

Making it All Fun and Games in the Biomedical Sciences

Over the course of my training in medical science, I have learned two things with great certainty: science is fascinating, but classes are *boring*. The trouble with classes in the biomedical sciences is that they rely heavily on lectures, textbooks, and other forms of passive learning to deliver information. Paradoxically, we use uninteresting methods to teach exciting subjects, and so fail to intellectually engage students. The challenge for science educators of the future is to find formats that encourage students to actively participate. Could we design an interactive medium that educates, engages, and even entertains its participants? An ambitious idea indeed, but in fact, this format already exists and is known to us under a familiar name: video games.

Video games are extremely popular as a form of entertainment and have become a massive industry. Over 2 billion individuals worldwide play electronic games in some form, generating nearly \$138 billion in revenue¹. Video games are particularly popular among young adults², which coincidentally, is the key demographic that take classes in the biomedical sciences. So, video games' popularity and capacity for entertainment are undeniable, but how can we leverage them as an educational tool?

To better understand the educational potential of video games, we should take a look at the historical strategy genre. Game series such as *Civilization* and *Age of Empires* weave together elements of historical civics, diplomacy, and warfare into their gameplay. Through the game mechanics, players learn about ancient civilizations in surprising detail. In *Age of Empires* for example, players learn that the Phoenicians had powerful warships, which is both part of the game's strategy and a historical fact about that civilization. These games are tremendously successful and have even been incorporated into college history courses³, proving that an entertainment medium can be successful in delivering scholastic information.

The strength of games lies in their ability to motivate players to learn about the game's subject in order to win. Games feed our impulse to overcome challenges and solve problems, which has a gratifying and even addictive quality. In a word, games are *fun*. This motivates players to succeed and improve, which means they must learn more about the underlying rules of the game, be it history or say, biology. Consider *Age of Empires* again; most young adults would have little reason to ever think about the ancient Phoenician navy, but in the context of the game, this information becomes essential.

So, what might video games for biomedical sciences look like? There are some precedents already, such as the online puzzle game developed by researchers at the University of Washington called *Foldit*⁴. Here, players are tasked with finding optimal 3D-conformations of proteins, thus learning how protein structure is determined by their constituent amino acids. In addition, consider the popular strategy game *Plague Inc.*, where players assume the role of a highly infectious bacterium, virus, or other pathogen in an effort to spread across the globe and cause a cataclysmic pandemic. In the process, players learn about microbiology, infectious disease, and population health. *Plague Inc.* became so popular that the Centers for Disease Control became interested in it as a platform for education and public outreach⁵.

In principle, games could be designed for any subject in the biomedical sciences. For example, immunology could be taught through a strategy game format, where players

coordinate different types of immune cells to fight off pathogens. Cancer biology could be simulated in the style of *Plague Inc.*, where players control a tumor cell that mutates and acquires the various hallmarks of cancer. Biochemistry, neuroscience, physiology etc. could all be taught through games; the only limit is creativity.

Games also have a long-term, career-motivating effect. This is already recognized by the U.S. military, which has had a long-standing presence in the gaming industry and has even developed its own video games⁶. The rationale is simple: people are interested in careers related to hobbies they enjoy. The National Institutes of Health would be wise to take a page from this playbook and promote game development for the biomedical sciences. After all, there is no better way to reach a wide demographic than by using entertainment mass media. Considering how the film industry introduced many young minds to archaeology with *Indiana Jones* or to paleontology with *Jurassic Park*, video games just might be able to inspire tomorrow's molecular biologists and biochemists.

Of course, electronic games won't be replacing traditional teaching methods any time soon. Instead, they should be used synergistically and in parallel to classwork and reading, engaging students in the subject matter and motivating them to learn. In this way, science-based video games just might be the impetus that drives interest in biomedical sciences in the next generation.

¹Warzman P. (2018) Global Games Market Report (Light Version). Newzoo.

² Morris C. (2018) The Demographics of Video Gaming. *Earnest*. Accessed from: <https://www.earnest.com/blog/the-demographics-of-video-gaming/>

³ Kuran M et al. (2018) History-Themed Games in History Education: Experiences on a Blended World History Course. *arXiv.1805.00463 [cs.CY]*.

⁴ Kleffner R. et al. (2017) Foldit Standalone: a video game-derived protein structure manipulation interface using Rosetta. *Bioinformatics*. 33(17) 2765-2767.

⁵ Khan A. (2013) *Plague Inc.* *Public Health Matters Blog*. Centers for Disease Control.

⁶ McMahon J. (2018) The US military is using video games and esports to recruit – it's downright immoral. *The Independent*. Accessed from: <https://www.independent.co.uk/voices/army-military-video-game-fortnite-battlegrounds-call-duty-esports-defence-a8648656.html>