Module variant to: Foundations of Biodiversity, Evolution and Ecology

Module: Evolution, Systematics, and Biogeography: Concepts and Analytical Methods	
University/Department/Teaching Unit: Freie Universität Berlin/Department of Biology, Chemistry, Pharmacy/Biology	
Module coordinator: Dr. Konstantina Koutroumpa	
Prerequisites: none	
Learning objectives: The main goal of the course is to provide students with the conceptual foundation, critical thinking skills, and practical analytical skills necessary to address key questions in evolutionary biology (with a focus on macroevolution), systematics and biogeography. Through a combination of theoretical exploration and hands-on application, students will: (1) develop the ability to understand and interpret phylogenetic trees ("tree thinking"); (2) infer evolutionary relationships; (3) explore how traits have evolved across clades; (4) understand how organisms are classified based on shared derived traits and common ancestry (5) analyse patterns of species diversification; and (6) explore biogeographical theory and analyse how biodiversity has accumulated across space.	
Content: This course covers major conceptual and methodological foundations of evolutionary biology, systematics, and biogeography. Students will engage with key topics including character evolution, phylogenetic tree inference methods, gene trees versus species trees, and the reconstruction of evolutionary history accounting for processes such as incomplete lineage sorting, hybridization, and reticulate evolution. The systematics component focuses on the integration of molecular, morphological and other data sources to inform and revise biological classification, with examples primarily drawn from plants. Students will gain experience in designing systematic studies and interpreting evolutionary relationships to understand how biodiversity is organized into taxonomic units. The course also introduces historical biogeography and diversification rate analysis as complementary approaches to understanding how biodiversity has changed through time and space. Students will apply methods such as molecular dating using fossil calibrations, ancestral area estimation, biogeographical stochastic mapping, and test for variation of speciation and extinction rates across clades, through time and in relation to biotic and abiotic factors. Special emphasis is placed on modern analysis of large-scale datasets using bioinformatic tools (phylogenomics), highlighting how high-throughput data and computational methods are reshaping systematics and evolutionary biology. Grounded in real biological examples, the course emphasizes critical interpretation, methodological reasoning, and the integration of theory with analytical tools, preparing students to contribute to contemporary biodiversity research.	

Modes of instruction	**Contact hours** (hours per week during the semester)	**Types of active participation**	**Workload** (in hours)	
Seminar (S)	1	–	Class attendance (seminar) Preparation, before and after (seminar)	15 15
Practice sessions (Ü)	2	Carrying out and documenting experiments in the lab	Class attendance (practice session) Preparation, before and after (practice session) Exam preparation and exam	30 15 75
Module assessment		Written exam (60 minutes), wholly or partially in multiple-choice format; can also be carried out electronically or written report on research results (approx. 10 pages) or examination colloquium (approx. 20 minutes)		
Language		English		
Regular attendance required		yes		
Total workload		150 hours		5 credit points
Duration		one semester		
Frequency		irregular		
Applicability		Master's degree program M.Sc. Biology; Master's degree program M.Sc. Biodiversity, Evolution and Ecology		

Utilization in the following specializations (decision by the examining board):

Biodiversity, Evolution and Ecology	x

Genetics and Genomics	x
Microbiology	
Molecular- and Cellular Biology	x
Molecular Plant Sciences	x
Neurobiology	
Biology	x