

Syllabus of the program «Soil microbiology»

Sections and topics of the discipline	Total hours	Including	
		Lectures	Practical work
1. History of development and main directions of modern soil microbiology. Descriptive period in the history of microbiology. Physiological stage in the development of microbiology. Studies by Louis Pasteur and Robert Koch. Discovery of chemosynthesis by S.N. Vinogradsky. Role of microbial communities in various natural habitats. Development of soil algology and mycology (E.A. Shtina, M.M. Gollerbakh, T.G. Mirchink). Microbiological method of production of amino acids (N.A. Krasilnikov).	2	2	
2. Basic research methods in soil microbiology. Microscopy (light, fluorescent, electron microscopy). Analytical methods (physiological, biochemical, genetic, molecular biological). Methods for isolation of pure cultures and cultivation of soil microorganisms. Elective cultivation methods. Nutrient media and conditions for growth of microorganisms. Sterilization methods.	4	2	2
3. Main objects of study of soil biota. Characterization of main groups of eukaryotic organisms comprising the soil biota – algae, soil animals, fungi, lichens – and their role in natural habitats. Characterization of specific features of ontogenesis of individual groups of soil organisms.	2	2	
4. Morphology of microorganisms. Modern classification of microorganisms. Structure and composition of the prokaryotic cell. Size, shape and grouping of cells. Reproduction and development of prokaryotes. Viruses and phages. Fundamentals of modern taxonomy of microorganisms.	4	2	2
5. Biosynthetic processes in microorganisms. Energy processes in microorganisms. General scheme of catabolism. Lactic acid, butyric acid, and alcohol fermentation types. Anaerobic and aerobic breathing.	4	2	2
6. Carbon assimilation. Carbon fixation processes. Methane formation. Methane oxidation. Decomposition of complex organic nitrogen-free substances (cellulose, lignin, pectin, starch, etc.) by microorganisms. Formation of humus. Use of light energy by halobacteria.	4	2	2
7. Nitrogen metabolism. Biological fixation of nitrogen. Biochemistry of nitrogen fixation. Microorganisms capable of nitrogen fixation. Significance of nitrogen fixation process. Bacterial preparations based on nodule bacteria. Oxidation of ammonia and nitrites. Denitrification and reduction of nitrates.	4	2	2

8. Sulfur cycle. Transformations of phosphorus, iron, manganese and other elements by microorganisms. Formation of hydrogen sulfide during sulfur reduction. Sulfate breathing. Magnetic bacteria. Heterotrophic iron-oxidizing bacteria. Black smokers. Oxidation of ferrous iron. Mineralization of organophosphorus compounds. Aluminum metabolism.	4	2	2
9. Antagonistic activity and antibiotic resistance of microorganisms. Secondary metabolites of microorganisms. What are antibiotics? Evolutionary significance, classification and areas of application of antibiotics. Antibiotic resistance of microorganisms and methods for determining antibiotic activity of microorganisms.	2	2	
10. Action of physical and chemical factors on microorganisms. Specificity of the soil as a habitat. Effects of acidity of the medium (pH), temperature, hydrostatic pressure, oxygen presence, radiation, water activity on microorganisms. Adhesion of microorganisms and activity of adhered cells. Gas phase of soils, development of microorganisms in films and capillaries.	2	2	
11. Microorganisms as objects of biotechnology. Practical application of microorganisms. Use of microorganisms in food production (kvass, beer, wine, cheese, bread, etc.). Production of individual chemical substances (hormones, antibiotics, plant growth stimulants). Leaching of metals from ores. Bioremediation of natural objects contaminated with oil. Negative activity of microorganisms in relation to human activities (food spoilage, microbial corrosion of industrial facilities, microbial contamination of soil, water, atmosphere, pathogenicity to humans, animals and plants).	2	2	
12. Basic principles of biological indication and diagnostics of soils. Interactions between organisms. Soil algological indication. Biological indication of soil contamination and soil self-cleaning. Lichen indication. Microorganisms of rhizosphere and rhizoplane. Mycorrhizal fungi.	2	2	
Total:	36	24	12