
Using a One Health Assignment as a Final Project in a Microbiology Course

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INTRODUCTION

Globalization has led to a high degree of interconnectedness among all inhabitants of the earth and has served as the impetus for the One Health initiative. This initiative is a strategic program aimed at understanding the intersecting health of humans, animals, and the environment (<https://cdc.gov/onehealth>). The One Health initiative is supported by the CDC, the American Veterinary Medical Association, and the American Medical Association, and was originally adopted as a collaboration in 2007 (1). Its primary focus is on the zoonotic diseases that can wreak havoc on both animal and human populations. It is for this reason that One Health should be an initiative of utmost relevance and importance to undergraduate students learning microbiology.

A few undergraduate classroom activities have previously addressed One Health (2, 3), but most students are introduced to the concept in graduate, veterinary, or medical school. However, there is a movement to introduce One Health to students earlier in their educational careers (4). The assignment described here is given as a final project in an undergraduate microbiology course. It serves as both formative and summative in learning about specific aspects of One Health, integrating this knowledge, and addressing all of the objectives of AAAS *Vision and Change* and American Society for Microbiology (ASM) Curriculum Guidelines (5, 6). The objectives are listed in Table 1. This assignment gives students an opportunity to demonstrate knowledge while integrating it into a One Health framework, focusing heavily on the ASM guidelines related to scientific thinking (guidelines 30, 30a, 30b, 31, 31a) (6).

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PROCEDURE

At the beginning of the 3-week unit, students are introduced to the One Health initiative through a series of formative assignments that are also scaffolding assignments for the final submission (see Appendix S1 and S2 in the supplemental material). The students learn about the initiative through a series of videos and the CDC website. They choose three topics which are given peer and instructor feedback, followed by a final topic decision. Three primary sources are chosen to learn source selection and proper citation style. The students then submit an annotated bibliography with at least 10 peer-reviewed sources, followed by an outline and part of a rough draft. Finally, they submit their projects (see Appendix S3) through an originality program in the course management system, which allows multiple resubmissions before the deadline and reinforces proper paraphrasing as students see their mistakes highlighted and have a chance for correction. The students then give an oral presentation summarizing their topic to classmates. This allows all students to learn about an array of different problems addressed by One Health. Students are evaluated with a single-point rubric (Table 2) that gives transparent expectations of the project and efficient individualized feedback. The project comprises 10% of the final course grade (see Appendix S4).

Students may change their topic at any point. Sometimes students realize there is not enough information on their topic, or their topic is causing them emotional trauma (e.g., SARS-CoV-2 and a COVID-19 death in the family). Other than potential emotional trauma, there are no safety issues with this assignment.

This assignment has been used with four semesters of microbiology students ($n=73$) who have participated in informal conversations. The students appreciate writing a paper about a self-chosen topic over studying for a comprehensive exam. The most common challenge is learning how to discern primary peer-reviewed sources and how to paraphrase with integrity. Student feedback has led to improved transparency of the rubric (to expand types of topics, clarify length, etc.) and to a knowledge of how to direct students toward more achievable topics. Topics that have been

TABLE 1
Unique learning objectives for the One Health assignment

One Health assignment	ASM guidelines ^a
Demonstrate understanding of basic microbiology knowledge and terminology	Cell structure and function (8, 9, 10) Metabolic pathways (12, 13) Information flow and genetics (15, 16, 17, 18, 19)
Apply basic microbiology knowledge and tools to problem-solving in the context of the One Health initiatives	Evolution (3) Microbial systems (23) Impact of microorganisms (24, 27)
Analyze sources for currency, relevance, authority, accuracy, and purpose	Scientific thinking (30b)
Synthesize information found in sources to educate and challenge the audience of the final project	Scientific thinking (30b)
Judge, evaluate, and select best solutions to the microbiological problem based on evidence from peer-reviewed sources	Scientific thinking (31a)
Communicate findings in an effective manner through written and oral communication through a variety of formats	Scientific thinking (30a)

^aFrom the list of concepts, competencies, and skill areas of the *ASM Recommended Curriculum Guidelines for Undergraduate Microbiology* (6) (numbers in parentheses are the item numbers from the ASM list).

successfully developed include Middle Eastern respiratory syndrome, antibiotic usage in agriculture, Rift Valley fever, Lyme disease, coral bleaching, and others.

Initially, this assignment was intended to allow for a variety

of different types of projects, such as movies, not just papers. However, the students chose the paper format because of lack of rubric clarity for other types of projects, but with a modification, this assignment could allow for different project types.

TABLE 2
Single-point rubric for assessment of One Health assignment

Criterion	Points possible
Microbiological in scope Any microorganism found in any domain is allowed as a topic of the project. This also includes viruses. Topics of direct microbiological importance, such as antibiotic resistance, are also allowed.	5
Natural history of the microbe or history of the problem The student clearly and completely explains what is known about this microbe (or problem), what kind of microbe it is, where is it normally found, etc.	10
One Health The project must explicitly address all of the ways that the topic relates to the initiatives of One Health.	15
Problem The problem is explained from several perspectives, not just the biological perspective.	15
Solutions Proposed solutions are discussed, with critiques and advantages.	15
Mechanics of the project The student exhibits excellent command of standard English that skillfully communicates meaning to the audience with clarity and fluency and is virtually error-free.	15
Ethical and appropriate use of sources There must be a minimum of 10 peer-reviewed, relevant references. These sources must be from legitimate science journals and must have an impact factor. The final reference list should not be annotated. Correctly implement all four of the following strategies: 1. Select critical sources. 2. Adhere to the citation and reference style indicated by the instructor. 3. Paraphrase or summarize in ways that are true to the original context. 4. Distinguish between common knowledge and ideas requiring attribution; practice ethical and legal restrictions on the use of published, confidential, and/or proprietary information.	15
Presentation The student clearly communicates the main concept of the project in a 10- to 15-min oral presentation, using visual aids that are helpful and engaging for the audience; the student is prepared to answer questions.	10
Total	100

CONCLUSION

The concepts in the One Health initiative are imperative for all citizens to understand, but they are especially important for microbiology students as future health care providers, veterinarians, teachers, researchers, and voting citizens. This assignment allows them to think critically and delve deeper into crises that our world is facing.

SUPPLEMENTAL MATERIAL

Supplemental material is available online only.

SUPPLEMENTAL FILE 1, PDF file, 0.1 MB.

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