



JAGIELLONIAN
UNIVERSITY
IN KRAKÓW

Earth System Science

Educational subject description sheet

Basic information

Field of study Joint Bachelor in Sustainability	Education cycle 2025/26	
Speciality Environmental & Life Sciences	Subject code UJ.WPAJBSELSS.840.16543.25	
Organizational unit Faculty of Law and Administration	Lecture languages english	
Study level first cycle (joint degree programme)	Subject related to scientific research Yes	
Study form full-time degree programme	Disciplines Earth sciences and the environment, Biological sciences	
Education profile General academic	ISCED classification 0532 Earth sciences	
Mandatory obligatory	USOS code	
Subject coordinator	Piotr Szwedo	
Lecturer	Mario Morellón Marteles, Javier Martin Chivelet, Soledad Domingo Martinez, Laura Domingo Martinez, Alejandra Garcia Frank, Lourdes López Merino, Rosario Gloria Gavián Garcia	
Period Semester 3	Examination graded credit	Number of ECTS points 5.0
	Activities and hours Lecture: 26 Classes: 19	

Goals

C1	The aim of this course is to provide basic knowledge on the main components and processes operating in the Earth System at different spatial and temporal scales and how human activities have been impacting on the environment, modifying natural processes. Students will learn how environmental changes are archived in the geological record, providing the scientific basis to evaluate the sustainability of human activities and advice in decision-making.
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Subject's learning outcomes

Code	Outcomes in terms of	Effects	Examination methods
Knowledge - Student knows and understands:			
W1	the internal and external structure of the Earth System and is able to identify its components, including their composition and physical-chemical properties.	JBS_K1_W06, JBS_K1_W07	written credit, credit with grade, report
W2	the basic geological processes within the internal and external geodynamics of the Earth System and how these processes have operated at different timescales during the Earth's history.	JBS_K1_W06, JBS_K1_W07	written credit, credit with grade, report, presentation
W3	how human activities have impacted on the Earth System at different spatial and temporal scales, leading to sustainability-related problems and identifies the international institutions assessing and solving these problems.	JBS_K1_W01, JBS_K1_W03, JBS_K1_W04, JBS_K1_W05	written credit, credit with grade, report, presentation
Skills - Student can:			
U1	apply different scientific methods and tools to evaluate the potential impact and sustainability of diverse human activities on the Earth System based on the achieved knowledge.	JBS_K1_U01, JBS_K1_U02, JBS_K1_U03	written credit, credit with grade, report, presentation
U2	identify specific sustainability-related problems and develop potential solutions, referring to main components and processes of the Earth System at different spatial and temporal scales, using the correct terminology based on available scientific literature.	JBS_K1_U01, JBS_K1_U02, JBS_K1_U03, JBS_K1_U04	written credit, credit with grade, report, presentation
Social competences - Student is ready for:			
K1	to take a position in relation to the sustainability of different human activities based on scientific data and interdisciplinary knowledge of the Earth System components and processes.	JBS_K1_K01, JBS_K1_K02, JBS_K1_K03, JBS_K1_K05	credit with grade, report, presentation
K2	to critically assess how scientific evidence of environmental change on the Earth System can be used for decision-making.	JBS_K1_K02, JBS_K1_K03, JBS_K1_K05	credit with grade, report, presentation

Calculation of ECTS points

Activity form	Activity hours*
Lecture	26
Classes	19
preparation for classes	40
preparation for final test	45
report preparation	20

Student workload	Hours 150	ECTS 5.0
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* hour means 45 minutes

Study content

No.	Course content	Subject's learning outcomes
1.	Components of the Earth System I	W1, U2, K1, K2
2.	Components of the Earth System II	W1, U2, K1, K2
3.	Basic geological processes I. Internal geodynamics.	W2, U1, U2, K1, K2
4.	Basic geological processes II. External geodynamics.	W2, U1, U2, K1, K2
5.	Introduction to hydro-biogeochemical cycles	W2, U1, U2, K1, K2
6.	Functioning of the climate system. Components and mechanisms.	W2, U1, U2, K1, K2
7.	Evolution of the Earth system and climate I. The geological timescale. Early Earth. Snowball Earth. Phanerozoic times	W1, W2, U1, U2, K1, K2
8.	Evolution of the Earth system and climate II. Past climate changes during the Quaternary	W1, W2, W3, U1, U2, K1, K2
9.	Recent climate change, causes and potential consequences in the context of Earth's history. The instrumental record. Geological hazards.	W1, W2, W3, U1, U2, K1, K2
10.	Fieldwork. Evidence of climate change during Earth History in the geological record.	W1, W2, W3, U1, U2, K1, K2
11.	Early human impact	W2, W3, U1, U2, K1, K2
12.	The Anthropocene. Planet boundaries and tipping points	W2, W3, U1, U2, K1, K2
13.	Evidence of past anthropogenically-induced environmental changes	W1, W2, W3, U1, U2, K1, K2
14.	Future projections. Early warning systems. The IPCC reports. The Net Zero transition.	W3, U1, U2, K1, K2
15.	Practical session: Oral presentations/posters	W1, W2, W3, U1, U2, K1, K2

Course advanced

Teaching methods :

text analysis, brainstorming, lecture with multimedia presentation, discussion, case study, laboratories

Activities	Examination methods	Credit conditions
Lecture	written credit, credit with grade	Written Exam (40%) - Students should demonstrate their knowledge of the topics discussed in the course.
Classes	credit with grade, report, presentation	Coursework and practical sessions report evaluation (30%) - Students should demonstrate their work during practical sessions. Oral evaluation (15%) - Students must work collaboratively, present a final report, and discuss their results in public. Fieldwork report (15%) - Students should demonstrate their knowledge of the topics discussed in field sessions.

Entry requirements

None

Literature

Obligatory

1. Gillson, L. (2015). Biodiversity Conservation and Environmental Change: Using Palaeoecology to Manage Dynamic Landscapes in the Anthropocene. Oxford and New York: Oxford University Press.
2. Lenton, T. (2016). Earth System Science: A Very Short Introduction. Oxford University Press.
3. Marshak, S. (2021). Earth. Portrait of a Planet. Seventh Edition. W.W. Norton & Co. New York.
4. Monroe, J.S.; Wicander, R. (2005). Physical Geology: Exploring the Earth. 5th ed. Thomson Brooks/Cole.
5. Ruddiman, W.F. (2014). Earth's Climate: Past and Future. Third edition. W.H. Freeman and Company.
6. St. John, K.; Leckie, R. M.; Pound, K.; Jones, M.; Krissek, L. (2021). Reconstructing Earth's Climate History: Inquiry-Based Exercises for Lab and Class, 2nd Edition. Willey Blackwell.
7. Tarbuck, E.J.; Lutgens, F.K. (2005). Earth: An Introduction to Physical Geology. 8th ed. Pearson/Prentice Hall.
8. Turner II, B. L. (2022). The Anthropocene. 101 Questions and Answers for Understanding the Human Impact on the Global Environment. Columbia University Press.
9. Wicander, R.; Monroe, J. S. (2007). Historical geology: evolution of Earth and life through time. 5th ed. International student edition. Thomson Brooks/Cole. <https://www.ipcc.ch/reports/>

Effects

Code	Content
JBS_K1_K01	The graduate can encourage sustainability-driven practices in the workplace and appraise sustainability of own values, perceptions, roles, and actions, with a special focus on environmental wellbeing.
JBS_K1_K02	The graduate can demonstrate considerable entrepreneurial initiative, autonomy, and readiness to act in complex and changing environments, especially in the context of supporting, undertaking, and co-organising activities beneficial for a sustainable society.
JBS_K1_K03	The graduate can consider different visions of the future and develop own evidence-based opinions in reference to the balance of values linked to economic development, social welfare, and environmental protection.
JBS_K1_K05	The graduate can defend the importance of scientific data and methods as a basis for decision-making.
JBS_K1_U01	The graduate can critically analyse academic literature, formulate research questions and conduct research under supervision.
JBS_K1_U02	The graduate can present and report knowledge, methodologies, ideas, problems and solutions, clearly and comprehensively, in different forms destined for different audiences – including discussions and debates which require defending a substantiated opinion, as well as conversations in a foreign language at the CEFR B2 level.
JBS_K1_U03	The graduate can apply adequate methods and tools, including selected IT tools, to solve problems related to data collection, analysis, and management in the context of sustainability.
JBS_K1_U04	The graduate can plan and effectuate simple sustainability-related projects under supervision and in the context of personal lifelong learning, both individually and in a team, using appropriate transversal skills and taking shared responsibility for the outcome.
JBS_K1_W01	The graduate can describe the concept of sustainability and recognize the differences in relevant definitions, models and approaches.
JBS_K1_W03	The graduate can give examples of sustainability-related dilemmas and hypothesize on the optimal course of action.
JBS_K1_W04	The graduate can identify sustainability-related problems specific to selected cultural, geographical, and political contexts.
JBS_K1_W05	The graduate can identify essential international instruments and institutions related to sustainability and explain their potential role in resolution of a given problem.
JBS_K1_W06	The graduate can describe interconnections between various aspects of sustainability and identify their significance in the context of natural and social sciences, with a special focus on disciplines included in the selected specialisation track (law and politics; chemistry and physics; chemistry and biology; economics and geography; economics, management and engineering; humanities).
JBS_K1_W07	The graduate can apply the theory and methodology of disciplines included in the selected specialisation track to sustainability-related problems, taking into consideration practical limitations such as protection of intellectual property.