FOCUS ON MICROBIOLOGY EDUCATION

NEWSMAGAZINE

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AMERICAN SOCIETY FOR MICROBIOLOGY

FEATURES

From the Editor

Teaching microbiology outside the box! What fun is that? Click and see. The fall issue of *Focus on Microbiology Education* is full of ideas for you to try. Larry Aaronson starts us off with the appropriately titled "Novel Approach" using popular fiction to teach undergraduate microbiology. Check out Gary Kaiser's creative projects, look at all the pictures, and consider turning your students loose to do the same. His projects range from creating three-dimensional models, even mobiles, to edible versions of microbes on the one hand, and creating puns, poems, songs, and haiku on the other.

Carl Winter sang some of his songs at the American Society for Microbiology Conference for Undergraduate Educators at Endicott College in 2008. His article, "Singing the Songs of Science," invites us to incorporate music into our curricula. Amy Miller sends us out to help our students learn by creating crossword puzzles. Kim Finer has her allied health students create public health brochures about different microbial diseases. Students show their brochures to one another at a health fair late in the semester. Finally, I give you a microbial rap to help students learn some of the many bacteria with which we might want them to be familiar.

The Journal and Web Watch columns return with the fall issue. We're in good company: other journals have published articles with creative ways to teach microbiology. Check out the Web Watch sites for some interesting information on molecular genetics, smallpox, even movies, and molecules.

Above all, have fun. Enjoy the issue.

Lucy W. Kluckhohn Jones
Editor—*Focus on Microbiology Education*

Any comments, questions or suggestions for the *Focus on Microbiology Education* newsmagazine? Please e-mail us at:

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FEATURES

The "Novel Approach": Popular Fiction as a Teaching Tool in Undergraduate Microbiology Courses

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Science fiction has been introduced into the classroom in a variety of ways as a means to engage students in learning complex scientific concepts. Episodes of *Star Trek: The Next Generation* have been used to promote learning in physics courses on topics from robotics to worm holes (4). Sci-fi cinema, with films such as *The Core* and *Red Planet*, has also been employed in the science classroom to support critical analysis in the geosciences (1). Michael Crichton's recent novel about an environmental catastrophe, *State of Fear*, was used as a classroom case study (5). Even a simple medium like comic strips, including *The Far Side*, *Frank and Ernest*, and *Peanuts*, has become a learning tool (3).

Ever since the publication of *Jurassic Park* in 1990, I have incorporated novels with a scientific theme in my courses. When I taught molecular biology, I used *Jurassic Park* as the focal point of a research paper in which students integrated the arguments of the characters in the book about the ethics of recombinant DNA technology with the writings of scholars in the scientific literature. Since the students were learning to manipulate DNA in the course, the assignment gave them an opportunity to think about the consequences of the technology they were mastering. Their papers indicated that they were learning from reading the novel, and the outcome encouraged me to integrate fiction as a learning tool into all of my courses.

Recently, I have become fascinated with the expansive genre of novels that employ microorganisms as central plot elements, and I have begun to investigate the utility of these books in my undergraduate microbiology courses. I have grouped these "microbe fiction" novels into three categories: the good, the bad, and the ugly. "Good" novels are those in which the organism is accurately described and the biological aspects of the plot are plausible. "Bad" novels poorly describe the organism (or completely fabricate one), or the biology is implausible. Finally, "ugly" novels are those in which the biological scenario is completely fallacious or contrived. These include all stories in which a virus turns a human into a brain-sucking zombie (and there are many such novels out there!). Among my favorite books in the "microbe fiction" genre are Crichton's *The Andromeda Strain*, Richard Preston's *The Cobra Event*, John S. Marr's *The Eleventh Plague*, and Robin Cook's *Vector*. My book list has more than 65 titles at this date, and the top 20 examples of what I consider "good" novels for learning are found in Table 1.

The keys to using fiction as a learning tool are (i) connecting the reading to a major writing assignment and (ii) placing a significant value on the assignment to underscore its significance in the course. As described above, I have students integrate elements of the novel into research papers. Students in my immunology course read *Chromosome 6* by Cook and *The Organ Grinders* by Bill Fitzhugh, both of which deal with the use of genetically modified primates

TABLE 1. Selected titles of "microbe fiction" useful in undergraduate microbiology courses

Title	Author	Year Published	Organism(s)	Synopsis
Darwin's Radio	Bear, Greg	2000	Virus: scattered endogenous retrovirus	The activation of endogenous retroviruses triggers dramatic changes in human evolution.
The Plague Tales	Benson, Ann	1998	Bacteria: hypervirulent strain of *Yersinia pestis*	Parallel stories of plague outbreaks in 14th century Europe and near-future London are spotlighted; *Yersinia pestis* acquires virulence factors through conjugation with *Escherichia coli*.
The First Horseman	Case, John	1998	Virus: 1918 Spanish flu influenza virus	A religious cult isolates H1N1 Spanish flu virus from remains of victims in the Arctic Circle for use as a bioweapon.
Clinical Trial	Christoffersson, April	2001	Virus: hantavirus	Native Americans die from a hantavirus outbreak on an Indian reservation. An experimental vaccine is tested to curb the outbreak.
Buffalo Medicine	Christoffersson, April	2004	Bacteria: *Brucella abortus*	A Montana veterinarian's attempt to develop a spray vaccine for brucellosis is met with violent resistance by cattlemen. Meanwhile, a scientist at Rocky Mountain Laboratories creates a hypervirulent mutant strain of *B. abortus* that is deadly to humans.
Death Rounds	Clement, Peter	1999	Bacteria: *Legionella pneumophila, Staphylococcus aureus*	Antibiotic-resistant bacteria are intentionally released in a Buffalo, NY hospital by a demented, disgruntled medical technologist. Bacteria were spread to unknowing hospital workers by contaminated nasal swabs and surgical masks.
Outbreak	Cook, Robin	1988	Virus: Ebola virus	Outbreaks of Ebola virus infections occur in clinics and hospitals. A CDC investigator tracks the outbreaks to an Atlanta virology lab that acquired virus samples from the CDC.
Contagion	Cook, Robin	1996	Bacteria: *Yersinia pestis, Francisella tularensis, Neisseria meningitidis, Rickettsia rickettsii*	A variety of pathogens are intentionally released in a hospital setting. A pathologist investigates to locate the source of the outbreaks.
Toxin	Cook, Robin	1998	Bacteria: *E.coli* O157:H7	A doctor tracks down the source of a hypervirulent strain of *E. coli* through meat processing industry after his daughter dies from a contaminated hamburger.
Vector	Cook, Robin	1999	Bacteria: *Bacillus anthracis, Clostridium botulinum*	A former Soviet bioweapons scientist teams up with a domestic skinhead group to release anthrax and botox in New York City. The history of the former Soviet bioweapons program is described.
The Andromeda Strain	Crichton, Michael	1969	Virus: virus-like pathogen	A space satellite lands in the Southwestern United States carrying a virus-like entity that leads to the death of all but two individuals in a secluded town. A special team of scientists investigates the outbreak to find a cause and cure.
Plum Island	DeMille, Nelson	1997	Virus: Ebola; Bacteria: *Bacillus anthracis*	Two microbiologists working on Plum Island are murdered, and pathogens are missing from their lab. A retired New York City detective investigates the murders, taking him to the animal disease research facility.
Plague Maker	Downs, Tim	2007	Bacteria: *Yersinia pestis*	A World War II era Japanese bioweapons expert plots to release plague-infected fleas in New York City with the help of Syrian terrorists. The history of Japanese wartime experimentation with biological weapons is recounted.
The Last Leaf	Hughes, Walter T.	2003	Bacteria: *Bacillus tobaccoensis,* a gram-positive spore former that destroys tobacco plants	Members of the U.S. bioweapons team at Ft. Detrick isolate and weaponize a bacterium that kills tobacco plants. The original isolate was recovered from Iraqi bioweapons labs. The bacterium is stealthily delivered and causes complete destruction of the tobacco crop within 3 years. Economic and political upheaval ensues. Eventually, the germ becomes an opportunistic pathogen in highly immunocompromised individuals.
Pandemic	Kalla, Daniel	2005	Virus: influenza A virus	A virulent strain of flu virus emerges in China; Middle Eastern terrorists spread the virus in the West using human carriers.
Resistance	Kalla, Daniel	2006	Bacteria: genetically engineered hypervirulent group A *Streptococcus*	A pharmaceutical company releases an antibiotic-resistant strain of streptococcus to expedite FDA approval of a new antibiotic that has bad side effects in initial tests.

Omega	Lynch, Patrick	1998	Bacteria:multidrug resistant *Streptococcus pneumoniae, Staphylococcus aureus, Clostridium perfringens, Clostridium botulinum, Enterobacter faecalis, Shigella dysenteriae, Salmonella typhi, Vibrio cholerae*	MDR strains of a variety of bacteria break out in the Los Angeles area, creating a public health crisis and troubles for area hospitals. One doctor, whose daughter has come down with MDR-botulism, seeks out the makers of an experimental ribozyme-based antimicrobial agent to save his daughter and relieve the crisis.
The Eleventh Plague	Marr, John S.	1998	Bacteria: *Bacillus anthracis, Clostridium botulinum*; Virus: Rift Valley fever virus, bunyavirus; Fungi: *Aspergillus flavus* (aflatoxin), *Claviceps purpurea* (ergot)	A demented toxicologist hears "the Voice" telling him to recreate the ten plagues of Exodus using biological agents. Public health professionals track unusual disease outbreaks to discover the terrorist's plot.
The Third Pandemic	Ouellette, Pierre	1996	Bacteria: *Chlamydia psittaci, Salmonella enterica* serova Typhimurium*; Treponema pallidum, Streptobacillus* sp.*, Escherichia coli*	Antibiotic resistance in *C. psittaci* is acquired by mutation and lateral gene exchange between various strains of virulent bacteria, creating a global pandemic.
The Cobra Event	Preston, Richard	1997	Virus: recombinant viral bioweapon containing parts of rhinovirus, variola virus, and nuclear polyhedrosis virus	A virologist constructs and releases a recombinant viral bioweapon in New York City. The author describes the history of international bioweapons development and testing.

as sources of organs for transplantation in humans. Students use these stories as launch points to research the ethics and efficacy of xenotransplantation and tie details from the novels into their research papers. In my microbiology course, students read *Vector*, which describes the production and release of *Bacillus anthracis* spores and botulinum toxin by domestic terrorists. The students also research the biology of a randomly selected microorganism from the list of potential biological agents and write about the potential use of that organism as a bioweapon within the context of the novel.

Very recently, I have had students in my courses write blogs while they read the novels. This not only enabled me to assess what they were learning as they read the books but also gave me insight into how they were learning as they read. Using a rubric based on the levels of learning according to Bloom's taxonomy (2), preliminary results indicate that biology majors in my advanced courses demonstrate higher levels of learning while reading novels than do nursing students in my allied health microbiology course. The reasons for this difference are not clear, but the novels do facilitate learning as part of a larger integrative learning strategy.

I am often asked if students resist the requirement to read up to 350 pages of fiction during a busy semester. The answer is emphatically, "No!" Because the assignment associated with the reading may account for 15 to 20% of the final course grade, students view the effort of reading the novel as having significant value. But more importantly, students report that they actually enjoy reading the novels—and many of them never read for recreation. Students who enroll in my courses now ask in advance which novel they will be reading the next semester, so they might get a head start. Some have even come to me with suggestions of possible titles. Last year, a small group of students found such pleasure in reading this kind of fiction that they created the "Biology Book Club" and held monthly meetings to discuss their current literary selection.

In my experience, the "novel approach" has been a successful teaching and learning tool in undergraduate biology courses at any level. The stories may be viewed as case studies, applied learning, or simply a nonthreatening means to engage students and introduce complex concepts, but no matter how one looks at it, it is fun and enriching for the student. And as my bookshelf fills up with more titles in "microbe fiction," I look forward to new opportunities to engage my students in learning about microorganisms.

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