SEE3208: PALEOBIOLOGY: CLIMATE, ENVIRONMENTAL, AND BIOSPHERE INTERACTIONS

Effective Term
Semester A 2026/27

Part I Course Overview

Course Title
Paleobiology: Climate, Environmental, and Biosphere Interactions

Subject Code
SEE - School of Energy and Environment
Course Number
3208

Academic Unit
School of Energy and Environment (E2)

College/School
School of Energy and Environment (E2)

Course Duration
One Semester

Credit Units
3

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
CHEM 1200 Discovery in Biology

Part II Course Details

Abstract
This course is for students who are interested in developing a basic understanding and appreciation for paleobiology (the field that use fossils to understand ecology and evolution on long-time scales) and its application to the study of global change across geologic and contemporary timescales. The course will cover deep-time paleontology (biological change over long periods of time) and recent historical climate and environmental impacts on global ecosystems (scale of millennia to decades), driven by both human and natural causes. Through case studies from mass extinctions to the Anthropocene, students will learn to interpret fossil and historical records, establish ecological baselines, and use deep time to inform predictions about Earth’s biosphere and human society. This course provides baseline knowledge of the historical

dimensions of environmental science, global biodiversity, and environmental change, which is fundamental for understand the future of our planet.

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	demonstrate a basic understanding of historical/ temporal aspect of environmental science	30		x	
2	describe historical human-induced and natural environmental changes in various ecosystems	30	x	x	x
3	explain the importance of historical and paleontological information to study environmental science, and past, present, and future of our planet and its biosphere	40	x		x

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Learning and Teaching Activities (LTAs)

	LTAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Lectures	Lectures cover fundamentals of paleobiology and the fossil record, paleobiology of environmental change, and applications in conservation paleobiology.	1, 2, 3	3 hrs/week
2	Practical sessions	Practical sessions in micropaleontology and paleoecology will involve sampling and processing sediments, microscope identification and counting of key microfossil groups, and quantitative analysis of assemblage changes to interpret historical and environmental implications.	1, 2, 3	6 hours throughout the course

3	Reading/ Self study	Study of reading list and provided materials.	1, 2, 3	

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks ("-" for nil entry)	Allow Use of GenAI?
1	Mid-term exam	1, 2, 3	20	There will be 1 midterm exam for to assess students' learning progress on the concepts as outlined in Lectures.	No
2	Assignments	1, 2, 3	20	Group reports linked to practical sessions will assess students' ability to apply paleoecological methods.	Yes
3	Group Project	1, 2, 3	20	Students will produce group reports and presentations on palaeoecological topics, to be shared and discussed during the course.	Yes

Continuous Assessment (%)

60

Examination (%)

40

Examination Duration (Hours)

2

Minimum Continuous Assessment Passing Requirement (%)

30

Minimum Examination Passing Requirement (%)

30

Additional Information for ATs

To pass a course, a student must do ALL of the following:

1) obtain at least 30% of the total marks allocated towards continuous assessment (combination of assignments, pop quizzes, term paper, lab reports and/ or quiz, if applicable);

2) obtain at least 30% of the total marks allocated towards final examination (if applicable); and

3) meet the criteria listed in the section on Assessment Rubrics.

Assessment Rubrics (AR)

Assessment Task

Mid-term exam

Criterion

Demonstrate ability to identify basic paleontology concepts taught in the first half of the course: stratigraphy, paleoecology, taphonomy, fossils, macroevolution, past biodiversity, and mass extinctions.

Excellent (A+, A, A-)

Capacity to accurately define the concepts taught during the first half of the course and strong ability to critically integrate topics.

Good (B+, B, B-)

Demonstrate good ability to define the concepts taught during the first half of the course and good ability to integrate topics.

Fair (C+, C, C-)

Demonstrate acceptable ability to define the concepts taught during the first half of the course and moderate ability to integrate topics.

Marginal (D)

Demonstrate limited ability to define the concepts taught during the first half of the course and limited ability to integrate topics.

Failure (F)

Demonstrate an inability to identify basic topics in the study of paleobiology and shows a Lack of understanding on how to integrate and apply the topics covered during the first half of the course.

Assessment Task

Assignments

Criterion

Ability to process, analyse, and synthesize findings from environmental datasets and micropaleontological samples using correct laboratory workflows, reproducible data handling, justified quantitative methods, culminating in a clear, logical data interpretation.

Excellent (A+, A, A-)

Excellent analysis and problem-solving skills to demonstrate in-depth understanding of paleobiology, paleoecology, micropaleontology, and fossils.

Good (B+, B, B-)

Good analysis and problem-solving skills to demonstrate good understanding of paleobiology, paleoecology, micropaleontology, and fossils.

Fair (C+, C, C-)

Acceptable analysis and problem-solving skills to demonstrate adequate understanding of paleobiology, paleoecology, micropaleontology, and fossils.

Marginal (D)

Marginally acceptable analysis and problem-solving skills to demonstrate some understanding of paleobiology, paleoecology, micropaleontology, and fossils.

Failure (F)

Poor analysis and problem-solving skills and is barely able to demonstrate an understanding of paleobiology, paleoecology, micropaleontology, and fossils.

Assessment Task

Group project

Criterion

Demonstrate knowledge about main fossil groups, their application in paleontological studies, and how fossil record reflect environmental changes.

Excellent (A+, A, A-)

Fully understand what characterize main fossil groups and their application in paleoecological studies. Capacity to demonstrate the history of fossils and their association with global change events.

Good (B+, B, B-)

Demonstrate solid knowledge of main fossil groups characteristics and their paleoecological applications. Show good understanding of how these groups associate with environmental change events.

Fair (C+, C, C-)

Demonstrate knowledge on basic characteristics of main fossil groups; have a basic understanding of their application in paleoecological studies. Understand the association of main fossil groups with global change events.

Marginal (D)

Demonstrate limited knowledge about main fossils and their defining characters; show limited knowledge about main fossil groups and how they are associated with different geological ages.

Failure (F)

Demonstrate no knowledge about main fossil groups and lack of understanding about their applications.

Assessment Task

Examination

Criterion

Ability to analyse and solve problems related to paleobiology, paleoecology, micropaleontology, and fossils.

Excellent (A+, A, A-)

Excellent analysis and problem-solving skills to demonstrate in-depth understanding of paleobiology, paleoecology, micropaleontology, and fossils.

Good (B+, B, B-)

Good analysis and problem-solving skills to demonstrate good understanding of paleobiology, paleoecology, micropaleontology, and fossils.

Fair (C+, C, C-)

Acceptable analysis and problem-solving skills to demonstrate adequate understanding of paleobiology, paleoecology, micropaleontology, and fossils.

Marginal (D)

Marginally acceptable analysis and problem-solving skills to demonstrate some understanding of paleobiology, paleoecology, micropaleontology, and fossils.

Failure (F)

Poor analysis and problem-solving skills and is barely able to demonstrate an understanding of paleobiology, paleoecology, micropaleontology, and fossils.

Part III Other Information

Keyword Syllabus

The course will include the topics:

a. Origin and history of life on earth;
b. History of Earth's biosphere;
c. Ecosystems and biodiversity through time;
d. Fossil record;
e. Mass extinctions;
f. Paleoecologial methods;
g. Past and present marine ecosystems and biodiversity;
h. Evolutionary responses to environmental change;
i. Historical and anthropogenic global change;
j. Conservation paleobiology.

Reading List

Compulsory Readings

	Title
1	Condamine, F.L., Rolland, J., Morlon, H., 2013. Macroevolutionary perspectives to environmental change. Ecol Lett 16, 72–85. https://doi.org/10.1111/ele.12062
2	Jeremy B. C. Jackson et al., Historical Overfishing and the Recent Collapse of Coastal Ecosystems. Science 293, 629-637 (2001). https://doi.org/10.1126/science.1059199
3	S.M. Kidwell, Biology in the Anthropocene: Challenges and insights from young fossil records, Proc. Natl. Acad. Sci. U.S.A. 112 (16) 4922-4929, https://doi.org/10.1073/pnas.1403660112 (2015).
4	Yasuhara, M., H.-H.M. Huang, P. Hull, M.C. Rillo, F.L. Condamine, D.P. Tittensor, M. Ku#era, M.J. Costello, S. Finnegan, A. O' Dea, Y. Hong, T.C. Bonebrake, N.R. McKenzie, H. Doi, C.-L. Wei, Y. Kubota, and E.E. Saupe. 2020. Time machine biology: Cross-timescale integration of ecology, evolution, and oceanography. Oceanography 33(2):16–28, https://doi.org/10.5670/oceanog.2020.225.
5	Yasuhara, M., Tittensor, D.P., Hillebrand, H. and Worm, B. (2017), Combining marine macroecology and palaeoecology in understanding biodiversity: microfossils as a model. Biol Rev, 92: 199-215. https://doi.org/10.1111/brv.12223

Additional Readings

	Title
1	Alroy, J., Aberhan, M., Bottjer, D.J., Foote, M., Fu#rsich, F.T., Harries, P.J., Hendy, A.J.W., Holland, S.M., Ivany, L.C., Kiessling, W., Kosnik, M.A., Marshall, C.R., McGowan, A.J., Miller, A.I., Olszewski, T.D., Patzkowsky, M.E., Peters, S.E., Villier, L., Wagner, P.J., Bonuso, N., Borkow, P.S., Brenneis, B., Clapham, M.E., Fall, L.M., Ferguson, C.A., Hanson, V.L., Krug, A.Z., Layou, K.M., Leckey, E.H., Nu#rnberg, S., Powers, C.M., Sessa, J.A., Simpson, C., Tomas#ovy#ch, A., Visaggi, C.C., 2008. Phanerozoic Trends in the Global Diversity of Marine Invertebrates. Science (1979) 321, 97–100.
2	Barnosky, A.D., Matzke, N., Tomiya, S., Wogan, G.O.U., Swartz, B., Quental, T.B., Marshall, C., McGuire, J.L., Lindsey, E.L., Maguire, K.C., Mersey, B., Ferrer, E.A., 2011. Has the Earth' s sixth mass extinction already arrived? Nature 471, 51–57. https://doi.org/10.1038/nature09678
3	Benton, M. J., Harper, D. A. T. 2020 Introduction to Paleobiology and the Fossil Record, 2nd Edition. Wiley.
4	Bottjer, D. J. 2016 Paleoecology: Past, Present and Future. Wiley-Blackwell.
5	Foote, M., Miller, A. I. 2007, Principles of Paleontology, 3rd Edition. W.H. Freeman and Co.

6	Gould, S. J., Lewontin, R. C. 1979 The spandrels of San Marco and the Panglossian paradigm: a critique of the adaptationist programme. Proc Biol Sci 1; 205 (1161): 581–598. https://doi.org/10.1098/rspb.1979.0086
7	Jablonski, David, Kaustuv Roy, and James W. Valentine. "Evolutionary macroecology and the fossil record." Macroecology: Concepts and Consequences: 43rd Symposium of the British Ecological Society. Vol. 43. Cambridge University Press, 2003.
8	Louys, J. (Ed.) 2012 Paleontology in Ecology and Conservation. Springer.
9	McCauley, D.J., Pinsky, M.L., Palumbi, S.R., Estes, J.A., Joyce, F.H., Warner, R.R., 2015. Marine defaunation: Animal loss in the global ocean. Science (1979) 347. https://doi.org/10.1126/science.1255641