommended reading	Quinn G.P., Keough M.J. (2002) Experimental Design and Data Analysis for Biologists. Cambridge University Press, Cambridge, UK. Silobrčić V. (2003) Kako sastaviti, objaviti i ocijeniti znanstveno djelo. Medicinska naklada, Zagreb.		
Optional reading	Glass D.J. (2014) Experimental Design for Biologists. 2nd ed. Cold Spring Harbor Laboratory Press, Cold Spring Harbor, NY. Optional reading list will be selected from the latest scientific publications referring to the topics of students' interest.		
Conditions for obtaining teacher's signature	Students are obliged to participate in lectures actively and to fulfil all assignments within the course.		
Exam passing procedure	During the course, the teacher monitors and evaluates the activities of students by awarding points according to determined criteria. After lectures and practices, students take a written exam and then an oral exam. Points achieved at written and oral exam are added to the points obtained up to the final exam, thus making a total number of points to be converted to final grade.		
Main language of instruction; other languages	Croatian language, English language		
Method of monitoring the quality and efficiency of teaching	Survey on the subjective impression about the organisation of the course will be carried out after the course; during the course, students will be given an opportunity to make oral or written remarks; the teacher monitors students' success at exams.		

Course title	**Vegetation Mapping**
Code	BMZ92
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	2
Course status	Elective
Course teacher	Prof. Dr. Janja Horvatić
Associate teachers	Aleksandra Kočić, Ph.D.
Course entry requirements (Preceding courses)	
Course objective	To enable students to apply methods for making flora inventory, to determine and identify habitat types and to create, use and interpret flora and vegetation maps. Students will be taught how to use vegetation-mapping techniques along different environmental gradients within a research project.
Learning outcomes	1. Skills in using methods for making flora inventory. 2. Ability to compare different habitat types. 3. Ability to determine relations between inherent and differential species and plant community. 4. Skills in using vegetation-mapping techniques along different environmental gradients. 5. Skills in applying research into vegetation in future teaching activity.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading points	
					min	max
1-5	0.5	Lectures	Lecture attendance and active participation	Records related to student performance	6	10
1,2,3,4	0.5	Practices	Practical classes attendance and active participation, work on a research project within a workshop	Records and evaluation of performed activities and skills	24	40
1,4,5	1	Exam in form of a research project design	Preparation for designing a research project	Assessment of a research project	30	50
Total	**2**				**60**	**100**

Final grade:
60-69.9 points: grade 2 (sufficient)
70-79.9 points: grade 3 (good)
80-89.9 points: grade 4 (very good)
90-100 points: grade 5 (excellent)

Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	15	0	15
Course content / teaching units	Lecture: • Overview of basic structure and dynamics of vegetation • Phytocenological analysis and vegetation units • Research methods and field work: site selection, geolocation, identification of habitat types • Floristic lists, usage of the plant field survey forms, taxonomy and nomenclature standards • Vegetation maps – inventory of the plant cover of specific area • Maps of actual and potential vegetation, maps of climazonal vegetation • Searching of databases of flora, vegetation and environment • Vegetation sampling • Monitoring methods • Research planning • Research into vegetation used in teaching biology Practices: • Geolocation and identification of habitat types • Completion of the plant field survey forms, identification, determination and records on plants • Making of a floristic list • Geocoding and mapping the species distribution; areal representation • Identification of the plant communities, identification of inherent and differential species • The vegetation mapping techniques along different environmental gradients		
Recommended reading	Nikolić T., Bukovec D., Šopf J., Jelaska S.D. (1998) Kartiranje flore Hrvatske - mogucnosti i standardi. Nat. Croat. 7, Suppl. 1: 1-62.Topić J., Vukelić J. (2009) Priručnik za određivanje kopnenih staništa u Hrvatskoj prema Direktivi o staništima EU. Državni zavod za zaštitu prirode, Zagreb. Topić J., Ilijanić LJ., Tvrtković N., Nikolić T. (2006) Staništa. Priručnik za inventarizaciju, kartiranje i praćenje stanja. Državni zavod za zaštitu prirode, Zagreb.		
Optional reading	Domac R. (2002) Flora Hrvatske. Priručnik za određivanje bilja. 2. izd. Školska knjiga, Zagreb. Javorka S., Csapody V. (1991) Iconographia florae partis Austro-orientalis Europae centralis. Akademiai Kiado, Budapest. Nikolić T., Topić J. (2005) Crvena knjiga vaskularne flore Hrvatske. Minstarstvo kulture, Državni zavod za zaštitu prirode, Zagreb.Pedrotti F. (2013) Plant and Vegetation Mapping. Springer-Verlag, Berlin, Heidelberg. Vukelić J., Mikac S., Baričević D., Bakšić D., Rosavec R. (2008) Šumska staništa i šumske zajednice u Hrvatskoj. Nacionalna ekološka mreža. Državni zavod za zaštitu prirode, Zagreb.		
Conditions for obtaining teacher's signature	Students are obliged to attend and actively participate in lectures and to fulfil all assignments within the course.		
Exam passing procedure	During the course, the teacher monitors and evaluates the performance of each student at tasks and at collecting and determining of plant material, which makes up to 50% of the final grade. Preparation of a research project contributes with 50% to the final grade.		
Main language of instruction; other languages	Croatian language		

Method of monitoring the quality and efficiency of teaching	Student survey after the course; reviews during the course and possibility to give oral or written remarks after lectures; monitoring of student success at exams.

Course title	**Protection and Revitalisation of Aquatic Ecosystems**
Code	BBZ55
Study programme	Graduate University Study Programme in Biology and Chemistry Teacher Education
Semester	III semester
Workload/ECTS credits	2
Course status	Elective
Course teacher	Assoc. Prof. Dr. Melita Mihaljević
Associate teachers	
Course entry requirements (Preceding courses)	Terrestrial Ecosystems or Aquatic Ecosystems
Course objective	To teach students how to assess and protect aquatic ecosystems, and how to apply revitalisation methods.
Learning outcomes	1. Ability to critically evaluate issues related to aquatic ecosystems and find an appropriate solution. 2. Ability to review measures for revitalisation of endangered aquatic ecosystems. 3. Ability to assess professional projects related to water revitalisation. 4. Skills in sustainable water management.

Link between learning outcomes, teaching and students' activities

Learning outcome	Share of ECTS	Form of teaching	Activities of learning and teaching	Assessment		
				Methods of monitoring and evaluation	Grading Points	
					min	max
1-4	0.25	Lecture	Lecture attendance and active participation	Records, evaluation	10	15
1-4	0.25	Seminar	Attendance at the seminar, prepared seminar paper containing results and conclusions of the performed analyses	Records, evaluation of seminar paper	15	20
1-4	0.5	Written exam	Preparation for written preliminary exam	Written exam/preliminary exam	15	20
1-4	1	Oral exam	Exam preparation	Oral exam	20	45
Total	**2**				**60**	**100**

Final grade:
60-70 points: grade 2 (sufficient)
71-80 points: grade 3 (good)
81-90 points: grade 4 (very good)
91-100 points: grade 5 (excellent)

Consultation hours	By appointment		
Teaching	**Lectures**	**Seminars**	**Practices**
Hours - total	15	15	0
Course content / teaching units	Lecture: • Structure and function of aquatic ecosystems • Water quality - indicators, classification • Usage of waters and sources of water pollution • Water monitoring • Legal framework for water protection - national and international conventions (EU Water Directive) • Aquatic ecosystem management • Water revitalisation methods • Trends in changes in aquatic ecosystems and climate change Seminars: • Water protection in strategic documents for nature and environmental protection in the Republic of Croatia (National Environment Protection Strategy and National Environment Protection Action Plan, Water Management Strategy, Nature Protection Act, Laws and regulations on waters) • Revitalisation of lakes - examples of implementation • Revitalisation of wetland ecosystems - examples • Current state of selected aquatic ecosystems in the Republic of Croatia (endangerment, protection and revitalisation projects) • Ecological network NATURA 2000 - aquatic ecosystems		
Recommended reading	Wetzel R.G. (2001) Limnology - Lake and River Ecosystems. 3rd ed. Academic Press, San Diego.		
Optional reading	Jørgensen S.E., Vollenweider R.A. (ed.) (1989) Guidelines of Lake Management: Vol. 1, Principles of Lake Management. International Lake Environment Committee Foundation. Shiga.		
Conditions for obtaining teacher's signature	Attendance at lectures and seminars by obtaining minimum 25 points and by achieving at least 40% of the total number of points at the preliminary exam.		
Exam passing procedure	During the course, the teacher monitors and evaluates the work of each student, which makes up to 25% of the final grade. Preliminary exam or final written exam contribute with 25% to the final grade, while oral exam makes up to 45% of the final grade.		
Main language of instruction; other languages	Croatian language		
Method of monitoring the quality and efficiency of teaching	Periodic evaluation of students and teachers is planned to be carried out in order to assure and continuously improve the quality of teaching and of the study programme. During the last week of lectures, an anonymous student survey will be carried out to evaluate the overall quality of the course. The analysis of students' success at exams will be carried out.		