

Public Review

Title: *Virology Lab Exercises for Undergraduates*

Author: Eric Ryndock

Reviewers: Brian Bowser and Christopher Stieha

Review by Brian Bowser

The “Virology Lab Exercises for Undergraduates” manual was designed to provide students with a hands-on introduction to the world of viruses. The content was carefully selected to strengthen laboratory skills and to complement what you are learning in the classroom.

The manual teaches both classic microbiological methods and more modern molecular approaches to studying microbes. The content includes studies of viruses that infect bacteria, plants and animal cells to give you a broad range of experiences.

It begins with time-tested techniques such as culturing bacteria and performing plaque assays with bacteriophages—viruses that infect bacteria and produce visible plaques in bacterial lawns. These foundational skills provide insight into viral replication, host range, and virus quantification.

You will then explore methods used to study viruses that do not produce plaques, such as Deformed Wing Virus (DWV)—an RNA virus that infects insect cells – as a model system. Since DWV cannot be detected through traditional plaque assays, you will use molecular techniques to detect and quantify the virus. The manual also includes exercises using Zucchini Yellow Mosaic virus, which infects species of plants.

The work is more than a collection of protocols—it is a guide for developing your technical skills, critical thinking, and scientific reasoning. As you move through the experiments, you are encouraged to think like a researcher: ask questions, consider controls, interpret results thoughtfully, and appreciate the challenges and creativity involved in studying organisms too small to see.

I expect that the laboratory experiences found within this manual will inspire curiosity, sharpen your skills, and deepen your understanding of the unseen world around us.

Reviewer’s Bio: Brian Bowser received his Ph.D. from the University of North Carolina at Chapel Hill and did his post-doctoral work at the Penn State College of Medicine. He is a Molecular Biologist and Virologist who has worked in the contract research field for 15 years. He currently

directs a group of Process Analytics/Quality Control scientists responsible for the testing of antibody and cell therapy drug products in Phase I and II clinical trials.

Review by Christopher Stieha

Eric Ryndock has written a unique laboratory manual for a virology laboratory for undergraduates that introduces students to the standard techniques in the field as well as to the diversity of biological questions and organisms that these techniques can be applied to. As the students learn the techniques outlined in the manual, they will be developing the skills that will get them employed in an industrial setting or give them the tools to pursue graduate education. Moreover, the multi-staged exercises stress the process of science by allowing students to use prior knowledge to ensure an understanding of the lab, develop predictions that can be tested, apply their knowledge to novel situations, and complete activities that build upon one another to complete a project. I find that this final component is required to stress to upper-level students that science is not a one-and-done process like many skill-only or freshman/sophomore laboratory manuals espouse (usually as an accidental by-product of their design and inferences made by the students), but a process that takes time beyond a single lab period.

In Chapter 1: Bacteriophage Investigation, students are guided through three activities to culture bacteriophages and quantify their concentrations. Early on, students are introduced to the use of aseptic practices to avoid contamination when isolating pure cultures of bacteria. Students then use these bacterial cultures to propagate the bacteriophages, identify the life cycle of the bacteriophages as either lytic or lysogenic, and quantify the concentration of the bacteriophages and their thermostability. Throughout the activity, Dr. Ryndock has students apply prior knowledge, make predictions, make observations, and apply their new knowledge to novel situations, such as the preventing bacteriophage growth in areas where bacteria are grown as a product, such as food production and medicine.

In Chapter 2: Deformed Wing Virus Investigation, students will be using molecular techniques to study a disease-causing virus from the Iflaviridae family that is known to infect the European honey bee. Through four activities, students will extract RNA from honey bees and determine RNA concentration and purity using a spectrophotometer, synthesize cDNA from the RNA, use PCR to amplify the cDNA associated with the Deformed Wing Virus, and use gel electrophoresis to determine the presence of the virus. By using honey bees, Dr. Ryndock has taken these experiments out of the lab and into the outside world, which may then attract and inspire students who focus more on organisms yet may be curious about molecular biology.

In Chapter 3: Zucchini Yellow Mosaic Virus Investigation, students will be studying the Zucchini Yellow Mosaic Virus, a well known and hated disease of agriculturally important crops such as

zucchini, squash, and cucumbers. Throughout these three activities, students will follow procedures to connect a disease to a specific virus using enzyme-linked immunosorbent assay (ELISA---a technique that anyone who used the COVID test kits is unknowingly aware of). Students will extract virus from diseased plants, infect other plants using mechanical transmission (grinding) and vector transmission (via aphids), and quantify the effects of disease on the plant through chlorosis using ImageJ and differences in mass between infected and uninfected plants. Again, Dr. Ryndock successfully guides the students through a process that applies to all disease, independent of host organism, and has the students develop specific skills and techniques within the context of this question.

An instructor using this manual in their course will develop students who are capable of asking questions and developing a process to study these molecular pirates known as viruses.

Reviewer's Bio: Christopher Stieha is a quantitative ecologist who combines mathematical modeling, statistics, and bioinformatics to elucidate the effects of biotic and abiotic interactions on populations and communities, whether these interactions are plant-plant, plant-insect, plant-microbes, native and invasive organisms, or even genes. After receiving his Ph.D. from the University of Kentucky on competition between males and females in a clonal plant, he completed post-doctoral work at Cornell University and Case Western Reserve University on the effects on plant-insect interactions on insect population dynamics. Currently, he teaches undergraduates students at Millersville University of Pennsylvania and collaborates with many of them on projects as diverse as plant-insect interactions, implications of stochasticity on communities, microbial community ecology, and gene expression and regulation in developmental biology.