Advanced Veterinary Microbiology: Bacterial Metabolism and Host-Pathogen Interactions

Course Description:

This advanced course examines the crucial role of bacterial metabolism in veterinary infectious diseases, focusing on the dynamic interactions between bacterial pathogens and their animal hosts. Students will explore how metabolic pathways affect bacterial virulence, antibiotic resistance, and the emergence of zoonotic diseases. The course combines cutting-edge research, case studies, and hands-on laboratory experiences to provide a comprehensive understanding of host-specific bacterial interactions, immune evasion strategies, and the influence of metabolic dynamics on animal health. By the end of the course, students will have the knowledge and skills necessary for advanced research and clinical applications in veterinary bacteriology.

Course Learning Objectives:

By the end of this course, students will be able to understand the fundamental principles of bacterial metabolism and its role in pathogenesis. They will elucidate the mechanisms of bacterial virulence and host-pathogen interactions in veterinary contexts. Students will assess the metabolic basis of antibiotic resistance and its implications for veterinary medicine. They will analyze case studies of zoonotic diseases and their public health impacts. Furthermore, students will learn about experimental techniques to explore bacterial metabolism, virulence, and host interactions, while developing critical thinking and problem-solving skills through research presentations and discussions.

Course Topics and Schedule:

Week 1: Introduction to Veterinary Bacteriology: The course begins with an overview of bacterial species of veterinary importance, emphasizing the role of bacterial metabolism in pathogenicity and host adaptation. It then introduces key concepts in bacterial genetics and molecular biology.

Week 2: Bacterial Metabolism in Animal Hosts: This week centers on the metabolic adaptations of bacteria in various host environments, including the gut, respiratory tract, and skin. Students will investigate how pathogens acquire and utilize nutrients, featuring a case study on the metabolic strategies of *E. coli* in ruminants compared to monogastric animals.

Week 3: Host-Pathogen Metabolic Interactions: Students will examine how pathogens manipulate host metabolism to promote infection, including metabolic crosstalk between pathogens and host immune cells. They will also discuss the implications for disease progression in zoonotic infections, such as those caused by *Brucella* and *Salmonella*.

Week 4: Bacterial Virulence Factors: The focus will be on toxins, adhesins, and secretion systems, with an in-depth look at their mechanisms and roles in disease. Case studies on *Salmonella* spp., *Brucella* spp., and *Pasteurella multocida* will be explored.

Week 5: Antibiotic Resistance in Veterinary Pathogens: This week, we will examine the metabolic basis of antibiotic resistance, including mechanisms such as efflux pumps and enzymatic inactivation. We will also discuss the role of horizontal gene transfer in spreading resistance and the challenges and solutions of antibiotic stewardship in veterinary practice.

Week 6: Metabolic Regulation and Adaptation: Students will explore quorum sensing and bacterial communication within host environments, stress responses, and metabolic adaptation to host defenses.

Week 7: Zoonotic Infections and Public Health: This week, we will explore the transmission dynamics of zoonotic bacteria, such as *Leptospira* and *Campylobacter. We* will also highlight the One Health approach, which merges veterinary and human medicine, and the role of veterinarians in monitoring and controlling zoonotic diseases.

Week 8: Gut Microbiota and Host Health: This week examines the role of gut microbiota in animal health and disease, focusing on how dysbiosis affects metabolic and immune functions. The therapeutic uses of probiotics and prebiotics in veterinary medicine will also be addressed.

Week 9: Emerging Pathogens and Antimicrobial Strategies: Students will study emerging bacterial threats in veterinary medicine, such as *Mycobacterium bovis* and *Clostridioides difficile*. They will also explore alternative antimicrobial strategies, including phage therapy, antimicrobial peptides, and CRISPR-based approaches

Week 10-12: Student Research Presentations: In the final weeks, students will present on current research topics in veterinary microbiology, emphasizing novel findings, methodologies, and potential applications in veterinary practice. Peer feedback and discussions regarding future directions in the field will be encouraged.