Module syllabus: ***Methods in ecophysiological research***

1. Overall information

Module coordinator	dr Aleksandra Nadgórska-Socha
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ECTS	**2**
Method for the verification of learning outcomes	The final grade for the module is weighted on the average of the following student activities: - Active participation in laboratory classes (continuous evaluation of practical skills) (0.3) - reports (0.7) To be awarded a final grade, the student must have passed each activity of the module. Grades: below 51% – fail (F); 52-60% – with minimum academic criteria (E); 61-65% – satisfactory (D); 66-75% – good (C); 76-85% – very good (B), ≥ 85% – excellent (A)

2. Description of student activity and work

Laboratory	
Responsible instructors	Staff of the Department of Ecology (dr A. Nadgórska-Socha, dr M. Kandziora-Ciupa)
Laboratory projects	**The main objective of this module** is to broaden students' knowledge of the methods used in plant ecophysiological research with an emphasis on understanding the varied effects of heavy metals on plants, bioaccumulation capability, toxicity, as well as to develop their skills for critically interpreting the published data on environmental research. Project 1: Students will learn different methods for analysing heavy metals in soil and plants with special emphasis on appropriate sample collection. Project 2: Students will become acquainted with the assessment methods for selected metabolites that are involved in defence response of plants to heavy metals (e.g. chlorophylls, anthocyanins, prolines) as well as the histochemical staining of lipid peroxidation, measuring cell viability and locating various heavy metals in roots). Project 3: Students will focus on the application of the above-mentioned ecophysiological parameters and environmental indices such as the pollution index, translocation factor, bioconcentration factor, enrichment factor and chemical fingerprints of selected elements in plants.
Methodology of laboratory classes	Experiments will be performed in small groups under the supervision of the instructors and will include: • Designing and accomplishing the procedure • Calculating and presenting the results • Protocols commitment and presentation
Number of didactic hours	15

(contact hours)	
Literature	Markert, B. 1992. Establishing of "Reference Plant for inorganic characterization of different plant species by chemical fingerprinting. Water Air Soil Poll, 64, 533–538. Bates, L., Waldren, R., Teare, D. 1973. Rapid determination of free proline for water-stress studies. Plant Soil, 39, 205–207. Remon E., Bouchardon J-L, Guédard MLe, Bessoule J-J, Conord C. 2013. Are plants useful as accumulation indicators of metal bioavailability. Environmental Pollution, 175, 1-7. Nadgórska-Socha, A., Ptasiński, B., Kita, A. 2013. Heavy metal bioaccumulation and antioxidant responses in *Cardaminopsis arenosa* and *Plantago lanceolata* leaves from metalliferous and non-metalliferous sites. Ecotoxicology, 22, 1422–1434. Liu, Y-J., Zhu, Y-G., Ding, H. 2007. Lead and cadmium in leaves of deciduous trees in Beijing China: Development of metal accumulation. Environ Pollut, 145, 387–390. Serbula SM, Miljkovic DD, Kovacevic RM, Ilic AA 2012. Assessment of airborne heavy metal pollution using plant parts and topsoil. Ecotox Environ Safe, 76, 209–214 Ostrowska, A., Gawliński, S., Szczubiałka, Z. 1991. Method of analysis and estimate soil and plants property, Catalogue of the Environmental Protection Institute, Warsaw (pp 334–336)

3. Forms of verification

Continuous evaluation of knowledge, activity and practical skills	
Grades	Grades are awarded on a scale of A-F, where A is the best and F is a fail. An excellent performance (A) – the student actively participates in the laboratory work, demonstrates an excellent understanding of the experimental procedures (its aims, sequence and outcomes), is engaged and creative in solving current problems and in assessing and presenting the experimental results. A good performance (C) – the student demonstrates good judgment and knowledge, correctly performs an experiment, correctly exhibits a sense of the experimental procedure, properly assesses and presents the experimental results. A satisfactory performance (E) – the student demonstrates satisfactory judgment and knowledge, is poorly engaged and needs additional help to finish the experiment and the final assessment of the experimental results correctly, presents a satisfactory presentation of the experimental results. A performance that does not meet the minimum academic criteria (F) – the student is not engaged in the experiment, does not exhibit a sense of experimental procedures, poorly interprets and presents experimental results.

Reports from realised laboratory projects	
Evaluation	Evaluation comprised judgment and knowledge related to the sense and methods of the laboratory project, engagement in realisation, quality of assessing and presenting experimental results. Grades for reports are awarded on a scale of A-F, where A is the best and F is a fail. An excellent report (A) – without any essential errors Fail (F) – no report