

Using science fiction to teach science facts

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The contributors to this discussion teach in three different Faculties at the University of East Anglia (UEA) – Science, Arts & Humanities and Medicine & Health Sciences. They have each used science fiction to explore learning outcomes in their distinct teaching practices. The discussion below highlights how contemporary science fiction can operate as a touchstone for debate that informs biochemistry teaching. Laura, Helen and Richard have all studied basic sciences, gaining PhDs in various aspects of biochemistry and molecular biology, and each have taught undergraduates and postgraduates at UEA. Helen and Richard are based in the Faculty of Science. Laura is based in the Faculty of Medicine & Health Sciences, and uses her interest in science communication to explore university teaching practices that involve science fiction. Christine gained a PhD from her research of technology and performance in science fiction film and is based in the Faculty of Arts & Humanities.

Laura Bowater (LB): Christine, as an experienced lecturer in the humanities, what do you consider that science fiction offers to someone studying biochemistry?

Christine Cornea (CC): Science fiction is often politically charged and its frequent extrapolation of current scientific trends can ignite debate among students about scientific ethics, application and advocacy. The traffic between science fiction and science fact is growing and, with the proliferation of this genre in mainstream film, television and even computer gaming, it seems likely that, for a number of students, an interest in science may have been inspired by science fiction. To me, it makes sense to use science fiction as a tool in the teaching of science and, more specifically, biochemistry, to foster student engagement and reflection.

LB: Can you suggest how this can happen?

CC: Well, I should mention that American universities and schools have been using science fiction in the teaching of science for several decades. For instance, Physics Professor Leroy W. Dubeck was an early proponent of using science fiction as a tool for scientific learning. Since the late 1980s, he has produced several textbooks covering a variety of scientific disciplines, with extensive subsections focusing broadly upon biology and using case studies of films that are appropriate to biochemistry teaching^{1,2}. The use of film is intended to build student interest, and exercises are designed in such a way that the student is encouraged to bring their experience of

actual scientific procedures to bear upon the ways in which these are represented in the films. More recent academic publications have examined and critiqued science fiction films in terms of ‘reel’ versus real science. Molecular and immunology researcher, Mark C. Glassy’s *The Biology of Science Fiction Cinema* uses films like *Outbreak* and *Dark Breed*, as well as television series like *Space: 1999* to illustrate theories and procedures in the areas of microbiology, virology and biochemistry³.

LB: How do you suggest science fiction films are used to engage students to think about scientific issues?

CC: Well, understanding these films simply from a good science/bad science perspective is effective, but somewhat limiting. I suggest that students should be encouraged to engage with the issues and anxieties that are raised in these films with regard to the science, and this could include biochemistry. In addition, students can develop critical viewing abilities that are more usually associated with arts and humanities disciplines.

Richard Bowater (RB): It is clear that it is helpful for biochemistry students to develop these types of intellectual skills. At UEA, in the School of Biological Sciences, in our efforts to widen the types of training offered to students, we recently developed a module, called *Biology in Society*, which includes discussion about science fiction. (Some details about the teaching delivered and learning outcomes of the module are provided in Table 1.) Helen, as you are the co-ordinator of this module, could you outline why we chose to develop it as part of a science-based curriculum?

Key words: film, humanities, science communication, science fiction, teaching

Helen James (HJ): As we introduced our Biology with Science Communication BSc degree, we developed the Biology in Society module as a core year 2 subject. It focuses on the scientific, political and social ethical debates surrounding various biological developments and the way fiction can be used to explore these issues and present various topics to the public. As the module developed, we realized that it provided opportunities for any student with an interest in biology to explore these topics, so we made it available to the majority of students in the Faculty of Science. Although the biological details and principles are key to everything that we teach within the module, the learning outcomes and skills, such as the ability to critically analyse and compose a reasoned argument, are useful for the majority of students enrolled on undergraduate science degrees. The teaching of science fiction is one component of the module, and it has proved to be really useful in exploring ethical issues and routes for communicating science.

LB: So, do you think this teaching provides additional transferable/employability skills that are valuable to biochemistry students?

HJ: Yes. In developing our module, it soon became clear that discussing science fiction allows critical evaluation of the effect of biology, including biochemistry, on society. The module explores how popular contemporary science fiction focuses on topics that are often at the cutting-edge of scientific

research. The reasons for this can be many, ranging from identification of exciting breakthroughs to the discussion of difficult ethical problems, such as using stem cells and cloning, and the emergence of infectious diseases, etc. The discussion topics allow students to develop their ability to research scientific literature and improve their skills of critical thinking and analysis. It also allows development of the skills to make a reasoned argument, and improves their communication and presentation skills.

CC: I should point out that, increasingly, productions of Hollywood science fiction films employ the services of academic researchers as scientific advisors. In looking at this area, reference can be made to David A. Kirby's book, *Lab Coats in Hollywood: Science, Scientists, and Cinema*⁴, which offers a comprehensive account of the various levels of effect this involvement has upon the representation of science and scientists in recent films.

LB: I can imagine that some students and faculty members will question whether this type of teaching has a place in a basic sciences degree. How has this module been received?

HJ: It has been a popular choice for students on the degree programmes that have the option to take it. The students have really appreciated the opportunities that this module offers and have rated it highly in evaluations. For example, students have commented that "this is a good module for anyone who is studying



The panel: (from left) Richard P. Bowater, Christine Cornea, Laura Bowater and Helen James

Biology [...] I believe that the issues examined and questions raised should be given due attention and consideration by anyone who wishes to pursue a career in the field” and “[it is] much needed to put our studies in context within society”. It is also pleasing that students have recognized that this module provides opportunities to develop key transferable skills. This is highlighted in student comments, which included “[we] gained lots of analytical and writing skills” and “[gained] skills in research, presentation, debate and discussion as well as allowing us to use some initiative”. The module is assessed by coursework only, which is a reason why some students take it as they perhaps perceive it as a ‘soft option’. However, they have found it challenging and academically rigorous. Colleagues have generally been supportive of the module and its objectives, although, when it was initially proposed, a few expressed some unease about a possible lack of academic expertise in ethics and science fiction among the teaching staff in the School. Because of these comments, we have involved some staff from other areas of the university to deliver these topics.

LB: Christine, how do you incorporate science fiction into your teaching and what do you aim to

impart to your students? (Some details about the teaching delivered and learning outcomes of a relevant module are provided in Table 1.)

CC: I have noticed how some scientists have used the popularity of the science fiction genre to advance awareness and support of their research and teaching. But this traffic between arts/humanities and the sciences goes both ways. For example, in my School, I teach science fiction at both undergraduate and postgraduate levels based upon the assumption that the genre can be used to explore the relationship between science and culture. My modules look at the historical development of the science fiction genre, with an emphasis on situating films/television programmes within an historical, scientific and socio-cultural context. In doing this, I aim to encourage my students to look at the relationship between science and science fiction. Hopefully, this can inspire them to take an interest in scientific issues and persuade them to participate in the controversial science debates of today.

RB: This is certainly relevant to the way that we use science fiction within our science module. Since these types of stories strive to be of interest to a wide audience, discussion of this topic in a science-based



For many people, television series provide the initial contact with visual representation of science fiction. In the UK, the BBC has transmitted a wide variety of stories. Many early series reflected the interest in space and time travel, although the content has also examined the impact of scientific developments on Earth. Image from *Blake's 7* (1978–1981); from left: Tarrant (Steven Pacey), Daya (Josette Simon), Vila (Michael Keating), Cally (Jan Chappell) and Avon (Paul Darrow). © BBC

Table 1. Comparison of use of teaching of science fiction in science- and humanities-based modules at UEA

	Science-based module	Humanities-based module
Title	Biology in Society	Science Fiction: Film and Television
Level and credits (hours of study)	Year 2 of BSc degree, 20 credits (~200 hours of student learning)	Postgraduate, MA degree, 20 credits (~200 hours of student learning)
Aims	<p>To provide opportunities to discuss various aspects of the roles and application of biology in society</p> <p>To use critical evaluation of science fiction in different media to illustrate ethical issues in biological studies</p>	<p>To develop an advanced critical understanding of theories of genre as they apply to science fiction film and television</p> <p>To explore the significance of the science fiction genre in film and television in terms of its thematic concerns and innovative formal structures</p> <p>To examine key moments in the history of science fiction film and science fiction television within an industrial and wider social, political and cultural context</p>
Learning outcomes	<p>Upon successful completion of this module students will be able to:</p> <ol style="list-style-type: none"> 1. Compose a reasoned argument (both in writing and orally) 2. Complete in-depth literature reviews within specified scientific areas 3. Discuss ethical issues associated with rapid and exciting developments in contemporary scientific research (bioethics) 4. Describe how technological and scientific advances are changing our perception of what can be defined as science fiction 5. Discuss the degree to which the media can influence public perception of what is fact and what is fiction 6. Illustrate that the sciences and the arts are disciplines that overlap significantly 	<p>Upon successful completion of this module students will be able to:</p> <ol style="list-style-type: none"> 1. Display a sophisticated and critical understanding of theories of genre and their application to the specificities of science fiction cinema and television 2. Analyse the formal structures and thematic concerns of science fiction in film and television 3. Demonstrate advanced research and communication skills (both in writing and orally) in presenting arguments about science fiction cinema and television
Assessments	<ol style="list-style-type: none"> 1. Critical evaluation of bioethics case study (45% weighting) 2. In-depth critical review of how a specific area of biology is portrayed in science fiction stories (45% weighting) 3. Participation including involvement in class and online discussions and a presentation (10% weighting) 	<ol style="list-style-type: none"> 1. 1000 word essay proposal – to include annotated research/reading list (20% weighting) 2. 4000 word final essay (80% weighting)
Delivery and overview of topics	<p>Lectures and workshops to discuss case studies</p> <p>Ethical discussions to be from: Genetic screening and pre-implantation diagnosis; Stem cells/cloning; Transplantation/xenotransplantation; GM crops; Assisted fertility; Animal rights; Environmental issues; Science fact or science fiction (TV, films, literature, art)</p> <p>In relation to science fiction, students must conduct independent research, including viewing or reading of works that are relevant to the theme of their review</p>	<p>Lectures, seminar classes, and a series of set film/television screenings. Introductory talks/lectures outline each week's main theme. A variety of learning and teaching strategies are used in seminar classes, including organized discussion/debate, student presentations, workshops.</p> <p>Students are required to view the set film(s) and/or television programs and to complete 'key reading' assigned in conjunction with each week's topic, prior to each seminar</p> <p>Students are also required to give a short presentation to the class</p>

module allows evaluation of the difficulties that scientists can have in communicating to non-scientists. It provides good and clear examples of the types of language that allows correct discussion of the science while making the messages accessible to non-scientists. We go on to evaluate discussion that stems from C.P. Snow's proposal that the arts and sciences differentiate into "two cultures"⁵. This discussion allows us to highlight how scientists must try to bridge such gaps in order that their research is seen to be relevant to and have impact on society as a whole.

LB: Christine, from your humanities perspective, what are your thoughts about divisions between academic disciplines that exists in higher education today?

CC: The structure of university education and research suggests that academic study is rationally separated into discrete and specialized disciplines. However, this contemporary institutional arrangement hides a developmental history in academia in which important fields of study have frequently emerged in the convergence of previously distinct disciplines.

RB: Which, I guess, is how many of the contemporary scientific disciplines emerged from traditional areas of the natural sciences?

CC: Yes, and biochemistry is, of course, a clear example of just such a discipline. According to Joseph S. Fruton⁶, it can be traced back through a sporadic set of disciplinary intersections in the 19th Century and through to a growing confidence in the 20th Century in the 'power of chemistry to illuminate (...) biological problems'. While biochemists may have fought to establish themselves as a distinct academic discipline, it could also be argued that its inherently interdisciplinary foundations mean it is now well placed to explore further disciplinary intersections, even reaching across the traditional science/arts and humanities divide.

LB: Do you see opportunities for increased collaboration between arts and humanities disciplines and scientists when teaching interdisciplinary subjects such as science fiction?

CC: On one hand, current higher education reforms have brought about the shoring up of boundaries between traditional disciplines in many UK universities. On the other, our universities are also adopting a market-led culture that reaches out to potential 'customers', that needs to attract, satisfy and retain students (particularly in STEM [science, technology, engineering and mathematics] subjects), and a funding system that increasingly places emphasis upon the impact and wider communication of its research and teaching agenda. Although I am not an advocate of the corporatization of university education, opportunities for interdisciplinary education continue

to exist within this framework, not least as evidenced in a renewed interest in using science fiction in the teaching of science.

LB: Can you explain what the term 'interdisciplinary education' means to you?

CC: This is described well by Moti Nassani, who states that academy interdisciplinarity relates to the four areas of 'knowledge, research, education and theory'⁷. So far, our discussion has focused primarily upon education, but I also believe that fruitful exchange between disciplines can lead to exciting developments in knowledge, research and theory. I come from a background in the arts and humanities and have an established research interest in science fiction. So, a basic fascination with science has led me to look at the ways in which it is represented in fictional texts and films, as well as the intersections between actual science and the science fiction genre.

LB: Richard and Helen, Christine has described how her fascination with science led to her interest in science fiction, how did you develop an interest in this topic?

RB: As a child of the 1960s, science fiction programmes on TV were a major driving force behind my interest in science. Whether it was through the 'SuperMarionation' puppets of the series produced by the Andersons, or series that travelled to other worlds, such as *Land of the Giants* and *Doctor Who*, there were always some fascinating scientific theories that were being promoted or challenged. For most of my childhood, it was space travel and the laws of nature that drove the science fiction, and it is only recently that I have begun to appreciate the importance of the genre to biology.

HJ: Like Richard, I grew up watching science fiction programmes on TV with the likes of *Doctor Who* and *Blake's 7*, re-runs of *Star Trek* and various Irwin Allen series dominating my viewing. My interest has continued, with recent favourites such as *Survivors* and *Fringe*. While I really enjoy watching science fiction, I have also found it to be thought-provoking and an unusual means to start discussions on a number of important issues that are relevant to science.

LB: Finally, do you see any other potential useful outputs for using science fiction in academic life, for example in public engagement or outreach activities?

CC: Well, academic institutions are increasingly encouraging scientists to seek out entertainment media as an aid to promote their research or simply to build a higher public profile. For example, Professor Ian Lipkin's association, as Chief Science Advisor, with the recent science fiction film *Contagion* led to press releases in which he was able to outline the crucial nature of his research. Lipkin insisted that, although *Contagion* was a work of fiction, in his view it was based on fact not

fantasy and he went on to justify his involvement by stressing the film's educational aspects for the general public. For Lipkin, this film made the case that scientists and public health professionals who put themselves on the line to fight infectious diseases are heroes. He hoped it would inspire young people to pursue these careers. Reviews of the film in the UK press made connections with academic research being carried out at Warwick and Liverpool Universities. This example makes it clear that contemporary science fiction continues to operate as a touchstone for press reports and debate on science.

RB: I would definitely agree with that. One of the most important aspects of this type of interdisciplinary teaching is that it develops general skills, which improves the employability of the students that pass through our degrees. I think we all recognize that this is an important issue in the era of increasing student fees, university league tables and challenging times for graduate employment. ■



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