University of Gdańsk

Subject card

Subject name and code	Iron metabolism, PG_00153614		
Field of study	Biotechnology		
Date of commencement of studies	October 2026	Academic year of realisation of subject	2026/2027
Education level	Master's studies	Subject group	Obligatory subject group in the field of study Optional subject group Subject group related to scientific research in the field of study
Mode of study	full-time studies	Mode of delivery	at the university
Year of study	1	Language of instruction	Polish
Semester of study	1	ECTS credits	2.0
Learning profile	academic	Assessment form	credit
Conducting unit	Laboratory of Evolutionary Biochemistry -> UG Institute of Biotechnology -> Intercollegiate Faculty of Biotechnology UG-MUG -> Rector		
Name and surname of lecturer (lecturers)	Subject supervisor	dr hab. Rafał Dutkiewicz	
	Teachers		

Lesson types

Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
Number of study hours	15.0	0.0	0.0	0.0	0.0	15

E-learning hours included: 0.0

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	15	5.0	30.0	50

Subject objectives

The aim of the course is to acquaint students with the problems concerning the significance of iron in biological systems. Students will get to know complex biological phenomena concerning iron turnover, regulation of iron homeostasis in living organisms, will acquire an ability to analyze problems connected with iron metabolism; will acquire knowledge in the field of chemistry of iron, with the focus on the understanding of intracellular mechanisms in which iron is involved, and in the field of medicine, with the focus on pathologies causing the disturbance of iron metabolism

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[BIOTECHMU2_W02] The graduate has in-depth knowledge of the application of laboratory techniques and methods of genetic modification of cells and organisms and their use in biotechnology.	The student analyzes complex issues in iron chemistry, with particular emphasis on understanding the intracellular processes involving iron, and in medicine, with particular emphasis on pathologies that disrupt iron metabolism in biological systems. The student analyzes the results of laboratory experiments related to iron metabolism.	[SW4] test/exam - oral or written
	[BIOTECHMU2_W04] The graduate has in-depth knowledge of selected biotechnology problems currently discussed in the literature.	Student explains with understanding complex biological phenomena regarding iron metabolism, regulation of iron homeostasis in living organisms at the molecular level.	[SW4] test/exam - oral or written
	[BIOTECHMU2_K01] The graduate consciously combines knowledge acquired in previous stages of education with knowledge acquired on an ongoing basis to solve problems in the field of biotechnology; consciously deepens and updates knowledge and improves qualifications related to biotechnology in the field of exact and natural sciences and medical and health sciences.	The student is able to justify the choice of subject in writing, providing scientific argumentation, indicating content that deepens previously acquired knowledge of biotechnology.	[SK3] text preparation/written work
Subject contents	1. Selected information concerning the chemistry of iron (water solutions of iron; generating free radicals, iron and Fentons reaction; mechanisms of cell defense against oxidative stress); 2. Issues concerning the significance of iron in biological systems and techniques used in examining iron metabolism in biological systems; 3. Mechanisms of iron assimilation by Prokaryotes (siderophores; systems involved in the transport of Fe2+, the bacterial system regulating iron absorption Fur protein, Fur regulon, genes regulated by Fur; bacterial virulence connected with iron metabolism); 4. Mechanisms of iron uptake by plants and yeasts (assimilation of iron Fe2+ by the roots of non-grass dicotyledons and monocotyledons;assimilation of Fe3+ iron by grasses; plant ferritins; iron uptake by yeasts; reductases; iron transport through cell membrane; mitochondrial irontransport; iron accumulation in Saccharomyces cerevisiae); 5. Mechanisms of iron uptake by mammalian cells (structure of transferrins, binding and releasing iron by transferrin, uptake of transferrin-Fecomplex by mammalian cells; uptake of iron pool non- transferrin- bound; 6. Ways of intracellular iron accumulation (ferritin structure, mechanism of iron accumulation in ferritins, mechanism of releasing iron bound toferritin); 7. Cellular metabolism and iron homeostasis (pool of free iron; hem biosynthesis, biosynthesis of Fe-S centers NIF, ISC, SUF system; Fredrich ataxia and mitochondrial iron metabolism; iron homeostasis; structural characteristics of IRE regions, translation regulators within IRE regions, mRNA IRE stability; IRP1 and IRP2 proteins); 8. Mammalian iron absorption strategies, with particular focus on humans: sources of iron in human diet, molecular mechanism of iron absorption through intestinal mucous membrane, mechanism of iron uptake by enterocyte; 9. Pathophysiology of deficiency or surplus of iron in the human organism; acquired and inborn diseases disturbing iron homeostasis, and an impactof infection on iron turnover in the host		
Prerequisites and co-requisites	Inorganic chemistry, Organic Chemistry, Microbiology, Molecular Biology, Biochemistry, Written justification of the choice of the course. The condition for admission to the examination is a written justification for the choice of subject.		

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<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>written exam with open questions</td><td>51.0%</td><td>100.0%</td></tr></table></td></tr>
<tr><td rowspan="3">Recommended reading</td><td>Basic literature</td><td>Inorganic Biochemistry of Iron Metabolism: From Molecular Mechanism to Clinical Consequences, 2nd edition (2001), Robert Crichton
Iron metabolism: From Molecular Mechanism to Clinical Consequences, 3rd edition (2009), Robert Crichton
Balk J. & Lill R., Chembiochem. 2004, 5:1044-1049
Hentze M.W., Muckenthaler M.U. and Andrews N.C., Cell 2004, 117: 285-297
Lill R. & Mühlenhoff U., Trends Biochem Sci. 2005, 30:133-141
Balk J. & Lobreaux S., Trends Plant Sci. 2005, 10: 324-331
Johnson D., Dean D.R., Smith A.D., and Johnson M.K. Annu. Rev. Biochem. 2005, 74: 247-281
Philpott C.C., Biochim Biophys Acta. 2006, 1763: 636-645
Ajioka R.S., Phillips J.D., Kushner J.P., Biochim Biophys Acta. 2006, 1763: 723-736
Lill R. & Mühlenhoff U., Annu Rev Cell Dev Biol. 2006, 22:457-486
Lill, Dutkiewicz, et al. (2006) BBA-Mol.Cell Res. 1763: 652-67
Lill , Dutkiewicz, et al. (2015) Eur. J. Cell Biol. 94(7-9): 280-91
Dutkiewicz et al. (2017) Methods Enzymol. 595: 161-184
Dutkiewicz, R. and Nowak, M. (2017) JBIC Journal of Biological Inorganic Chemistry, (doi: 10.1007/s00775-017-1504-x)</td></tr>
<tr><td>Supplementary literature</td><td>not applicable</td></tr>
<tr><td>eResources addresses</td><td></td></tr>
<tr><td>Example issues/ example questions/ tasks being completed</td><td colspan="2"></td></tr>
<tr><td>Work placement</td><td colspan="2">Not applicable</td></tr>
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