UNIWERSYTET PEDAGOGICZNY
IM. KOMISJI EDUKACJI NARODOWEJ W KRAKOWIE

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winter semester:

Module I MODERN LABORATORY TECHNIQUES IN EARTH AND ENVIRONMENTAL SCIENCES

LABORATORY ANALYSIS OF FINE SEDIMENTS	20 ECTS
GEOGRAPHICAL INFORMATION SYSTEMS (QGIS)	
ATOMIC ABSORPTION SPECTROSCOPY – HOW TO QUANTIFY METALS IN ENVIRONMENTAL SAMPLES	
MICROSCOPY IN ENVIRONMENTAL STUDIES	

Module II PROTEOMICS

BIOINFORMATICS TOOLS IN PROTEOMICS	20 ECTS
FLUORESCENCE MICROSCOPY	
PROPAGATION OF HIGHER PLANTS	
PROTEIN EXTRACTION AND SEPARATION	

summer semester:

Module I ANTHROPOCENE

LIVING IN A POLLUTED ENIVIRONMENT	20 ECTS
GIS IN NATURAL DISASTER PREVENTION	
HUMAN IMPACTS ON LANDSCAPE	
PAST AND CURRENT CLIMATE CHANGE	

Module II HUMAN BOLOGY

HUMAN BIOMONITORING	20 ECTS
INTRODUCTION TO NEUROPHYSIOLOGY	
THE INFLUENCE OF ELECTROMAGNETIC RADIATION ON THE HUMAN BODY	
THE INFLUENCE OF THE ENVIRONMENT AND NUTRITION ON HUMAN HEALTH	

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Course card

Course title	**Laboratory methods of fine sediment analysis**		
Semester (winter/summer)	winter	ECTS	5
Lecturer(s)	Dorota Chmielowska-Michalak, PhD		
Department	Department of Physical Geography		

Course objectives (learning outcomes)

After completing the course, student can characterize the laboratory analysis for measurement of particle size and particle shape of fine grained sediments (from 0.5 microns to several millimeters). They are able to carry out analysis of their size and shape using specialist equipment and can interpret the results.

Prerequisites

Knowledge	The person who taking these course should understand and explain the relationships between the elements of the geographical environment based on the content of geology, geomorphology and hydrology. The person who taking these course should understand and describe basic statistical ratio.
Skills	The person who undertaking these course should be able to: - recognize and classify the basic types of rocks, - characterize the weathering covers made as a result of physical and chemical weathering processes from various types of rocks in various climatic conditions, - characterize the most important physical and chemical properties of the main soil types, - recognize the basic forms and describe the basic types of relief on the basis of cartographic materials.
Courses completed	

Course organization											
Form of classes	W (Lecture)	Group type									
		A (large group)		K (small group)		L (Lab)		S (Seminar)		P (Project)		E (Exam)	
Contact hours						15					

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Teaching methods:

Course is conducted as a laboratory exercises and during the course students carry out individual or group projects. The analysis of fine graidned material is partially carring out using Morphologi G3SE (produced by Malvern). Discussion of analysis results based on literature.

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student's presentation	Written assignment (essay)	Oral exam	Written exam	Other
					x	x		x					

Assessment criteria	

Comments	

Course content (topic list)

1. Research of textural features of the Quaternary sediments (selected methods)
2. Grain size analysis as a tool for classifying sedimentary environments
3. Laboratory analysis for measurement of particle size and particle shape of fine grained sediments

Compulsory reading

1. Blott, S. J., Pye, K. 2001. GRADISTAT: a grain size distribution and statistics package for the analysis of unconsolidated sediments. Earth surface processes and Landforms, 26(11), 1237-1248.
2. Blott, S., Pye, K., 2008. Particle shape: a review and new methods of characterization and classification. Sedimentology 55, 31-63.
3. Folk RL, Ward WC. 1957. Brazos River bar: a study in the significance of grain size parameters. Journal of Sedimentary Petrology 27: 3-26.
4. Cailleux, A., 1942. Les actiones eoliennes periglaciaires en Europe. Mémoires de la Société géologique de France. Paléontologie 41, 1–176 (in French).
5. Polakowski, C., Sochan, A., Bieganowski, A., Ryżak, M., Földényi, R., Tóth, J., 2014. The influence of the sand particle shape on particle size distribution measured by laser diffraction method. International Agrophysics 28, 195-200.
6. Mycielska-Dowgiałło, E., 1993. Estimates of Late Glacial and Holocene aeolian activity in Belgium, Poland and Sweden. Boreas 22, 165-170.
7. Campaña, I., Benito-Calvo, A., Pérez-González, A., de Castro, J. B., Carbonell, E., 2016. Assessing automated image analysis of sand grain shape to identify sedimentary facies, Gran Dolina archaeological site (Burgos, Spain). Sed. Geol. 346, 72-83. doi: 10.1016/j.sedgeo.2016.09.010
8. Varga, G., Kovács, J., Szalai, Z., Cserháti, C., Újvári, G., 2018. Granulometric characterization of paleosols in loess series by automated static image analysis. Sed. Geol. 370, 1-14.

doi:10.1016/j.sedgeo.2018.04.001
9. Chmielowska, D., Woronko, B., Dorocki, S.. 2021. Applicability of automatic image analysis in quartz-grain shape discrimination for sedimentary setting reconstruction. Catena, 207, 105602.

Recommended reading

1. Morphologi G3 Serise, August 2008. User Manual. Mano 410. Malvern Instruments Ltd (Issue 1.1)

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Course card

Course title	**Geographical Information Systems (QGIS)**		
Semester (winter/summer)	winter	ECTS	5
Lecturer(s)	Rafał Kroczak PhD		
Department	Department of Physical Geography		

Course objectives (learning outcomes)

After completing the course the student will know the most common types of spatial data and their extensions, as well as the methods of their acquisition. The student will be able to create digital maps, analyze them and prepare them for publication. The student will also know how to perform basic GIS analyzes.

Prerequisites

Knowledge	Basic knowledge of cartography.
Skills	Basic computer skills, knowledge of Microsoft or/and Libre Office package.
Courses completed	-

Course organization							
Form of classes	W (Lecture)	Group type					
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours				15			

Teaching methods:

The course is conducted with QGIS software. It is recommended to use personal laptops.

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student's presentation	Written assignment (essay)	Oral exam	Written exam	Other
							successful completion of all						

Assessment criteria	Pass: on the basis of successful completion of all exercises ordered by the teacher during the laboratory sessions (all partial exercises must be completed). Each student may be absent from a maximum of 2 sessions for whatever reason.

Comments	Each lecturer sets the method and date of delivering the exercise for final exam

Course content (topic list)

1. Introduction to QGIS. Functionalities and extensions.
2. Layers and their properties. Attribute table.
3. Geoprocessing and analysis tools
4. Working with the digital elevation model
5. Filtering and spatial queries
6. Spatial relations
7. Raster data and algebra maps
8. Final editing of maps (linear scale, legend, cartographic grid, descriptions, map orientation).

Compulsory reading

Bryndal, T., Kroczak, R. (2019). Reconstruction and characterization of the surface drainage system functioning during extreme rainfall: the analysis with use of the ALS-LIDAR data—the case study in two small flysch catchments (Outer Carpathian, Poland). Environmental Earth Sciences, 78(6), 1-16.
Fidelus-Orzechowska J., Wrońska-Wałach D., Cebulski J., Żelazny M. (2018). Effect of the construction of ski runs on changes in relief in a mountain catchment (Inner Carpathians, Southern Poland). Science of the Total Environment 630, 1298-1308.
Fidelus J., Kroczak R., Jucha W., Stasiak P. (2015). Interactive maps as an innovative tourist service – a comparison of cartographic websites of Polish National Parks. [w:] Managing the quality of tourism services, Lublin.

Recommended reading

Longley, P. A., Goodchild, M. F., Maguire, D. J., & Rhind, D. W. (2015). Geographic information science and systems. John Wiley & Sons.

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Course card

Course title	**Atomic absorption spectroscopy – how to quantify metals in environmental samples**

Semester (winter/summer)	winter	ECTS	5
Lecturer(s)	dr hab. prof. UP Łukasz Binkowski		
Department	Institute of Biology and Earth Sciences,		

Course objectives (learning outcomes)

The course considers modern laboratory techniques and methods for measuring metal concentrations (mercury, cadmium, lead, and others) in environmental samples. The main emphasis is put in the course on the following:

- preparation of samples for metal analyses
- flame and electrothermal atomic absorption spectroscopy
- cold vapor atomic absorption spectroscopy
- quality control system in instrumental laboratories

Students learn how the techniques work and can try themselves as analysts.

Prerequisites

Knowledge	principles of chemistry, physics and mathematics
Skills	communicative English
Courses completed	-

Course organization											
Form of classes	W (Lecture)	Group type									
		A (large group)		K (small group)		L (Lab)		S (Seminar)		P (Project)		E (Exam)	
Contact hours						15					

Teaching methods:

Laboratory classes with samples preparation and analysis with different atomic absorption spectroscopy techniques. Preparation of report from laboratory classes including method description and results obtained with the instrument. Individual work of students outside of the classroom (reading scientific articles, consultation with the course lecturer and working on the individual report from laboratory classes).

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Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student's presentation	Written assignment (essay)	Oral exam	Written exam	Other
					X	X		X		X			

Assessment criteria	The student graduate from the course based on active attendance at the laboratory classes. The quality of the report from the laboratory activities will be assessed.

Comments	Course taught in English.

Course content (topic list)

1. Introduction to sampling methods of environmental samples.
2. Preparation of the samples collected for further analyses.
3. Method of instrument calibration.
4. Flame and electrothermal atomic absorption spectrometry.
5. Cold-vapour atomic absorption spectrometry.
6. Results recalculations.
7. A quality control system in instrumental laboratories.

Compulsory reading

1. Publication of the course coordinator including a detailed descrpition of instrumental method used „Binkowski Ł.J., Meissner W., Trzeciak M., Izevbekhai K., Barker J. 2016. Lead isotope ratio measurements as indicators for the source of lead poisoning in Mute swans (Cygnus olor) wintering in Puck Bay (northern Poland). Chemosphere 164, 436–442."
2. Publication of the course coordinator including a detailed descrpition of instrumental method used „Binkowski Ł.J., Sawicka-Kapusta K. 2015. Lead poisoning and its in vivo biomarkers in Mallard and Coot from hunting activity areas. Chemosphere 127, 101–108".

Recommended reading

Skoog D., Holler F., Crouch S. 2007: Principles of Instrumental Analysis. Thomson Brooks/Cole.

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Course card

Course title	**Microscopy in environmental studies**

Semester (winter/summer)	winter	ECTS	5

Lecturer(s)	Dr hab. Gabriela Gołębiowska-Paluch, prof. UP	

Department	Institute of Biology and Earth Sciences, Chair of Genetics	

Course objectives (learning outcomes)

The course presents general principles of microscopy and how it is used to study environmental samples. It contains presentation of the structure and principle of operation as well as the possibility of practical use of the light microscope, fluorescence microscope, Nomarski contrast, dark field and polarized light microscope. During the course students will exercise various methods of preparation, staining and imaging possibilities as well as they will observe environmental objects like microbial, plant and animal samples from water, soil and other environmental samples. In addition, it will be possible to observe crystalline and paracrystalline substances in polarized light.

Prerequisites

Knowledge	Principles of biology
Skills	English medium stage
Courses completed	-

Course organization											
Form of classes	W (Lecture)	Group type									
		A (large group)		K (small group)		L (Lab)		S (Seminar)		P (Project)		E (Exam)	
Contact hours						15					

Teaching methods:

Laboratory classes with samples preparation and analysis under the microscope. Preparation of report from laboratory classes including method description and images taken under the microscope during classes by using digital camera. Individual work of students outside of the classroom (reading scientific articles, consultation with the course lecturer and working on the individual report from laboratory classes).

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student's presentation	Written assignment (essay)	Oral exam	Written exam	Other
					X	X		X		X			

Assessment criteria	The student graduate from the course based on active attendance at the laboratory classes. Quality of the report from the laboratory activities will be assessed.

Comments	Course taught in English.

Course content (topic list)

1. Construction and principles of operation of light and fluorescence microscope. Types of lighting and filters. Operation of the NIKON H600L microscope, change of filters, camera settings, observation of differences, use of the NIKON Nis-elements program and documentation of the obtained images. 2. Observation in Nomarski contrast, polarized light and dark field microscopy of biological and non-biological samples. 3. Autofluorescence - what and why gives fluorescence and how to use it. Preparation of material for autofluorescence observation. Observation of autofluorescence in various biological material. 4. Non-specific and specific fluorescent dyes: principle of operation and result. 5. Cell viability tests in reaction to environmental factors.

Compulsory reading

https://www.nikoninstruments.com/en_EU/Learn-Explore/Techniques/Fluorescence https://www.microscopyu.com/techniques/fluorescence/introduction-to-fluorescence-microscopy The indicated web-pages give clear description of the subjects presented during the course, together with schemes and illustrations. Much more is available for those who want to deepen their understanding of fluorescence.

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Recommended reading

Lembicz, M., Miszalski, Z., Kornaś, A., & Turnau, K. (2021). Cooling effect of fungal stromata in the Dactylis-Epichloë-Botanophila symbiosis. Communicative & integrative biology, 14(1), 151-157.

Dubas, E., Custers, J., Kieft, H., Wędzony, M., & van Lammeren, A. A. (2014). Characterization of polarity development through 2-and 3-D imaging during the initial phase of microspore embryogenesis in Brassica napus L. Protoplasma, 251(1), 103-113.

Szechyńska-Hebda, M., Hebda, M., Mierzwiński, D., Kuczyńska, P., Mirek, M., Wędzony, M., ... & Karpiński, S. (2013). Effect of cold-induced changes in physical and chemical leaf properties on the resistance of winter triticale (× Triticosecale) to the fungal pathogen Microdochium nivale. Plant Pathology, 62(4), 867-878.

Dubas, E., Golebiowska, G., Zur, I., & Wedzony, M. (2011). Microdochium nivale (Fr., Samuels & Hallett): cytological analysis of the infection process in triticale (× Triticosecale Wittm.). Acta physiologiae plantarum, 33(2), 529-537.

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Course card

Course title	**Living in a polluted environment**		
Semester	summer	ECTS*	4
Lecturer(s)	Dr hab. prof. UP Łukasz Binkowski		
Department	Institute of Biology and Earth Sciences		

Course objectives (learning outcomes)

Heavy metals, pesticides, smog, PAHs and dioxins – every day we hear about the different elements and chemicals that threaten the biosphere, including man. What is the real risk? How to defend against them? Are these threats real or just catchy slogans? And why all of this combines ecology? The course is going to answer these questions. Participants will discuss the major threats to the environment, the mechanisms of circulation and detoxification as well as the impact of toxic substances on populations and ecosystems. They will also participate in the scientific project in the field of ecotoxicology.

Prerequisites

Knowledge	-
Skills	English: speaking, reading and writing
Courses completed	-

Course organization							
Form of classes	W (Lecture)	Group type					
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours	10			5			

Teaching methods:

Lab classes and tutoring discussions accompanied with multimedia presentations, scientific movies, publications and e-learning platform activities.
Individual work of students outside of the classroom (scientific research – individual project, reading popular-scientific and scientific articles).

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Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student's presentation	Written assignment (essay)	Oral exam	Written exam	Other
	x				x	x		x					

Assessment criteria	Points from the test done on the e-learning platform, quality of the project.

Comments	Course taught in English.

Course content (topic list)

1. What is the ecotoxicology (short description of ecology and toxicology)?
2. The tragic story of the development of ecotoxicology.
3. Why everyone should be interested in ecotoxicology?
4. The main mechanisms studied by ecotoxicology.
5. Fundamentals of environmental monitoring.
6. The impact of pollutants on organisms and detoxification mechanisms.
7. Overview of key toxic substances (heavy metals, pesticides, pharmaceuticals, smog, etc.).
8. Interactions between toxic substances and environmental factors.
9. The impact of pollution on populations and aquatic and terrestrial ecosystems.
10. The latest trends in ecotoxicology and the applied ecotoxicology.

Compulsory reading

1. Walker C.H., Hopkin S.P., Sibly R.M., Peakall D.B. (2001). Principles of ecotoxicology. Taylor & Francis, New York.
2. Newman M.C. (2010). Fundamentals of ecotoxicology. CRC Press, Boca Raton.

Recommended reading

1. Carlson R. (1962). Silent Spring. Penguin Classic, London.
2. Colborn T., Dumanoski D., Myers J.P. (1996). Our stolen future. Plume Book, New York.
3. Murray B. (1962). Our synthetic environment. Knopf, New York.
4. Smith R., Lourie B. (2011). Slow death by rubber duck: the secret sanger of everyday things. Counterpoint, Berkeley.

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Course card

Course title	**GIS in natural disaster prevention**		
Semester (winter/summer)	summer	ECTS	5
Lecturer(s)	Ph.D. Paweł Kroh		
Department	Institute of Biology and Earth Sciences		

Course objectives (learning outcomes)

Course presents use of Geographical Information Systems in prevention from landslides and floods. During classes students will learn how to use raster and vector data to evaluate areas that could be in danger in case of flood; how to use digital elevation models for landslide mapping. Use of GIS in mountain rescue and avalanche prediction will also be presented.

Prerequisites

Knowledge	
Skills	Basic GIS skills
Courses completed	

Course organization							
Form of classes	W (Lecture)	Group type					
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours				15			

Teaching methods:

At the beginning of the course short lecture will be presented. Then, after short introduction to each topic students will proceed with laboratory tasks realized in GIS programs.

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student's presentation	Written assignment (essay)	Oral exam	Written exam	Other
					x					x			

Assessment criteria	Proper execution of given tasks, essay.

Comments	

Course content (topic list)

1. Flood prevention project:
a) Presentation of national Polish data: flood risks maps and cartographic databases (BDOT10k)
b) Downloading data and their conversion to proper formats
c) Georeferencing flood hazard maps
d) Vectorization areas with flood hazard
e) Selection of objects (residential buildings, hospitals, schools etc.) which would be in danger
2. Landslides prevention project:
a) Presentation of digital elevation models (DEM) based on LIDAR
b) DEM conversion
c) Landslides mapping and vectorization
d) Selection of buildings which are localized on landslides areas

Compulsory reading

Salata, T., & Prus, B. (2017). Geodata Modelling Applied to the Planning and Land Use of Rural Areas in Conjunction with the Polish Spatial Information Infrastructure. Land Ownership and Land Use Development: he Integration of Past, Present, and Future in Spatial Planning and Land Management Policies, 195.
Jaboyedoff, M., Oppikofer, T., Abellán, A., Derron, M. H., Loye, A., Metzger, R., & Pedrazzini, A. (2012). Use of LIDAR in landslide investigations: a review. Natural hazards, 61(1), 5-28.

Recommended reading

Kroh, P., Struś, P., Wrońska-Wałach, D., & Gorczyca, E. (2019). Map of landslides on the commune scale based on spatial data from airborne laser scanning. Carpathian Journal of Earth and Environmental Sciences, 14(1).

Kroh, P. (2020). Identification of landing sites for rescue helicopters in mountains with use of Geographic Information Systems. Journal of Mountain Science, 17(2), 261-270.

Kroh, P. (2017). Analysis of land use in landslide affected areas along the Łososina Dolna Commune, the Outer Carpathians, Poland. Geomatics, Natural Hazards and Risk, 8(2), 863-875.

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Course card

Course title	**Human impacts on landscape**		
Semester (winter/summer)	summer	ECTS	5
Lecturer(s)	dr hab. Joanna Zawiejska, prof. UP		
Department	Department of Physical Geography		

Course objectives (learning outcomes)

The course explores human agency in transforming various geomorphological landscapes as well as the causes and effects of the modification of the operation of geomorphic processes. Interactions between natural and anthropogenic conditions for development of landforms are discussed based on case studies from different environments.

Prerequisites

Knowledge	Basic geomorphology, geology, climate, hydrology.
Skills	-
Courses completed	-

Course organization							
Form of classes	W (Lecture)	Group type					
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours			15				

Teaching methods:

Following introductory lectures students prepare preseentations and discuss assigned topics.

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student's presentation	Written assignment (essay)	Oral exam	Written exam	Other
						x		x	x			x	

Assessment criteria	Presentations (30%) and final test (70%)

Comments	

Course content (topic list)

1. Human agency in geomorphology over time. Natural and anthropogenic drivers of change in geomorphic processes and creation of landforms.
2. Indirect human impact on the operation of geomorphic processes in different climates
3. Man-made landforms and their development.
4. Complexity of impacts and consequences: cases studies.

Compulsory reading

Goudie A., 2018, The Human Impact on the Natural Environment, Wiley- Blackwell
Gregory K.J., 2006, The human role in changing river channels, Geomorphology 79(3):172-191

Recommended reading

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Course card

Course title	**Past and current climate change**		
semester	summer	ECTS*	5
Lecturer(s)	Dr Barlomiej Pietras		
Department	Department of Ecology and Geoinformation		

Course objectives (learning outcomes)

This course focuses on past and ongoing climate change, its drivers and consequences.

Prerequisites

Knowledge	Basic knowledge about climate.
Skills	The ability to obtain basic information about climate
Courses completed	

Course organization						
Form of classes	W (Lecture)	Group type				
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours				15			

Teaching methods:

Lectures, participatory discussion, individual projects

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student's presentation	Written assignment (essay)	Oral exam	Written exam	Other
						X		X		X			

Assessment criteria	Students prepare and present a project, final test.

Comments	

Course content (topic list)

1. Ongoing climate change
2. Proxy data
3. Regional aspects of climate change
4. Regional climate models

Compulsory reading

1. Burroughs W.J., 2001: Climate Change. Cambridge University Press.
2. Desonie D., 2008: Climate: causes and effects of climate change. Chelsea House, USA.
3. IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp, doi:10.1017/CBO9781107415324.
4. Jonathan Cowie, 2007. Climate Change: Biological and Human Aspects, Cambridge University Press, Cambridge, UK. ISBN 978-0-521-87399-4. XVI + 487 pp
5. McGuffie K., Henderson-Sellers A., 2005: A Climate Modelling Primer, 3rd Edition. University of Technology, Sydney, Australia.

Recommended reading

1. IPCC, 2007: Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 996 pp.
2. Wang J., Oppenheimer M. The Latest Myths and Facts on Global Warming - 2005 - pp. 2-7

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Course card

Course title	**Human biomonitoring**		
Semester	winter, summer	ECTS*	4
Lecturer(s)	Dr Martyna Błaszczyk		
Department	Institute of Biology		

Course objectives (learning outcomes)

The main aim of the course is to present what human biomonitoring (HBM) is and what are the differences between human and environmental biomonitoring. Why HBM is so important nowadays? What are the main sources of human exposure to chemical substances? In what matrices these chemicals may be detected? How to appropriate conduct HBM research? During the course students will get answers for these and further questions, and will experience personally how to work with human-derived material.

Prerequisites

Knowledge	Principles of chemistry and biology.
Skills	English: speaking, reading and writing.
Courses completed	-

Course organization							
Form of classes	W (Lecture)	Group type					
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours			7	8			

Teaching methods:

Tutoring discussions accompanied with multimedia presentations and laboratory practice.

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student's presentation	Written assignment (essay)	Oral exam	Written exam	Other
					X			X					X

Assessment criteria	The student graduate from the course based on attendance at the classes and taking part in discussions.

Comments	Course taught in English.

Course content (topic list)

- Biomonitoring (environmental and human).
- Sources of human exposure to chemical substances (with particular reference to heavy metals).
- Matrices used in human biomonitoring (pros and cons; why blood is considered to be a universal matrix).
- Stages of typical human biomonitoring research (what kind of errors on each stage may disturbed the whole research).
- Scales and automated pipette calibration.
- General introduction to atomic absorption spectrometry and voltammetry.
- Good laboratory practice.

Compulsory reading

1. Esteban M., Castaño A. (2009). Non-invasive matrices in human biomonitoring: a review. Environment International 35: 438-449.
2. National Research Council. (2006). Human biomonitoring for environmental chemicals. The National Academies Press. Washington DC, USA.

Recommended reading

UNIWERSYTET PEDAGOGICZNY
IM. KOMISJI EDUKACJI NARODOWEJ W KRAKOWIE

Erasmus+

Course card

Course title	**Introduction to Neurophysiology**		
Semester	winter, summer	ECTS*	4
Lecturer(s)	Dr hab. Grzegorz Formicki, prof. UP		
Department	Institute of Biology		

Course objectives (learning outcomes)

The aim of the courses is to present basic information on the physiology and anatomy of human neural system and to expand the knowledge on neurobiological aspects of human cognition and behavior. The special interest will be put on the interpretation of human behavior in neurobiological context.

Prerequisites

Knowledge	principles of biology
Skills	English: speaking, reading and writing
Courses completed	-

Course organization							
Form of classes	W (Lecture)	Group type					
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours			11	4			

Teaching methods:

Tutoring discussion accompanied with multimedia presentations.

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student's presentation	Written assignment (essay)	Oral exam	Written exam	Other
								X					X

Assessment criteria	The student graduate from the course based on attendance at the classes and taking part in discussions.

Comments	Course taught in English.

Course content (topic list)

- Principles of brain functions.
- Evolution of brain and cognition.
- How does the brain work? Signal propagation in neural system.
- Functional and anatomical structures in neural system.
- Perception and reflexes.
- Formation of language.
- Memory and learning.
- Neurobiology of drives and emotions.
- Neurobiology of sleep and dreams.

Compulsory reading

Longstaff A. 2007. Instant Notes in Neuroscience. Garland Science.

Recommended reading

Allen J. S. 2009. The lives of brain. Harvard University Press.

UNIWERSYTET PEDAGOGICZNY
IM. KOMISJI EDUKACJI NARODOWEJ W KRAKOWIE

Erasmus+

Course card

Course title	**The influence of electromagnetic radiation on the human body**

Lecturer(s)	Dr hab. Bartosz Różanowski	ECTS 5
Department	Institute of Biology	

Course objectives (learning outcomes)

- ✓ The aim of the course is to familiarize students with the nature of electromagnetic radiation and in particular with optical radiation.
- ✓ Discussion of the impact of electromagnetic radiation radiation on the human body.
- ✓ Discussion of the impact of individual ranges of optical radiation (infrared, visible light, ultraviolet) on the human body at the cellular, tissue and the whole organism level.
- ✓ Presentation of issues related to free radical reactions (free radicals, photosensitizing reactions - photosensitizers). Discussion of issues concerning sources of optical radiation applicable in biology and medicine, photochemotherapy and photodynamic therapy.
- ✓ Discussion of the role of antioxidants and antioxidant enzymes under stress caused by optical radiation.

Prerequisites

Knowledge	In the field of physics, chemistry, biology
Skills	The use of knowledge in the field of the above items
Courses completed	

Course organization							
Form of classes	W (Lecture)	Group type					
		A (large group)	K (small group	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours	10					4	1

Teaching methods:

Lectures in the form of multimedia presentations

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student's presentation	Written assignment (essay)	Oral exam	Written exam	Other
												X	

Assessment criteria	The student receives passing the classes for the course based on the colloquium and attendance at the lectures Lectures are obligatory

Comments	

Course content (topic list)

- Issues related to the nature of electromagnetic radiation, optical radiation.
- The influence of optical radiation on the human body.
- Free radical reactions - free radicals, photosensitizing reactions - photosensitizers.
- Sources of optical radiation applicable in biology and medicine.
- Photochemotherapy and photodynamic therapy. The role of antioxidants and enzymes

Compulsory reading

1. Lars Olof Bjorn,; Photobiology; The Science of Light and Life 2015
2. Roland Glaser; Biohysics An Introduction, Springer 2012

Recommended reading

UNIWERSYTET PEDAGOGICZNY
IM. KOMISJI EDUKACJI NARODOWEJ W KRAKOWIE

Erasmus+

Course card

Course title	**The influence of the environment and nutrition on human health**

Lecturer(s)	Dr hab. Bartosz Różanowski	Teaching team
		Dr hab. Bartosz Różanowski
Department	Institute of Biology	

Course objectives (learning outcomes)

- ✓ The main objective of the course is to familiarize the participants with knowledge about the impact of the environment and the way and quality of nutrition on human health.
- ✓ As part of the lectures, the concept of health will be defined.
- ✓ Health determinants and health determinants will be discussed, according to the concept of Lalonde and the World Health Organization (WHO), i.e. lifestyle, physical environment, human biology, organization of health care.
- ✓ The issue of nutrition as an element of pro-health behavior will be discussed.
- ✓ You will be presented with nutritional recommendations in the health pyramid.

Prerequisites

Knowledge	In the field of, biology, ecology, geography.
Skills	The use of knowledge in the field of the above items
Courses completed	

Course organization								
Form of classes	W (Lecture)	Group type						
		A (large group)	K (small group	L (Lab)	S (Seminar)	P (Project)	E (Exam)	
Contact hours	10					4	1	

Teaching methods:

Lectures in the form of multimedia presentations

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student's presentation	Written assignment (essay)	Oral exam	Written exam	Other
												X	

Assessment criteria	The student receives passing the classes for the course based on the colloquium and attendance at the lectures Lectures are obligatory

Comments	

Course content (topic list)

- Defining the concept of health
- Discussion of health determinants and factors determining health - the concept of Lalonde'a and the World Health Organization (WHO), i.e. lifestyle, physical environment, human biology, organization of health care.
- Presentation of the issue of nutrition as an element of pro-health behavior.
- Presentation of nutritional recommendations in the health pyramid.

Compulsory reading

3. Chemicals, Environment, Health: A Global Management Perspective; group work, publisher: Taylor & Francis Inc, 2011
4. Langley-Evans Simon Nutrition, Health and Disease: A Lifespan Approach. publisher: Blackwell Publ. 2021

Recommended reading

UNIWERSYTET PEDAGOGICZNY
IM. KOMISJI EDUKACJI NARODOWEJ W KRAKOWIE

Erasmus+

Course card

Course title	**Bioinformatics tools in proteomics**		
Semester (winter/summer)	Summer	ECTS	5
Lecturer(s)	Dr hab. Gabriela Gołębiowska-Paluch, prof. UP		
Department	Institute of Biology and Earth Sciences, Chair of Genetics		

Course objectives (learning outcomes)

The aim of the course is to familiarize the student with bioinformatics tools for the analysis, synthesis and interpretation of data obtained from the protein analysis, both at the theoretical and practical level. An additional goal is to acquire the ability to use appropriate databases as well as bioinformatics tools and programs, as well as methods of data preparation for the needs of engineering thesis and scientific publication.

Prerequisites

Knowledge	Principles of biology
Skills	English medium level
Courses completed	-

Course organization							
Form of classes	W (Lecture)	Group type					
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours				15			

Teaching methods:

Laboratory activities including bioinformatics tools for the analysis, synthesis and interpretation of data obtained from proteomics research, both at the theoretical and practical level. Individual work of students outside of the classroom (reading scientific articles, consultation with the course lecturer and working on the individual report from laboratory classes).

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IM. KOMISJI EDUKACJI NARODOWEJ W KRAKOWIE

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Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student's presentation	Written assignment (essay)	Oral exam	Written exam	Other
	x				x	x		x		x			

Assessment criteria	The student graduate from the course based on active attendance at the laboratory classes. Quality of the report from the laboratory activities will be assessed.

Comments	Course taught in English.

Course content (topic list)

1. Preparation of data for creating a protein profile.
2. Creating protein maps.
3. Work in proteomic analysis programs.
4. Protein databases and on-line tools.

Compulsory reading

Jozefowicz, A. M., Döll, S., & Mock, H. P. (2020). Proteomic Approaches to Identify Proteins Responsive to Cold Stress. In Plant Cold Acclimation (pp. 161-170). Humana, New York, NY.

Perlan Technologies Polska Sp. z o. o. – webinars and tutorials.

Bio-Rad – webinars and tutorials.

Recommended reading

Żur I., Gołębiowska G., Dubas E., Golemiec E., Matušíková I., Libantová J., Moravčiková J. 2013. β-1,3-glucanase and chitinase activities in winter triticales during cold hardening and subsequent infection by Microdochium nivale. Biologia 68(2): 241-248, DOI: 10.2478/s11756-013-0001-0, ISNN: 0006-3088 (Print), 1336-9563 (Online), Wydawca: Versita.

Gołębiowska-Pikania* G., Golemiec* E. 2015. Cold-enhanced gene expression of the foliar thiol-specific antioxidant protein in triticale (xTriticosecale Wittm.) seedlings resistant to Microdochium nivale (Samuels & I.C. Hallett) infection. Acta Biologica 22: 98-117, DOI:10.18276/ab.2015.22-08.

Gawrońska* K., Gołębiowska-Pikania* G. 2016. The effects of cold-hardening and Microdochium nivale infection on oxidative stress and antioxidative protection of the two contrasting genotypes of winter triticale. European Food Research and Technology, 242(8): 1-10, DOI: 10.1007/s00217-015-2630-8, ISNN: 1438-2377 (Print) 1438-2385 (Online), Wydawca: Springer.

Gołębiowska-Pikania* G., Kopeć* P., Surówka E., Krzewska M., Dubas E., Nowicka A., Rapacz M., Wójcik-Jagła M., Malaga S., Żur I. 2017. Changes in protein abundance and activity involved in freezing tolerance acquisition in winter barley (Hordeum vulgare L.). Journal of Proteomics, 169: 58-72, DOI: 10.1016/j.jprot.2017.08.019, ISSN: 1874-3919, Wydawca: Elsevier.

Gołębiowska-Pikania* G., Kopeć P., Surówka E., Janowiak F., Krzewska M., Dubas E., Nowicka A., Kasprzyk J., Ostrowska A., Malaga S., Hura T., Żur I. 2017. Changes in protein abundance and activity induced by drought during generative development of winter barley (Hordeum vulgare L.). Journal of Proteomics, 169:73-86. 10.1016/j.jprot.2017.07.016, ISSN: 1874-3919, Wydawca: Elsevier.

Krzewska, M., Gołębiowska-Pikania G., Dubas, E., Gawin, M., & Żur, I. 2017. Identification of proteins related to microspore embryogenesis responsiveness in anther cultures of winter triticale (× Triticosecale Wittm.). Euphytica, 213(8), 192. Open Access, 10.1007/s10681-017-1978-1, issn: 0014-2336, Wydawca: Springer.

Golebiowska GJ, Bonar E, Emami K, Wędzony M. 2019. Cold-modulated small proteins abundance in winter triticale (x Triticosecale, Wittm.) seedlings tolerant to the pink snow mould (Microdochium nivale, Samuels and Hallett) infection. Acta biochimica Polonica, 66(3), 343-350.

Gołębiowska, G., Stawoska, I., & Wesełucha-Birczyńska, A. 2022. Cold-modulated leaf compounds in winter triticale DH lines tolerant to freezing and Microdochium nivale infection: LC-MS and Raman study. Functional Plant Biology, 49(8), 725-741.

UNIWERSYTET PEDAGOGICZNY
IM. KOMISJI EDUKACJI NARODOWEJ W KRAKOWIE

Erasmus+

Course card

Course title	**Fluorescence microscopy**		
Semester (winter/summer)	Summer	ECTS	5
Lecturer(s)	Dr hab. Gabriela Gołębiowska-Paluch, prof. UP		
Department	Institute of Biology and Earth Sciences, Chair of Genetics		

Course objectives (learning outcomes)

The course presents general principles of fluorescence and how fluorescence is used to study biological objects. It contains presentation of the structure and principle of operation as well as the possibility of practical use of the fluorescence microscope. During the course students will exercise various methods of preparation, staining and imaging possibilities as well as they will observe auto-fluorescence of biological objects.

Prerequisites

Knowledge	Principles of biology
Skills	English medium stage
Courses completed	-

Course organization											
Form of classes	W (Lecture)	Group type									
		A (large group)		K (small group)		L (Lab)		S (Seminar)		P (Project)		E (Exam)	
Contact hours						15					

Teaching methods:

Laboratory classes with samples preparation and analysis under the fluorescent microscope. Preparation of report from laboratory classes including method description and images taken under the microscope during classes by using digital camera. Individual work of students outside of the classroom (reading scientific articles, consultation with the course lecturer and working on the individual report from laboratory classes).

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student's presentation	Written assignment (essay)	Oral exam	Written exam	Other
					X	X		X		X			

Assessment criteria	The student graduate from the course based on active attendance at the laboratory classes. Quality of the report from the laboratory activities will be assessed.

Comments	Course taught in English.

Course content (topic list)

1. Construction and principles of operation of fluorescence microscope. Types of lighting and filters. Operation of the NIKON H600L fluorescence microscope, change of filters, camera settings, observation of differences, use of the NIKON Nis-elements program and documentation of the obtained images. Observation in Nomarski contrast and dark field microscopy.
2. Autofluorescence - what and why gives fluorescence and how to use it. Preparation of material for autofluorescence observation. How to extinguish unwanted fluorescence in plants. Observation of autofluorescence in various biological material.
3. Non-specific fluorescent dyes: principle of operation and result. Staining of tissues using Calcofluor white and other non-specific dyes.
4. Markers of physiological reactions. Vital staining. Cell viability tests.
5. Histochemical fluorescence staining: DAPI (DNA), Aniline Blue (Callose), Schiff Reaction (DNA) and acridine orange (DNA and RNA).

Compulsory reading

https://www.nikoninstruments.com/en_EU/Learn-Explore/Techniques/Fluorescence
https://www.microscopyu.com/techniques/fluorescence/introduction-to-fluorescence-microscopy
The indicated web-pages give clear description of the subjects presented during the course, together with schemes and illustrations. Much more is available for those who want to deepen their understanding of fluorescence.

Recommended reading

Lembicz, M., Miszalski, Z., Kornaś, A., & Turnau, K. (2021). Cooling effect of fungal stromata in the Dactylis-Epichloë-Botanophila symbiosis. Communicative & integrative biology, 14(1), 151-157.

Dubas, E., Custers, J., Kieft, H., Wędzony, M., & van Lammeren, A. A. (2014). Characterization of polarity development through 2-and 3-D imaging during the initial phase of microspore embryogenesis in Brassica napus L. Protoplasma, 251(1), 103-113.

Szechyńska-Hebda, M., Hebda, M., Mierzwiński, D., Kuczyńska, P., Mirek, M., Wędzony, M., ... & Karpiński, S. (2013). Effect of cold-induced changes in physical and chemical leaf properties on the resistance of winter triticale (× Triticosecale) to the fungal pathogen Microdochium nivale. Plant Pathology, 62(4), 867-878.

Dubas, E., Golebiowska, G., Zur, I., & Wedzony, M. (2011). Microdochium nivale (Fr., Samuels & Hallett): cytological analysis of the infection process in triticale (× Triticosecale Wittm.). Acta physiologiae plantarum, 33(2), 529-537.

UNIWERSYTET PEDAGOGICZNY
IM. KOMISJI EDUKACJI NARODOWEJ W KRAKOWIE

Erasmus+

Course card

Course title	**Propagation of higher plants**		
Semester (winter/summer)	Summer	ECTS	5
Lecturer(s)	Dr hab. Gabriela Gołębiowska-Paluch, prof. UP		
Department	Institute of Biology and Earth Sciences, Chair of Genetics		

Course objectives (learning outcomes)

The course provides the basic knowledge about higher plants flowering, pollination, fertilization as well as embryo, seed and fruit and formation. The role of plant embryology in systematic and evolution studies is described. Environmental problems of plant propagation is discussed. The modern in vitro methods of fast plants propagation (micropropagation) and production of artificial seeds are to be implemented. This practical course also includes analysis of generative organs of plants as well as microscopy observation of pollen, pollen tube, embryo, seed and fruit structure and formation.

Prerequisites

Knowledge	Principles of biology
Skills	English medium level
Courses completed	-

Course organization							
Form of classes	W (Lecture)	Group type					
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours				15			

Teaching methods:

Laboratory activities with possibility to get experience in plant generative organs analysis, a method to stain biological object and a method to plant culture in in vitro conditions. Individual work of students outside of the classroom (reading scientific articles, consultation with the course lecturer and working on the individual report from laboratory classes).

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student's presentation	Written assignment (essay)	Oral exam	Written exam	Other
					x	x		x		x			

Assessment criteria	The student graduate from the course based on active attendance at the laboratory classes. Quality of the report from the laboratory activities will be assessed.

Comments	Course taught in English.

Course content (topic list)

Anatomy of typical flower of angiosperms.
What sort of problems are connected to regular pollination and fertilization?
Embryo and seed formation in angiosperms.
Fruits: their origin and role in human nutrition.
Plant embryology and systematic/evolution of plants.
Strategies to overcome problems in angiosperm propagation.
Micropropagation in horticulture and agriculture, and in protection of plant resources endangered with extinction.

Compulsory reading

1. Batygina T., Vasilyeva V. 2003. Periodization in the development of flowering plant reproductive structures: critical periods. Acta Biologica Cracoviensia ser. Botanica 45/1: 27-36
2. Endress P.K. 2005. Links between embryology and evolutionary floral morphology. Current Science. 89 (5) 729-754
3. Friedman W.E. 2001. Comparative embryology of basal angiosperms. Current Opinion in Plant Biology 2001 (4):14–20

Recommended reading

1. Pence V. 2011. Evaluating costs for the in vitro propagation and preservation of endangeredplants. In Vitro Cell.Dev.Biol.-Plant (2011) 47:176–187, DOI 10.1007/s11627-010-9323-6.
2. Wędzony M., Forster B.P., Zur I., Golemiec E., Szechyńska-Hebda M., Dubas E., Gołębiowska G., 2009. Progress in Doubled Haploid Technology in Higher Plants. In: Touraev A., Jain M., Forster B. (eds.): "Advances in Haploid Production in Higher Plants" ©

Springer Science + Business Media B.V. ISBN 978-1-4020-8853-7 DOI: 10.1007/978-1-4020-8854-4_1 pp. 1-33

3. Ziv M. 2005. Simple bioreactors for mass propagation of plants. Plant Cell, Tissue and Organ Culture (2005) 81: 277–285 DOI 10.1007/s11240-004-6649-y

UNIWERSYTET PEDAGOGICZNY
IM. KOMISJI EDUKACJI NARODOWEJ W KRAKOWIE

Erasmus+

Course card

Course title	**Protein extraction and separation**		
Semester (winter/summer)	Summer	ECTS	5
Lecturer(s)	Dr hab. Gabriela Gołębiowska-Paluch, prof. UP		
Department	Institute of Biology and Earth Sciences, Chair of Genetics		

Course objectives (learning outcomes)

Knowledge on basic proteomics methods. Experience in laboratory work, experiment design, protein isolation and purification, spectrophotometry, gel electrophoresis, protein visualisation and electropherogram analysis. Western Blot preparation and immunostaining.

Prerequisites

Knowledge	Principles of biology
Skills	English medium level
Courses completed	-

Course organization							
Form of classes	W (Lecture)	Group type					
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours				15			

Teaching methods:

Laboratory activities including lab rules, protein isolation and purification, spectrophotometry, gel electrophoresis, protein visualisation and electropherogram analysis. Western Blot preparation and immunostaining. Individual work of students outside of the classroom (reading scientific articles, consultation with the course lecturer and working on the individual report from laboratory classes).

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Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student's presentation	Written assignment (essay)	Oral exam	Written exam	Other
					x	x		x		x			

Assessment criteria	The student graduate from the course based on active attendance at the laboratory classes. Quality of the report from the laboratory activities will be assessed.

Comments	Course taught in English.

Course content (topic list)

Methods of protein isolation and purification.
Gel electrophoresis – types, principles and application.
Electropherogram – protein visualisation and analysis.
Western Blot – types, principles and application.

Compulsory reading

Jozefowicz, A. M., Döll, S., & Mock, H. P. (2020). Proteomic Approaches to Identify Proteins Responsive to Cold Stress. In Plant Cold Acclimation (pp. 161-170). Humana, New York, NY.

Perlan Technologies Polska Sp. z o. o. – webinars and tutorials.

Bio-Rad – webinars and tutorials.

Recommended reading

Żur I., Gołębiowska G., Dubas E., Golemiec E., Matušíková I., Libantová J., Moravčiková J. 2013. β-1,3-glucanase and chitinase activities in winter triticales during cold hardening and subsequent infection by Microdochium nivale. Biologia 68(2): 241-248, DOI: 10.2478/s11756-013-0001-0, ISNN: 0006-3088 (Print), 1336-9563 (Online), Wydawca: Versita.

Gołębiowska-Pikania* G., Golemiec* E. 2015. Cold-enhanced gene expression of the foliar thiol-specific antioxidant protein in triticale (xTriticosecale Wittm.) seedlings resistant to Microdochium nivale (Samuels & I.C. Hallett) infection. Acta Biologica 22: 98-117, DOI:10.18276/ab.2015.22-08.

Gawrońska* K., Gołębiowska-Pikania* G. 2016. The effects of cold-hardening and Microdochium nivale infection on oxidative stress and antioxidative protection of the two contrasting genotypes of winter triticale. European Food Research and Technology, 242(8): 1-10, DOI: 10.1007/s00217-015-2630-8, ISNN: 1438-2377 (Print) 1438-2385 (Online), Wydawca: Springer.

Gołębiowska-Pikania* G., Kopeć* P., Surówka E., Krzewska M., Dubas E., Nowicka A., Rapacz M., Wójcik-Jagła M., Malaga S., Żur I. 2017. Changes in protein abundance and activity involved in freezing tolerance acquisition in winter barley (Hordeum vulgare L.). Journal of Proteomics, 169: 58-72, DOI: 10.1016/j.jprot.2017.08.019, ISSN: 1874-3919, Wydawca: Elsevier.

Gołębiowska-Pikania* G., Kopeć P., Surówka E., Janowiak F., Krzewska M., Dubas E., Nowicka A., Kasprzyk J., Ostrowska A., Malaga S., Hura T., Żur I. 2017. Changes in protein abundance and activity induced by drought during generative development of winter barley (Hordeum vulgare L.). Journal of Proteomics, 169:73-86. 10.1016/j.jprot.2017.07.016, ISSN: 1874-3919, Wydawca: Elsevier.

Krzewska, M., Gołębiowska-Pikania G., Dubas, E., Gawin, M., & Żur, I. 2017. Identification of proteins related to microspore embryogenesis responsiveness in anther cultures of winter triticale (× Triticosecale Wittm.). Euphytica, 213(8), 192. Open Access, 10.1007/s10681-017-1978-1, issn: 0014-2336, Wydawca: Springer.

Golebiowska GJ, Bonar E, Emami K, Wędzony M. 2019. Cold-modulated small proteins abundance in winter triticale (x Triticosecale, Wittm.) seedlings tolerant to the pink snow mould (Microdochium nivale, Samuels and Hallett) infection. Acta biochimica Polonica, 66(3), 343-350.