Course Specifications

Valid as from the academic year 2019-2020

Microevolution and Speciation (C003316)

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	Study time	Contact hrs
6.0	180 h	58.0 h

Course offerings and teaching methods in academic year 2020-2021

A (semester 1)	English	Gent	seminar: practical PC room classes	12.5 h
			group work	10.0 h
			seminar: coached exercises	12.5 h
			lecture	27.5 h

Lecturers in academic year 2020-2021

Hendrickx, Frederik	WE11	lecturer-in-charge
De Clerck, Olivier	WE11	co-lecturer

Offered in the following programmes in 2020-2021	crdts	offering
Master of Science in Teaching in Science and Technology (main subject Biology)	6	A
Master of Science in Biology	6	A
Exchange Programme in Biology (master's level)	6	A

Teaching languages

English

Keywords

Evolutionary ecology, populationgenetics, quantitative genetics, evolvability, molecular methods, adaptive dynamics, evolutionary theory, epigenetics, speciation, adaptation genomics

Position of the course

This course provides a multi-disciplinary overview of the most important evolutionary-ecological and micro-evolutionary concepts, with particular emphasis on the interplay between genetic (population and quantitative genetics, evolvability, phenotypic plasticity, epigenetics), organismal (development) and ecological (frequency-dependent selection, adaptive dynamics) aspects. In a later stage, they learn how micro-evolutionary processen can give rise to the evolution of reproductively isolated entities i.e. species.

The course has a strong focus on the application of the most modern molecular and statistical methods and techniques that can be used to understand neutral as well as adaptive evolutionary processes. By means of coached exercises students learn how micro-evolutionary hypotheses can be tested (statistical tools and simulations) and how to search for the genetic basis of adaptive traits.

Contents

Theory
1 Heritability and quantitative genetics
2 Phenotypic plasticity and genetic assimilation
3 Genetic accommodation and adaptation by cryptic genetic variation
4 Maternal effects and epigenetics
5 Developmental plasticity and the extended evolutionary synthesis
6 Introduction to natural selection and population genetics
7 Gene genealogies, sequence evolution and the basics of coalescence theory
8 Extensions of coalescence theory: migration, population growth and selection

9 Detecting selection in wild populations
10 Evolutionary game theory and adaptive dynamics
11 Models of speciation
12 Molecular tools to study microevolution and speciation

Applications
1 Measuring genetic diversity and genetic differentiation (population genetic software)
2 Calculating genetic variances and covariances in quantitative genetic studies
3 Applications of coalescence theory (simulations and Bayesian methods)
4 Detecting the molecular signal of selection
5 QTL analysis and association mapping
6 Simulating and understanding evolutionary games
7 Exploring speciation models
8 Exploring next-generation sequence data
9 Student presentations on debated topics in evolutionary theory

Initial competences

Having successfully completed an introductory course in (i) population-ecology, e.g. Population ecology in Ba2, (ii) evolution, e.g. Evolution in Ba3 and (iii) genetics or having acquired the relevant knowledge by personal study or other means.

Final competences

1 Studenten hebben een basiskennis van de theorie van populatie-genetica.
2 Studenten hebben een basiskennis van de verschillende mechanismen die de overerfbaarheid van kenmerken bepalen.
3 Studenten begrijpen de mathematische achtergrond van de processen die genetische variatie bepalen.
4 Studenten begrijpen hoe populatiegrootte, migratie en selectie zich vertaalt in variatie in DNA sequenties.
5 Studenten hebben een goede kennis van hoe de omgeving de expressie van kenmerken kan beïnvloeden (fenotypische plasticiteit), hoe genetische variatie hierin een rol speelt (genotype x omgevingsinteractie) en hoe dit kan leiden tot evolutionaire wijzigingen (genetische assimilatie en accomodatie).
6 Studenten kennen de belangrijkste en recente technologische ontwikkelingen m.b.t. DNA sequentiebepalingen.
7 Studenten kennen het principe hoe genoom-wijde variatie gebruikt kan worden om selectie te detecteren.
8 De studenten kennen de meest recente inzichten in het ontstaan van soorten.

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

Group work, lecture, self-reliant study activities, seminar: coached exercises, seminar: practical PC room classes

Learning materials and price

Powerpoint presentations and primary literature available via the Ufora platform

References

- Coyne, J.A. & Orr, H.A. 2004. *Speciation.* Sinauer Associates, Massachusetts.
- Fox, C.W. & Wolf, J.B. 2006. *Evolutionary genetics: concepts and case studies*. Oxford University Press, New York.
- Dieckmann U., Doebeli M., Metz J. A. & Tautz D. (eds.) 2004. *Adaptive Speciation*. Cambridge University Press, Cambridge.
- Hein, J., Schierup, M. & C. Wiuf. 2005. *Gene genealogies, variation and evolution: a primer in coalescent theory.* Oxford University Press, New York
- Rice, S.H. 2004. *Evolutionary theory: mathematical and conceptual foundation*. Sinauer Associates, Massachusetts.
- Otto, S. & Day, T. 2007. *A biologist guide to mathematical models in ecology and evolution*.
- Van Straalen, N.M. & D. Roelofs. 2006. *An introduction to ecological genomics*. Oxford University Press, New York.
- Vincent, T.L. & Brown, J.S. 2005. *Evolutionary game theory, natural selection and Darwinian dynamics.* Cambridge University Press, New York.
- West-Eberhard, M.J. 2003. *Developmental plasticity and evolution*. Oxford University Press, New York.

Course content-related study coaching

Supervision of computer-aided interactive exercises. Supervision and guidance of group assignment. Personal contact with instructors by appointment.

Evaluation methods

end-of-term evaluation

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

Possibilities of retake in case of permanent evaluation

not applicable

Extra information on the examination methods

Theory: oral examination with written preparation
Exercises: written

Calculation of the examination mark

Theory: 50%
Exercises: 50%