COURSE DESCRIPTION CARD - SYLLABUS

Course name
Evolutionary Processes [S1Bioinf1>PREW]

Course

Field of study
Bioinformatics

Year/Semester
3/6

Area of study (specialization)
–

Profile of study
general academic

Level of study
first-cycle

Course offered in
Polish

Form of study
full-time

Requirements
compulsory

Number of hours

Lecture
15

Laboratory classes
0

Other (e.g. online)
0

Tutorials
15

Projects/seminars
0

Number of credit points

2,00

Coordinators

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Lecturers

Prerequisites

Students taking this course should have basic knowledge of molecular biology, genetics and general insight into biology. Moreover, students shall be familiar with basic probability calculus and combinatorics.

Course objective

The course objective is to introduce student to most important material in evolutionary biology, that has core role in modern biological studies and it is necessary to fully analyze biological problems. Student during the classes will develop ability to perceive and analyze biological problems in terms of modern theory of evolution. In addition to that, students will practice mathematical understanding of evolution, which might help them to design and implement algorithms related to this field in future.

Course-related learning outcomes

Knowledge:
1. Student possess knowledge about evolutionary processes, genetic mutations, recombination, adaptation to environment and he (or she) is able to refer to well-known biological examples of natural selection. Student understands basic applications of probability theory and combinatorics to evolutionary processes analysis (random mutations, gene recombination, mathematical modeling of

natural selection).
2. Student possess essential knowledge allowing him (or her) to solve basic exercises from evolutionary genetics and gene frequency analysis in population. Student can describe different types of mutation, sexual and asexual reproduction and their impact on genetic diversity in population. Student understands mechanism of gene evolution (gain and loss of function) and operates on terms such as heredity, inbreed, homozygosity, heterozygosity, allele, homologs, homoplasy, horizontal gene flow.
3. Student have knowledge of terms and processes such as natural selection, fitness, coevolution, genetic drift, adaptation, gene and genome evolution, neural theory of molecular evolution, speciation, reproductive barriers. Student operates with basic methods for evolutionary processes analysis. Student have essential knowledge about life history on Earth, systematics and phylogenetics.
4. Student knows basic mathematical models describing natural selection.

Skills:
1. Student uses and integrates data and information extracted from publications connected to evolutionary biology. Student interprets information and critically evaluates results in other works written in Polish or English.
2. Student draws conclusions about evolutionary processes and is able to clearly formulate his (or her) opinion based on integrated data from multiple sources.
3. Student is using elements of probability theory and combinatorics to solve exercises and basic problems connected to gene frequency analysis, mutation rate and natural selection impact on population genetic structure.
4. Student is able to use knowledge about evolutionary biology to solve biological problems and recognizes systems aspects of evolution. Student identifies evolutionary context of biological structure and function. Student can recognize consequences of evolutionary history and processes while solving bioinformatical problem (related to e.g. genomics or proteomics).

Social competences:
1. Student understands need for lifelong learning (problems covered by course includes evolutionary medicine and presentation of recent papers form evolutionary biology).
2. Student is able to discuss his (or her) view with group and works in teams to propose solution to given problem.

Methods for verifying learning outcomes and assessment criteria

Learning outcomes presented above are verified as follows:

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Knowledge accumulated during lectures will be verified based on test with closed and open questions. Students work will be scored on tutorials based on their preparation and activity. In order to pass the course students shall propose written solution for a chosen problem from a list (provided by teacher). Problem solution shall contain written descriptions, solution, and conclusions, but also mathematical calculations (if there were necessary).

Programme content

Lectures on Evolutionary Processes may be divided into six parts.
First part of lectures serves as introduction to modern evolutionary theory. In scope of this section elementary and some historical aspects of evolutionary biology will be covered.
Second part of lectures will focus on brief history of life on Earth. This section will cover topics such as origin of life hypotheses, geological periods, elements of phylogenetics and systematics. In addition students will be familiarized with terms such as homoplasy, homology, convergence and divergence.
Third part will be concentrated on mechanisms, processes and models of evolution. Students will gain knowledge about natural selection, sources of genetic diversity, genetic drift, population variability, adaptation, polymorphism, phenotypic plasticity, neutral theory of molecular evolution, Hardy-Weinberg law, mutation rate, speciation, linkage disequilibrium, quantitative traits evolution, alleles frequency analysis, hybridization, horizontal gene flow, frequency dependent selection, adaptive radiation. Moreover definitions of species, population and meta-population will be given.
Fourth part will address coevolution and different kinds of selection like group, kin or sexual selection.
Fifth part will cover evolutionary developmental biology and its role in study of gene, genome and protein evolution.
The last part will focus on research methods in evolutionary biology, known examples of fast adaptation

and experimental evolution. In addition to that lecture will cover evolutionary aspects of problems like somatic evolution of cancer, evolution of antibiotic resistance, biodiversity loss and species extinction. The practical part of the course will have problem-solving nature. During the tutorials students will be given practical exercises and problems to analyze, that will help them practice material presented on lectures.
Some problems and exercises to solve will have mathematical aspect that is crucial to develop understanding of basic models of natural selection. Students will learn how to perform basic analysis of gene frequency in population, fitness landscape, model natural selection, that will contribute to understanding of evolutionary and population genetics. Some aspects of combinatorics in context of evolution also will be covered.

Course topics

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Teaching methods

1. Lecture – multimedia presentation with examples presented on blackboard.
2. Tutorials – Exercise and problem solving on blackboard, discussion on topics related to material covered on lectures, case study of chosen examples, solving problems independently.

Bibliography

Basic
Futuyma D., Ewolucja, WUW, Warszawa 2008
Additional
Łomnicki A., Ekologia ewolucyjna, PWN, Warszawa 2012
Maynard Smith J., Evolutionary genetics, Oxford University Press, New York, 1998
Nowak M.A., Evolutionary dynamics: exploring the equations of life, The Belknap Press of Harvard University Press, Cambridge, Massachusetts and London, England, 2006

Breakdown of average student's workload

	Hours	ECTS
Total workload	50	2,00
Classes requiring direct contact with the teacher	30	1,00
Student's own work (literature studies, preparation for laboratory classes/ tutorials, preparation for tests/exam, project preparation)	20	1,00