GDAŃSK UNIVERSITY OF TECHNOLOGY

Subject card

Subject name and code	Environmental biological processes, PG_00057676						
Field of study	Green Technologies						
Date of commencement of studies	October 2025		Academic year of realisation of subject	2026/2027			
Education level	first-cycle studies		Subject group	Optional subject group			
Mode of study	Full-time studies		Mode of delivery	at the university			
Year of study	2		Language of instruction	Polish			
Semester of study	3		ECTS credits	3.0			
Learning profile	general academic profile		Assessment form	assessment			
Conducting unit	Department of Biotechnology and Microbiology -> Faculty of Chemistry -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. Beata Zalewska-Piątek					
	Teachers	dr hab. Beata Zalewska-Piątek					

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	30.0	0.0	0.0	45

E-learning hours included: 0.0

eNauczanie source addresses:

Moodle ID: 6159 Środowiskowe procesy biologiczne laboratorium
https://enauczanie.pg.edu.pl/2025/course/view.php?id=6159

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Learning activity and number of study hours

Learning activity	Participation in didactic classes included in study plan	Participation in consultation hours	Self-study	SUM
Number of study hours	45	5.0	25.0	75

Subject objectives

The aim of the course is to provide knowledge of biological processes occurring in the environment and the mechanisms by which natural and anthropogenic factors affect living organisms. Students acquire practical skills in performing and interpreting microbiological, genetic, and ecotoxicological analyses, as well as in the application of biomarkers and bioindication for environmental quality assessment.

Learning outcomes

Course outcome	Subject outcome	Method of verification
[K6_U04] capable of formulating and solving design tasks in the field of environmental technology to recognize their non-technical aspects, including environmental, economic and legal. Is capable of applying the principles of occupational health and safety. Is able to make initial assessment of engineering solutions and actions	is able to conduct a plant phytotoxicity test using liquid and soil samples and interpret the results for the preliminary assessment of the potential impact of chemical substances on the environment.	[SU1] Assessment of task fulfilment [SU3] Assessment of ability to use knowledge gained from the subject
[K6_W04] is aware of the importance of environmental protection and has a basic knowledge of chemical and biological threats to the environment, with particular emphasis on anthropogenic factors, has a basic knowledge of knowledge of the principles of sustainable development as well as national and European environmental management conditions.	has knowledge of chemical and biological hazards in the environment and methods used to assess the impact of pollutants on living organisms and environmental quality.	[SW1] Assessment of factual knowledge
[K6_K01] understands the need for learning throughout life, can inspire and organize the learning process of others. Is aware of his/ her own limitations and knows when to ask the experts, can properly identify priorities for implementation, critically evaluate his knowledge	recognizes the importance of bioindication methods in environmental assessment and critically interprets the results of environmental analyses, considering the limitations of the applied methods and their own knowledge.	[SK5] Assessment of ability to solve problems that arise in practice
[K6_U01] is able to obtain information from literature, databases and other sources, is able to integrate the information obtained, to make their interpretation, as well as draw conclusions and formulate and justify opinions, take part in the discussion	is able to analyze environmental research results using biological and ecotoxicological methods and draw conclusions regarding the impact of pollutants on living organisms.	[SU2] Assessment of ability to analyse information [SU3] Assessment of ability to use knowledge gained from the subject

Subject contents

Course content – lecture

Explanation of the concept of environmental biological processes and their significance in the functioning of the biosphere. The development of environmental biology as a scientific discipline studying processes occurring in the natural environment. The organization of life at different levels, from the cell to the ecosystem. Characteristics of selected groups of organisms involved in environmental processes. **Genetic material and variability of organisms.** Prokaryotic and eukaryotic genomes. **Mutations, mutagens, and environmental mutagenesis as a result of the impact of natural and anthropogenic** factors. Methods for assessing the genotoxic effects of environmental pollution. Selected cytogenetic and molecular tests. **Environmental biomarkers as a tool for assessing organism exposure to pollutants.** Mechanisms of action of pesticides, heavy metals, and other toxic substances on living organisms. Inhibition of acetylcholinesterase and δ-aminolevulinic acid dehydratase, induction of monooxygenases and vitellogenin, disruption of hormonal balance in organisms and their ecological significance. **Basic issues of ecotoxicology.** The fate and transformation of pollutants in the environment. Environmental toxicity and parameters used for its assessment. Factors influencing the bioavailability and bioaccumulation of pollutants. **Bioindication as a method for assessing environmental quality.** Classification of indicator organisms used in environmental research. Screening and dilution tests used to assess the toxicity of environmental samples. **Overview of toxicity tests using aquatic and terrestrial organisms.** Cryptobiotic forms of bioindicators. **Lichens as bioindicators of air quality.** Mechanisms of pollutant accumulation, sensitivity to anthropogenic factors, lichen scale, and transplant techniques. The importance of lichens in ecosystem functioning and environmental monitoring.

Course content – laboratory

Introductory classes. Familiarization with occupational health and safety rules in the laboratory and procedures for handling biological material. **Methods for determining the number of microorganisms in natural environments, including enumeration of bacteria using the spread plate and pour plate methods.** Determination of the number of microorganisms by the titer method and the most probable number (MPN). **Assessment of microbial counts in evaluating the sanitary condition of soil, water, and air.** Identification of ammonifying bacteria in soil samples based on microbial metabolic activity, changes in medium pH, and detection of ammonia using Nessler's reagent. Determination of the number of bacteria and fungi in air using the sedimentation method. **Examination of water samples for the presence of coli form bacteria by the fermentation method using LPB/Eijkman medium and determination of the coli form titer.** Confirmation of the presence of coli form bacteria by plating on MacConkey agar. **Isolation of plasmid DNA from bacterial cells using the alkaline lysis method.** Agarose gel electrophoresis. **Assessment of soil environmental toxicity using a phytotoxicity microbiotest (Phytotoxkit) on *Sorghum saccharatum*, *Lepidium sativum*, and *Sinapis alba*.** Determination of the inhibition of seed germination and root growth compared to a control sample for soil samples. **Evaluation of the direct effects of chemical substances on germinating seeds and seedlings in early growth stages using a phytotoxicity microbiotest on the same plant species.** Analysis of the effects of tested substances in liquid-phase samples in comparison with the control. **Summary of obtained research results.**

<table>
<tr><td>Prerequisites and co-requisites</td><td colspan="2">Knowledge of ecology and general microbiology.</td></tr>
<tr><td>Assessment methods and criteria</td><td colspan="2"><table>
<tr><th>Subject passing criteria</th><th>Passing threshold</th><th>Percentage of the final grade</th></tr>
<tr><td>Lecture: a written multiple-choice final test</td><td>60.0%</td><td>50.0%</td></tr>
<tr><td>Laboratory: entry tests and reports on the phytotoxicity test</td><td>60.0%</td><td>50.0%</td></tr>
</table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>Grabińska-Łoniewska A., Łebkowska M., Słomczyńska B., Słomczyński T., Rutkowska-Narożniak A., Zborowska E. Environmental Biology. Seidel-Przywecki. 2011.

Weiner J. Life and Evolution of the Biosphere. PWN. 2005.

Walker C.H., Hopkin S.P., Sibly R.M., Peakall D.B. Principles of Ecotoxicology. PWN. 2002.

Brown T.A. Genomes. PWN. 2009.

Grabińska-Łoniewska A., Łebkowska M., Słomczyńska B., Słomczyński T., Rutkowska-Narożniak A., Zborowska E. Environmental Biology. Seidel-Przywecki. 2011.

Weiner J. Life and Evolution of the Biosphere. PWN. 2005.

Walker C.H., Hopkin S.P., Sibly R.M., Peakall D.B. Principles of Ecotoxicology. PWN. 2002.

Beata Zalewska-Piątek, Marcin Olszewski, Rafał Piątek. Environmental Biology. Edited by Beata Zalewska-Piątek. Gdańsk University of Technology Publishing House. 2019.

Anna Brillowska-Dąbrowska, Marta Wanarska, Beata Zalewska-Piątek, Rafał Piątek, Józef Kur. Fundamentals of genetic engineering. Chapter 2. Gdańsk University of Technology Publishing House. 2014.</td></tr>
<tr><td>Supplementary literature</td><td>Wójciak H. Lichens, mosses, ferns. MULTICO.. 2023.</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2">Mutations, mutagens and the process of mutagenesis occurring under the influence of environmental factors.
Assessment of genotoxic effects caused by environmental pollutants based on selected toxicity tests.
The use of lichens as bioindicators of air quality and the level of its pollution.
The application of biomarkers in assessing the exposure of organisms to toxic compounds present in the environment.</td></tr>
<tr><td>Practical activites within the subject</td><td colspan="2">Not applicable</td></tr>
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