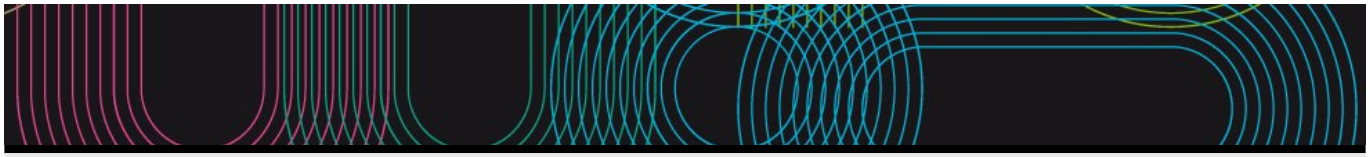

IDENTIFYING DATA				
Biological oceanography II				
Subject	Biological oceanography II			
Code	V10G061V01306			
Study programme	Grado en Ciencias del Mar			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	3rd	2nd
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	Marañón Sainz, Emilio			
Lecturers	Marañón Sainz, Emilio Mouriño Carballido, Beatriz Teira Gonzalez, Eva Maria			
E-mail	em@uvigo.es			
Web	http://https://mar.uvigo.es/			
General description	This course addresses the study of the interaction between the composition and dynamics of biological communities and the production and fate of organic matter in the ocean. The diversity and metabolic activity of microbial plankton receive special attention, due to their key role in the regulation of marine biogeochemical cycles. Multiple levels of organization are considered, including cells, populations, communities and the ecosystem. The ultimate aim is to understand the role of ocean's biology in the functioning of the Earth system. English Friendly subject: International students may request from the teachers: a) materials and bibliographic references in English, b) tutoring sessions in English, c) exams and assessments in English.			

Training and Learning Results	
Code	
A1	Students have demonstrated knowledge and understanding in a field of study that builds upon their general secondary education, and is typically at a level that, whilst supported by advanced textbooks, includes some aspects that will be informed by knowledge of the forefront of their field of study
B1	Know and use vocabulary, concepts, principles and theories related to oceanography and apply everything learned in a professional and/or research environment.
B4	Manage, process and interpret the data and information obtained both in the field and in the laboratory.
C10	Know the biological diversity and functioning of marine ecosystems.
C11	Apply the knowledge and techniques acquired to the characterization and sustainable use of living resources and marine ecosystems.
D1	Develop the search, analysis and synthesis of information skills oriented to the identification and resolution of problems.
D2	Acquire the ability to learn autonomously, continuously and collaboratively, organizing and planning tasks over time.

Expected results from this subject	Training and Learning Results			
Know and understand how organisms and communities drive the cycling of matter in the ocean, linking the physiological and ecological traits of key functional groups with their biogeochemical role.	A1	B1	C10	
Ability to connect the different physical, chemical and biological processes that determine the role of the ocean within the Earth system.	A1	B1	C10	D1
Know and understand the natural and anthropogenic variability in pelagic ecosystems and marine biogeochemical cycles, as well as their response to processes of global environmental change.	A1		C10 C11	D1
Ability to interpret biological oceanography data.		B4	C10 C11	D1
Ability to use computing applications to run mathematical models of biogeochemical processes.		B4	C11	D2

Ability to use specialised bibliography	D1 D2

Contents	
Topic	
Unit 1. Introduction	Distribution and abundance of chemical elements in the sea. Metabolic pathways and key plankton functional groups. Properties of element cycles.
Unit 2. Production of organic matter.	Variability and control of primary production. Stoichiometry of phytoplankton production. Dynamics of dissolved organic matter. New and regenerated production. Trophic organization and biogeochemical functioning of the ecosystem.
Unit 3. Remineralization.	Distributions of nutrients and oxygen. Oxygen utilization rates. Stoichiometric relations. Heterotrophic processes: quantification and variability. Photosynthesis respiration balance. Balance between N2 fixation and denitrification. Global nitrogen cycle.
Unit 4. Export.	The biological pump. Methodological issues. Spatio-temporal variability in export. Attenuation of vertical fluxes: controlling factors. Shallow and deep sedimentation. Coast-ocean gradients.
Unit 5. Biogeochemical processes in the sediments.	Physical structure of the sediment. Coast-ocean gradients. Reactions of organic matter oxidation. Redox potential. Spatio-temporal variability in benthic fluxes. Global carbon budget in the sediments.
Unit 6. The global carbon cycle.	Chemistry of dissolved inorganic carbon (DIC). Distribution and abundance of main DIC forms. CO2 fluxes between ocean and atmosphere. The biological pump and the solubility pump. Global C cycle: current unbalances.
Unit 7. The calcium carbonate cycle.	CaCO3 oceanic budget. Carbonate saturation. Production, export and redissolution of CaCO3. Distribution of carbonates in the sediments. Pelagic calcification: coccolithophore blooms and biogeochemical impacts.
Unit 8. Global change and the biology of the ocean.	Multiple environmental stressors. Warming. Acidification. Deoxygenation. Eutrophication. Impacts on species, communities, ecosystems and biogeochemical cycles. Global feedback processes.
Seminar program.	Biomass, production and growth of phytoplankton. Observation in oceanography: formulation and testing of hypotheses. Ecological and biogeochemical role of iron. Distribution patterns of diatoms and coccolithophores. Biogeochemistry of coastal eutrophication.
Practical session program.	Data analysis of phytoplankton cell size, abundance and metabolism. Graphical representation of xyz distributions. Open-ocean nitrogen budgets. Modelling the global carbon cycle using computer models. Case analysis.

Planning	Class hours	Hours outside the classroom	Total hours
Lecturing	22	46	68
Seminars	10	15	25
Problem solving	10	25	35
Practices through ICT	10	10	20
Objective questions exam	1	0	1
Problem and/or exercise solving	1	0	1
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	Description
Lecturing	Presentation of fundamental contents of the course, supported by graphic material.
Seminars	Using data and scientific articles, specific topics are exlored in detail. Subjects tackled include, amongst others, the ecology and biogeochemical role of diatoms and coccolithophores, the ecological and biogeochemical importance of iron, and ocean acidification.
Problem solving	Practical cases are solved using real data presented numerically and graphically.
Practices through ICT	Numerical modelling of the carbon biogeochemical cycle. Analysis of data on the size-scaling of phytoplankton abundance, biomass and metabolism.

Personalized assistance	
Methodologies	**Description**

Lecturing	Students can ask for assistance on any aspect of the course both on line and during personal interviews. Schedule for personal attention is Mon, Tue from 12:00 to 14:00. This schedule may be modified due to other teacher's commitments. Students are encouraged to contact the teacher via email to schedule interviews at a mutually convenient time.
Seminars	Students can ask for assistance on any aspect of the course both on line and during personal interviews. Schedule for personal attention is Mon, Tue from 12:00 to 14:00. This schedule may be modified due to other teacher's commitments. Students are encouraged to contact the teacher via email to schedule interviews at a mutually convenient time.
Problem solving	Students can ask for assistance on any aspect of the course both on line and during personal interviews. Schedule for personal attention is Mon, Tue from 12:00 to 14:00. This schedule may be modified due to other teacher's commitments. Students are encouraged to contact the teacher via email to schedule interviews at a mutually convenient time.

Assessment

	Description	Qualification	Training and Learning Results
Seminars	Students write a short assay in which they provide a critical synthesis of a scientific article. The clarity and correctness of the writing, as well as the rigour in the use and application of scientific concepts, are particularly valued. The mark obtained in June is maintained for the July call. Upon consultation with the course's coordinator, students may resubmit this work for the July call.	20	B1 C10 D1 D2
Problem solving	Students solve practical cases similar to those used during the practical sessions. The mark obtained the June call is maintained for the July call. Upon consultation with the course's coordinator, students may resubmit this work for the July call.	20	B1 C10 D1 B4 C11 D2
Objective questions exam	Intermediate test with closed answers (true/false, multiple choice) that assess the acquisition of knowledge and skills covered during lectures and seminars during the first half of the course.	20	A1 B1 C10 B4
Problem and/or exercise solving	Final written test includes short questions and practical cases. The test is designed to assess the acquisition of knowledge and skills covered during the lectures, seminars and practical sessions.	40	A1 B1 C10 B4 C11

Other comments on the Evaluation

The date, time and place of exams will be published in the official web of the Faculty of Marine Sciences:

http://mar.uvigo.es/alumnado/examenes/

Global assessment option: The application for this evaluation option must be submitted in the time and manner determined by the Center, which will be published prior to the academic start.

The mark obtained in the two tasks (synthesis of a scientific article and case resolution) is kept for the 2nd opportunity call. However, the marks obtained in the intermediate test and in the final written test are NOT kept for the 2nd opportunity call. Therefore, all students who make use of the second call must take the final exam, which represents 60% of the total mark for the course. It is possible, after consulting with the coordinator, to deliver the two tasks again for consideration in the second call.

All enrolled students must deliver the two tasks, because the marks obtained in earlier academic years are not kept.

Students must behave honestly and responsibly. Any form of copying or plagiarism, intended to alter the level of acquired knowledge and abilities, in exams, evaluations, reports or any other kind of student work is completely unacceptable. Fraudulent behaviour may result in the failing of the course for a whole academic year. An internal dossier of these activities will be kept and, in cases of reoffending, the University Rectorate will be asked to open a disciplinary enquiry

Sources of information

Basic Bibliography

Libes, S., **An introduction to marine biogeochemistry**, Wiley, 2009

Sarmiento, J., L., Gruber, N, **Ocean biogeochemical dynamics**, Princeton University Press, 2006

Williams RG, Follows MJ, **Ocean dynamics and the carbon cycle : principles and mechanisms**, Cambridge University Press, 2011

Complementary Bibliography

Miller, C. B., **Biological Oceanography**, Blackwell, 2012

Steele JH, Turekian KK, Thorpe SA, **Encyclopedia of Ocean Sciences**, 2a, Elsevier, 2008

Middelburg, Jack J., **Marine Carbon Biogeochemistry A Primer for Earth System Scientists**, Springer, 2019
Falkowski PG, **Life's Engines: How Microbes Made Earth Habitable**, Princeton University Press, 2015
Schlesinger, W.H., **Biogeoquímica: un análisis del cambio global.**, Ariel, 2000
Gasol JM, Kircvhman (Eds.), **Microbial ecology of the oceans**, 3a, Wiley-Blackwell, 2018

Recommendations

Subjects that it is recommended to have taken before

Marine Ecology/V10G061V01206
Biological oceanography I/V10G061V01301