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Promoting civic engagement with neglected tropical disease education

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Abstract. Neglected tropical diseases (NTDs) affect over one billion people globally creating a public health burden that has far reaching implications for the fields of economics, politics, sociology, and science. Educating students and the public about relevant risks, implications, and treatments is a key component of reducing the public health burden associated with NTDs. Furthermore, teaching and learning about NTDs provides myriad opportunities to incorporate interdisciplinary teaching, active learning, and civic engagement into a broad range of courses throughout grade school, high school, college. However, despite the importance of NTD-focused education, few educational programs sufficiently emphasize this topic. Presented here is an overview of NTDs, a brief rationale for broadening inclusion of NTDs in a variety of educational settings, and a series of suggestions for promoting civic engagement with NTD education.

Keywords: Neglected tropical diseases; Educational Biology; Microbiology; Parasitology.

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Introduction

Neglected tropical diseases (NTDs) are a diverse category of otherwise unrelated infectious diseases that are referred to collectively because they mainly affect low-income populations residing in tropical and subtropical regions. NTDs are often chronic and debilitating, and currently affect over one billion people worldwide (WHO, 2013). The 17 NTDs officially recognized by the World Health Organization represent a highly diverse group of bacterial, protozoan, and helminth infections, transmitted via insects, contaminated food, water, and soil, and/or through human-to-human contact. These diseases include Chagas disease, dengue, foodborn trematodiases, leishmaniasis, leprosy, lymphatic filariasis, schistosomiasis, soil transmitted helminthiases, and trachoma (WHO, 2013). In addition to causing over 200,000 deaths per year and collectively burdening 149 countries with billions of dollars in treatment and prevention costs, approximately 50 million years of healthy life and billions of dollars of productivity are lost to NTDs each year (CDC, 2011; Norris et al., 2012; WHO, 2013). Therefore, the socioeconomic impact of NTDs far exceeds that of any other infectious disease other than HIV/AIDS, and is likely to have long-lasting socioeconomic effects on many

nations, particularly those in the developing world (Norris et al., 2012). Due to increasing social, financial, and technological connectedness, the burden and threat of NTDs have become global issues that are no longer confined to nations where these diseases are endemic.

Reducing the significant public health burden that NTDs impose is a capacious problem that will require the concerted efforts of community activists, health care workers, scientists, politicians, and economists to solve (MacFarlane et al., 2008). Due to the lack of affordable or effective curative therapies and preventive vaccines, the most effective approach for reducing the disease burden of NTDs is often prevention. Education is integral to NTD prevention and treatment efforts, and offers a platform to bridge connections between important public health issues and the lives of those directly and also indirectly affected by them. Because of this, NTDs present a unique educational opportunity to promote civic engagement through the identification of issues of public concern and application of knowledge and actions that promote the wellbeing of communities.

Promoting civic engagement by teaching about NTDs

Several types of freely available open educational resources (OERs) and other educational tools are currently available to facilitate teaching about NTDs (Bonney, 2015). These include case studies, data sets, and informative websites produced by organizations including the CDC, WHO, and National Center for Case Study Teaching in Science (Bonney, 2015). The case study teaching method in particular has been widely reported to increase knowledge retention, analytical reasoning skills, and student engagement (Herreid et al 2011; Yalçınkaya et al., 2012; Bonney, 2015). Teaching about infectious diseases specifically has been reported to promote civic engagement through citizen science and interdisciplinary classroom activities that focus on social and ethical issues related to science, which are sometimes referred to as "socioscientific issues" (Senchina, 2016).

Despite the broad implications of NTDs and the collection of resources that are currently available, many classrooms do not devote the amount of attention to NTDs that is arguably warranted by their outsized impact (Bonney, 2013). To address the possibility that this may be due, at least in part, to lack of awareness among educators of how lessons that focus on NTDs can be helpful for fulfilling learning objectives in a variety of courses, Table 1 provides a number of tips for integrating NTD-themed lessons into the curriculum. The suggestions in Table 1 are grouped by discipline to demonstrate the breadth of applications for NTD-themed lessons. Each activity is applicable to both discipline-specific courses as well as courses in any discipline that incorporate interdisciplinary learning. For example, the activities suggested under the topic of economics could be used in an economics course to illustrate real-world applications of fundamental economic to principles, or in a biology course to emphasize connections between biological concepts and interdisciplinary implications. Interdisciplinary learning is the focus of Table 1 because it can help promote civic engagement by helping students identify, analyze, and evaluate relationships between scientific concepts and the daily lives of individuals and society (Lattuca, 2004). Lessons focused on NTDs could be especially useful for promoting collaboration among educators from different disciplines, such as through the development of linked courses or learning communities, in which a group of students completes two courses taught by different instructors simultaneously, and each course integrates content and concepts that demonstrate a clear connection between the two courses. For example, a microbiology course could be paired with a mathematics course using analysis of epidemiological data about NTDs to connect the two disciplines. Due to the far-reaching effects of NTDs, this type of connection could also involve forming interdisciplinary links between a life science course and a course

in the field of business, history, pharmacology, politics, public health, or sociology. In the biological sciences alone, NTDs present a diverse array of educational opportunities spanning many subfields including biostatistics, epidemiology, medicine, microbiology, and parasitology.

The suggestions in Table 1 are intended for courses at the undergraduate level, such as introductory biology for non-majors; however, these activities can be adapted to suit a range of courses from middle school all the way to the graduate level. Although Table 1 describes only a small number of the many ways NTDs can be integrated into in-class and out-of-class activities to address particular learning objectives, these suggestions can serve as a foundation from which educators can develop NTD-theme lesson plans.

Table 1. Interdisciplinary teaching applications of neglected tropical disease education.

Discipline	Sample Learning Objective	Sample Classroom Activity	Sample Out-of-Class Activity
Bioethics	Identify the ethical issues involved in allocating scarce health care resources.	Group debate about ethical issues associated with funding of NTD programs.	Volunteer for an international aid organization that focuses on NTDs.
Biology	Demonstrate mastery of the scientific method.	Complete a case study written about NTDs.	Write a mock grant proposal to fund a research project about NTDs
Economics	Apply economic theory and the statistical tools of economics to specific problems or questions.	Analyze economic data detailing the efforts of from organizations that work to treat and prevent NTDs.	Propose a development plan for an NGO that targets a specific NTD-related issue.
History	Demonstrate knowledge of important periods, events, and ideas in different cultures.	Construct a timeline identifying the main NTD outbreaks and interventions in a particular region.	Compile an annotated bibliography of first-hand accounts of individuals affected by of NTDs.
Mathematics	Given a set of data, create an appropriate graph or chart.	Synthesize an appropriate graph to display real-world data related to NTD epidemiology.	Access publicly available databases for statistics related to NTD epidemiology.
Political science	Describe political and governmental structure of a non-western country.	Engage in a mock United Nations session that addresses NTD issues in various countries.	Attend a meeting of a political or cultural organization focused on peoples affected by NTDs.
Writing	Justify argument using evidence from appropriate sources.	Use evidence to support a position/argument essay related to NTDs.	Write a letter to a politician or organization describing why they should do more to address NTDs.

Conclusion

NTDs exert a tremendous public health burden throughout much of the world, and are of increasing concern to non-endemic regions due to globalization and immigration, yet this diverse group of diseases is often underrepresented in the educational system. Benefits of broadening the inclusion of NTD-themed lessons into both science and non-science courses include the significant potential for promoting of civic engagement and active learning, and forming of a variety of interdisciplinary connections that may benefit both students and educators. The suggestions provided herein can serve as a useful framework for integrating NTD content into a variety of different courses, including biological sciences, economics, mathematics, politics, and sociology.

Conflict of interest statement

Author declare that they have no conflict of interests.

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