Module variant to: Foundations of Microbiology

Module: Antimicrobial resistance	
University/Department/Teaching Unit: Freie Universität Berlin/Department of Biology, Chemistry, Pharmacy/Biology	
Module coordinator: Dr. Frank Schreiber; Bundesanstalt für Materialforschung und -prüfung (BAM)	
Prerequisites: none	
Learning objectives: The module provides knowledge about the physiology of microorganisms and their specific survival strategies in the presence of antimicrobial substances. In addition, knowledge about the evolution and spread of antimicrobial resistance in the environment is conveyed. Another focus is the effectiveness of antimicrobial materials to prevent colonisation by biofilms. After completing the module, students are able to assess the antimicrobial properties of substances and materials and to critically evaluate the results of such experiments. They are also able to investigate the risk of resistance evolution for certain antimicrobial substances with suitable experiments.	
Content: Differentiation between resistance, tolerance and persistence. Physiology of bacteria in biofilms and correlation with antimicrobial tolerance and resistance. Basics of determining the minimum inhibitory concentration (MIC), the minimum bactericidal concentration (MBC), the number of persister cells using time-resolved killing curves and the tolerance of biofilms. Fundamentals of the evolution of antimicrobial resistance and fundamentals for conducting and evaluating evolution experiments and mutation rate determination. Consequences of the interaction of combinations of antimicrobial substances on microbial physiology and selection of resistance: synergy, antagonism, cross-resistance, co-selection. Regulation of antimicrobial substances: Medicinal products, plant protection products and biocides with focus on the EU Biocide Regulation. Determination of the efficacy of antimicrobial surfaces with ISO certified standard methods. Spread of resistance in the environment and the role of different environmental compartments.	

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	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		

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

Biodiversity, Evolution and Ecology	
Genetics and Genomics	
Microbiology	x
Molecular- and Cellular Biology	x
Molecular Plant Sciences	
Neurobiology	X
Biology	x

U. Hoch