GHENT UNIVERSITY

# Course Specifications

Valid as from the academic year 2020-2021

## Biogeochemical Cycles (I002453)

**Due to Covid 19, the education and evaluation methods may vary from the information displayed in the schedules and course details. Any changes will be communicated on Ufora.**

**Course size** *(nominal values; actual values may depend on programme)*

**Credits** 5.0 **Study time** 150 h **Contact hrs** 50.0 h

**Course offerings and teaching methods in academic year 2020-2021**

| | | | | |
|---|---|---|---|---|
| A (semester 2) | Dutch | Gent | practicum | 10.0 h |
| | | | lecture | 35.0 h |

**Lecturers in academic year 2020-2021**

| | | |
|---|---|---|
| Sleutel, Steven | LA20 | lecturer-in-charge |

| **Offered in the following programmes in 2020-2021** | **crdts** | **offering** |
|---|---|---|
| Bachelor of Science in Bioscience Engineering (main subject Land and Water Management) | 5 | A |
| Master of Science in Bioscience Engineering: Forest and Nature Management | 5 | A |

**Teaching languages**

Dutch

**Keywords**

Carbon, Nitrogen, elemental cycles, Terrestrial ecosystems, Soil, Freshwater, microbial processes, environmental chemistry, oceans, wetlands

**Position of the course**

In soils, submerged sediments, and surface there is a cycling of water, carbon, nutrients and metals between plants, organic matter and minerals. Fluxes of these elements of biological importance through and between ecosystems and earth compartments (lithosphere, atmosphere, hydrosphere and biosphere) reflect the functioning of the Earth system. This course aims to provide insight into their cycles on a global scale and main biological driving processes. The course leads to a discussion of anthropogenic interference in biogeochemical cycles in soil and surface water with focus on the impact of land-use change and pollution. Finally, the feedback between biological processes and global climate are discussed. Some basic methods to measure selected processes within cycles are explained.

**Contents**

Firstly, a thorough investigation is presented of cycles of carbon and nitrogen in terrestrial ecosystems, in wetlands, in inland waters and in oceans. The role of autotrophs and mirco-organisms as mediators of main transformation processes is discussed. Global cycles of C, N, P and S are then introduced. The dynamics of organic matter production and decomposition and limiting role of N and P for NPP are scrutinized.

Theory:

**A Global cycles and processes**

1. General introduction
(biogeochemistry, human influence, the impact of life on earth on element cycles)

2. The biosphere: Carbon in terrestrial ecosystems
(NPP, GPP & driving factors, OM degradation, soil organic matter, C balance and

succession)

3. The biosphere: cycles of nutrients
(uptake, intrasystem cycle, atmospheric deposition, leaching, human influence on nutrient cycles)

4. Wetlands
(types, werland soils, NPP, microbial breakdown of organic matter, anaerobic microbial metabolism & redox cascade)

5. Inland Waters
(links between the terrestrial and aquatic environments, aquatic chemistry, organic matter, lakes, rivers, human influence)

6. Oceans
(circulation, NPP, DOC and POC, the biological pump, nutrient cycles (N, P, S, Si, Fe))

**B Global cycles and processes**

7 Global C cycle
(modern C cycle, anthropogenic influence, O2 & CO2, methane, stable C isotopes)

8 Global N cycle
(N cycle, human influences, the N cascade)
(soil N cycle, internal and external N transformation processes)

9 Global P & S cycles
(P cycle, soil P pools and transformation processes)
(S oxidation stages and reservoirs, atmospheric S cycle, soil S cycle, transfers between compartments)

**Practicals:**
In several *practical sessions* a number of exercises are individually completed and several basic analyses are taught:
1 Practical gaseous C-emission (field or FBW greenhouse)
2 exercises: acid neutralizing capacity, marine biogeochemical cycling
3 Lab practical (submerged) soil (e.g. control of nutrient and organic matter quality on microbial activity and soil reduction and release of P & DOC)
4 Excursion (e.g. ICP-forest plots) or calculation exercise

**Initial competences**

The course Biogeochemical cycli requires a basic proficiency in Soil Science and Chemistry.
This course builds on learning outcomes of the course units 'Soil Science', 'General and Inorganic chemistry: Structure', 'General and Inorganic chemistry: Reactivity and Analysis', 'Organic Chemistry: Structure', and 'Organic Chemistry: Reactivity' ; or the learning outcomes have been achieved differently.

**Final competences**

1 Being able to describe global cycles of the biologically most relevant elements (C, N, P, S) and Si.
2 Being able to provide a summary of main factors determining the global distribution of these elements in terrestrial ecosystems
3 Being able to identify the chief biological processes driving these elemental cycles
4 Being able to explain how different ecosystems are interconnected by elemental cycles
5 Ability to provide examples of human perturbation of C and N cycles and argument implications for terrestrial ecosystems and the oceans
6 Recognize the complexity and interdisciplinary nature of biogeochemical cycles and realize existence of knowledge gaps

**Conditions for credit contract**

Access to this course unit via a credit contract is determined after successful competences assessment

## Conditions for exam contract

This course unit cannot be taken via an exam contract

**Teaching methods**

Lecture, practicum, seminar

**Learning materials and price**

Cost: 10.0 EUR
Extended syllabi and notes for exercises are available.
Slides are provided electronically (Ufora).

**References**

W.H. Schlesinger, E.S. Bernhardt. 2013. Biogeochemistry : an analysis of global change / . — 3rd edition. Academic Press, Oxford.
C.S. Cronan 2018. Ecosystem Biogeochemistry: Element Cycling in the Forest Landscape. Springer Nature, Cham.
F. Stuart Chapin III, P.A. Matson, H.A. Mooney. 2002. Principles of Terrestrial Ecosystem Ecology. Springer-Verlag, New York.

**Course content-related study coaching**

Both the professor and the assistant(s) are available to answer all questions concerning the course. Some background information is provided via Ufora.

**Evaluation methods**

end-of-term evaluation and continuous assessment

**Examination methods in case of periodic evaluation during the first examination period**

Written examination with open questions, oral examination

**Examination methods in case of periodic evaluation during the second examination period**

Written examination with open questions, oral examination

**Examination methods in case of permanent evaluation**

Report

**Possibilities of retake in case of permanent evaluation**

examination during the second examination period is not possible

**Calculation of the examination mark**

Practical work accounts for 20% of the marks, the theoretical examination accounts for 80%.
Students who eschew period aligned and/or non-period aligned evaluations for this course unit may be failed by the examiner.