UNIVERSITY OF GOTHENBURG

DEPARTMENT OF MARINE SCIENCES

MAR210 Biogeochemical cycles in the sea, 15 credits

Biogeokemiska kretslopp i havet, 15 högskolepoäng

First Cycle

Confirmation

This course syllabus was confirmed by Department of Chemistry and Molecular Biology on 2013-09-11 and was last revised on 2019-06-13 by Department of Marine Sciences to be valid from 2020-01-20, spring semester of 2020.

Field of education: Science 100%
Department: Department of Marine Sciences

Position in the educational system

The course can be taken as a freestanding course or be included in programme.

The course can be part of the following programmes: 1) Marine Science, Bachelor's Programme (N1MAV) and 2) Marine Science, Master's Programme (N2MAV)

Main field of studies	*Specialization*
Marine Sciences	G2F, First cycle, has at least 60 credits in first-cycle course/s as entry requirements
Chemistry	G2F, First cycle, has at least 60 credits in first-cycle course/s as entry requirements

Entry requirements

90 credits within natural science, including 15 credits in chemistry and the course BIO120 Ecology and Evolution, Basic Course, 15 credits, or equivalent

Learning outcomes

After having completed the course, the student is expected to:

Knowledge and understanding

- Describe the biogeochemical cycles for carbon, nitrogen, phosphorus and silicon in the sea at a general level
- Describe the general ocean circulation and how it influences the distribution of dissolved substances in the sea
- Explain different organism groups (such as fytoplankton, zooplankton and bacteria) role in the marine biogeochemical cycles
- Give an account of the basic principles of box models, the models of numerical 3-D and ecosystem models
- Reproduce the role of the sediments as reduce for biogenic elements and as source for dissolved substances
- Discuss the role of the sea in and response to a changeable climate with regard to heating and uptake/release of CO 2

Competence and skills

- Put up simple box models based on conservation principles
- Put up quantitative models over the biogeochemical renewals of carbon, nitrogen, phosphorus and silicon in the sea
- Present transports and fluxes of elements between atmosphere, seawater and bottom sediments
- Present the principles to the biological pump and the the solubility pump
- Present the most important methods to estimate speeds to biological and chemical renewals in the sea

Judgement and approach

- Evaluate factors that limit the production in the sea
- Evaluate the role of the sea in a changeable climate system
- Assess the applicability of different models to simulate and quantify biogeochemical renewals and oceanographic transports

Course content

The course covers the biogeochemical cycles for above all; carbon, nitrogen, phosphorus and silicon in the sea. The cycles are highlighted from a global oceanic perspective. Chemical, biological and physical aspects on the cycles. The course covers conservation principles, box models, wind-driven circulation and deep-sea circulation. Furthermore, gas-solubilities and gas-exchange atmosphere-ocean are covered as well as biological production in the ocean, limiting substances, vertical particle flow, the biological pump, the solubility pump, biochemical assimilation processes, transport between trophic levels, methods for estimating primary production, and ecosystem models. Other central parts of the course include oxygen and its distribution and consumption, and marine budgets for carbon, nitrogen, phosphorus and silicon The role of sediments in the cycles in terms of remineralisation and burial of carbon, nitrogen, phosphorus and silicon is

treated. The chemistry of the carbonate system and differences between the different world oceans (expansion), as well as the marine cycle of calcium carbonate are also included. Finally, the relationship between the carbon cycle, CO2 and climate is highlighted.

The course has a modeling perspective where the lectures are supplemented with exercises.

Sub-courses

1. **Theory** *(Teori),* 10 credits
   Grading scale: Pass with Distinction (VG), Pass (G) and Fail (U)
2. **Exercises** *(Övningsmoment),* 5 credits
   Grading scale: Pass (G) and Fail (U)

Form of teaching

Lectures are supplemented by compulsory practical exercises.

Language of instruction: English

Assessment

If the student has achieved the aim of the course is assessed through written examination and through the student's active participation in practical exercises. All practical exercises in the course are compulsory..

For students who have not passed the regular examination, additional examination sessions are offered. Opportunities to supplement failed compulsory components are limited and are decided upon in consultation with the course coordinator.

If a student, who has been failed on the same examining course component twice, requests a change of examiner before the next examination session, a request of this kind must be sent in writing to the department responsible for the course, and granted, unless there are special reasons to the contrary (Chapter 6, Section 22, Higher Education Ordinance).

In the event that a course has ceased or undergone major changes, the student shall be guaranteed access to at least three examination opportunities (including the regular examination opportunity) during a period of at least one year, but at the most two years after the course has ceased or undergone major changes.

Grades

The grading scale comprises: Pass with Distinction (VG), Pass (G) and Fail (U).
To Pass (G) MAR210, Pass (G) on all compulsory practical exercises and Pass (G) on the written examination are required. For Pass with distinction (VG) in the whole

course, Pass with distinction (VG) on the written examination and Pass (G) on all compulsory practical exercises are required.

Concerning application of the ECTS scale for grade, please see the decision of Vice-chancellor 28/05/2007, dnr Pass 8 197/07, and decision 28/02/2011, dnr O 2009/5545.

Course evaluation

A written evaluation is made at the end of the course. At the written evaluation, the student is anonymous. The results of and possible changes to the course will be shared with the students who participated in the evaluation and students who are starting the course.