The backlash at first was tremendous with concerns over genetic modification and the development of designer babies but over the coming decades, the practice was adopted worldwide as a miracle in reproductive technology. It may only be a matter of time – and taste – before the same can be said for "shmeat".

The success of "shmeat" may be in doubt but Dr. Post has worked to increase the odds for success. He has tentatively enlisted celebrated chef and "molecular gastronomist" Heston Blumenthal to cook the Maastricht burgers next month. Depending on Blumenthal's ability to turn the lab meat into a gourmet treat, the future of in vitro foods may indeed be bright. Even so, it may still be a while before Gordon Ramsay's cookbook on "shmeat" ends up on a bookshelf in your local bookstore.

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What can Zombies Teach us about Mathematics?

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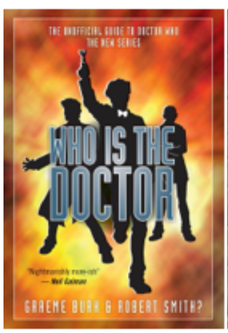

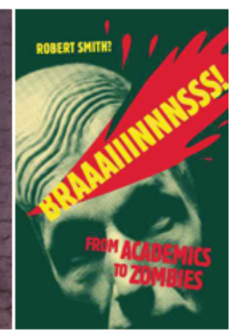

In 2009, I published an article I thought would amuse me and no one else: a mathematical model of zombies. The idea was to examine a hypothetical zombie apocalypse through the lens of disease modeling: that is, using the same types of differential equations I use every day to examine the spread of infections such as HIV, malaria, human papilloma virus and a variety of tropical diseases. What we found was that zombies would overwhelm a mid-sized city like Ottawa in just four days.

Much to my surprise, the media appeared to share my sense of humour. The zombie paper was the #1 story on the BBC, stories about it appeared in the Wall Street Journal, the UK Daily Telegraph, Dutch and Finnish papers, on television (TVO's The Agenda with Steve Paikin) and on radio, such as CBC and NPR. To this day, it remains the #1 pdf on Google. (Simply by typing "pdf" into Google, it comes up as the first pdf that's listed).

What this did was raise enormous awareness for disease modeling as a concept. Many people who had never heard of disease modeling became aware of it through this paper. High school teachers reported that their students became interested in mathematics for the first time as a result of reading the zombie paper. Popular science books on mathematics (The Calculus Diaries: How Math Can Help You Lose Weight, Win At Vegas and Survive a Zombie Apocalypse) were written that showcased both my zombie modeling and also my more serious work on AIDS.

In Winter 2012, I taught a class called "Mathematical Modeling of Zombies", which illustrated a variety of disease-modeling techniques through the angle of a zombie apocalypse. It received significant attention, with CBC coming to class to film the lectures and also interview students for a news segment. The fact that zombie modeling received so much attention, despite involving mathematics -- one of the most impenetrable disciplines and one which engenders fear-based reactions in many people -- is still astonishing to me. But zombies aren't just a piece of frivolity. There are important lessons to be learned that can help us understand just how useful mathematics can be -- and which could potentially save our lives someday.

No, really! When the next pandemic comes, what happens? First we need to understand the biology, then create accurate mathematical models that simulate the mechanics of the spread of disease. Once we have these models in place, we use mathematical analysis to develop a conclusion. The great thing about mathematics is that the conclusion is absolutely robust, based on the premise (ie the model). This gives us a way to see through the darkness that avoids the messiness and uncertainty of the real world. Every step of the process involved in developing a zombie model is conceptually the same step we want to take when the next pandemic comes (as it surely will).

Furthermore, by using pop culture and social media, mathematics can be made accessible to non-mathematicians. Where physics has a popular following -- concepts such as the Higgs Boson, black holes or quarks excite the popular imagination, even among people who may never understand the details -- mathematics struggles to make its concepts similarly appealing beyond a niche audience. Zombies break this trend, allowing people who will never solve an equation to be engaged and excited by mathematical modeling.

Zombies also have inherent properties that lend themselves very nicely to various mathematical techniques. They swarm, they act together without being conscious of it and they move about pseudo-randomly. There are also an enormous number of them! On the flipside, when faced with an outbreak, there are things we need to do that also lend themselves to mathematics: we need to estimate parameters, make decisions based on imperfect information and develop government policy that needs to evolve as the situation changes.

Swarming can be modeling via integro-differential equations, which helps us understand how people (or zombies) cluster together and what the effects of that are on an infectious disease. Pseudo-random movement (of a staggering zombie or an airborne virus) can be described by diffusion, which requires partial differential equations. With so many zombies, each with specific desires (to eat our braaaiiinnnsss), individual-based modeling can step in to numerically simulate the effects of many individuals in an urban environment. Then there are networks, which describe the interactions that people and zombies may have (for example, infection can only spread to those nearby), showing how a disease might spread in a neighbourhood or via international travel.

As for our own response, to estimate parameters we use statistical inference (filling in the gaps when we have some information, but not everything we'd like). We can also use fuzzy decision-making to make logical choices even when information is only "somewhat" true (for example, if we spy three zombies does that mean there's an epidemic underway or not?). There are also techniques to develop an evolvable linear system to simulate government responses to an emergency. Some of these techniques are analytical, some computational and others involve a combination of the two. All of them apply both to the fun thought experiment of a zombie outbreak and to the more serious possibility of a major infection sweeping across the globe.

Thus, what we learn from zombies is how to cope with the unknown. A pandemic might be terrifying, but if we know how many vaccines to stockpile in advance (or very quickly after it begins), then it becomes manageable. Knowing how a disease spreads through a population -- which requires knowing the makeup of that population and how it might change -- is immensely valuable information for knowing when to intervene. Mathematics can help us determine which control efforts might be most useful (and when to apply them) or it might tell us that a particular intervention will be functionally useless, thus saving lives, money and valuable time in an emergency.

So there you have it. Everything you ever needed to know to survive the next outbreak is right at hand. Just wait till the depraved undead arise from their graves and start munching on society's brains, unaware of the power of modelling to predict and thwart their every move. You'll be glad you took all those math classes then.