

BIOETHICS

Imagine that you've signed up to do a bioscience-related degree course (I hope, given the fact that you are reading this book, that this is not too difficult a stretch of the imagination). As you sit in the lecture theatre chatting with your neighbour, a man whose terrible dress sense betrays immediately that he must be an academic, comes into the room and starts talking with gusto about his research into terracotta figurines of the late Bronze Age or perhaps about the importance of authorial subjectivity in sixteenth century poetry. With some justification you might conclude that you've misread your timetable and gone to the wrong lecture theatre.

Now imagine instead that the lecturer had launched into consideration of the rival philosophical viewpoints espoused by Immanuel Kant and John Stuart Mill, would you still feel that you were in the wrong place? My aim within the next few pages is to try to demonstrate that, far from being an irrelevant distraction, having an understanding of ethics and moral philosophy will actually enrich your studies as a bioscientist (although, as we'll see below, I don't believe that contrasting Kant and Mill is the best place to start!)

THE RISE OF ETHICS IN THE BIOSCIENCE CURRICULUM

My conviction that discussion of ethics has an important role to play within science education is shared by a growing number of people. Recent curriculum developments around the world, but particularly within the UK, have emphasised the need to reflect upon the ethical and moral impact of scientific innovations (Willmott and Willis, 2008). For example, the National Curriculum for England and Wales includes as a foundational concept the importance of "*Examining the ethical and moral implications of using and applying science*" for all pupils over the age of eleven (QCA, 2007).

At University level, the subject benchmarking statement for Bioscience published by the Quality Assurance Agency in 2002, and lightly revised in 2007, outlines the expected content of all Bioscience courses in the UK (QAA, 2007). The statement contains recommendations regarding the opportunities for undergraduate bioscientists, in whatever field of study, to develop their ethical thinking. These include:

- an expectation that students will "*be confronted by some of the scientific, moral and ethical questions raised by their study discipline, to consider viewpoints other than their own, and to engage in critical assessment and intellectual argument*" (Section 3.1)
- Bioscience students, the statement continues, should be able to: "*recognise the moral and ethical issues of investigations and appreciate the need for ethical standards and professional codes of conduct*" (Section 3.5), and
- "*undertake field and/or laboratory investigations of living systems in a responsible, safe and ethical manner*" (Section 3.6)
- By the end of their degree, a typical honours graduate emerging from any bioscience programme should "*be able to construct reasoned arguments to support their position on the ethical and social impact of advances in the biosciences*" (Section 5.8)

One reason, therefore, that University courses in Biology and related disciplines are likely to include discussion of ethics is because programme directors have been told to ensure that this is the case! The motivation for developing ethics content in bioscience course is not, however, simply an issue of rule-

keeping. In this regard, it is useful to consider why emphasis on ethics was included in the benchmarking statement in the first place, and how science students who are mindful of these issues may actually become better scientists as a result.

Read All About It!

As moral philosopher Stanley Grenz has observed “*Modern Science has placed in our hands capabilities that have aggravated long-standing ethical problems as well as introducing new quandaries*” (Grenz, 1998). To recognise the importance of bioethics we actually need to look no further than the headlines of our newspapers and television news bulletins. In any given week there are likely to be several stories which starkly illustrate that science does not proceed in a value-free vacuum. Knowing I was due to write this chapter, I kept a careful eye on stories covered during a two-week period (an activity I have conducted periodically for a number of years and observed on each occasion a similar breadth of issues).

In the two weeks in question, the news included: discussion of preimplantation genetic diagnosis (PGD) and ‘designer babies’; concern about an ecological crisis; provision of fertility treatment to post-menopausal women; worries about use of nanotechnology in the food industry; genetically-modified crops; and fraud in scientific publications. Whatever particular flavour of bioscience you are interested in, this brief list likely contains some topic related to your studies (and if not, perhaps one of the other twenty stories I omitted from the list for clarity would have done so). This breadth of coverage is the norm and not in any way exceptional.

I’m Sorry I Haven’t a Clue

Hand in hand with an explosion of ethically-contentious developments in bioscience, there have also been concerns that the public in general are not well equipped to understand, and therefore evaluate the validity of, the stories under consideration. What, for example, is a “designer baby”? What are the technological issues associated with selection of a particular embryo? And what are the ethical consequences of any decisions made?

In recent years there has been lively debate about the need for scientists to engage with the public about the significance of their research and innovations. No-one questions the underlying relevance of the process but there has been some contention regarding whether scientists ought to be *telling* the public about the science (labelled the ‘deficit’ model) or *discussing* it with them (the ‘dialogue’ model) (Wilsdon and Willis, 2004). Whichever is preferable, one example will show why it is especially important that you as a student of bioscience have a good grasp of both the science and ethics of current developments.

Ever since 1973, the European Commission has conducted periodic surveys of public opinion within the various member states. In one of these so called “Eurobarometer” surveys they asked members of the public if they agree with the statement “Ordinary tomatoes do not contain genes while genetically-modified tomatoes do”. 35% of Europeans said that they agreed with the statement, and a further 30% said they did not know. In other words, nearly two-thirds of the people polled were not confident that ordinary tomatoes possessed genetic material.

Faced with this level of ignorance, it is important that bioscience graduates, at the very least, have a good grasp of the issues involved. Added to this, many readers of this book may actually go on to take an active role in scientific research and therefore it is all the more important that they (you?) have given careful consideration to the appropriateness of a line of scientific inquiry.

WHAT EXACTLY IS BIOETHICS?

Although we have started to consider some examples of specific biomedical and ecological developments where ethics plays a prominent role, we have thus far avoided a definition of bioethics as a discipline. It is possible that some readers, particularly those from America where the term “bioethics” is frequently synonymous with “medical ethics”, will be wondering about the breadth of issues that might be included.

In the context of this chapter we will use the term “bioethics” to encompass three distinct (though overlapping) areas; these are biomedical ethics, environmental ethics and research ethics. This broader definition is in keeping with the spirit of its usage by American cell biologist Van Rensselaer Potter who, it is generally acknowledged, was the first to use the word “bioethics” to describe “*a new discipline which combines biological knowledge with a knowledge of human value systems*” (Potter, 1971). Let’s take a closer look at the three dimensions of bioethics.

Biomedical Ethics

Many aspects of healthcare have clear ethical dimensions, though not all of these are equally relevant within bioscience courses. One commentator (Cameron, 2004) has advocated a classification of biomedical ethics issues into three subtypes. Firstly, there is “*Bioethics 1*”; these are issues such as abortion and euthanasia which are still highly relevant, but have been possible, and hence discussed, for many centuries. Secondly, there is “*Bioethics 2*”, which covers issues such as PGD and the use of stem cells. These are relatively new developments that are either already being used clinically, or are deemed likely to be used in the near future. Thirdly, there is “*Bioethics 3*”, which includes potential development in fields such as artificial intelligence and the creation of nanoscale robots that may, for example, be able to circulate within the bloodstream aiding the battle against infection. This kind of development is more speculative and may not have medical relevance for some time to come. One attraction of this three-part division into Bioethics 1, 2 and 3 is the fact that they equate respectively to ‘taking life’, ‘making life’ and ‘faking life’ as a helpful aide memoire.

Environmental Ethics

If biomedical ethics has most direct relevance to students with an interest in molecular biology, environmental ethics may have greater bearing for students within more whole-organism disciplines. Concern about the environment can be expressed with a variety of ethical motivations. At one end of the spectrum, which one author has labelled “light green ethics” (Curry, 2006), interest in ecology arises from its potential impact on mankind, in other words it retains an anthropocentric focus. From this perspective, global warming, sustainability, and concern about loss of habitat are of ethical relevance because they may end up affecting humanity. A recent headline on the BBC news website “*Nature loss ‘to damage economies’*” illustrates this type of thinking (Black, 2010).

At the other end of the scale, “dark green ethics” would be characterised by a more holistic or ecocentric approach in which the integrity of ecosystems and the planet as a whole are of maximum value. For those adopting this model, a clash between human self-interest and wider ecological interests retains the possibility, or even the probability, that correct resolution of the conflict will go against *human* interests.

Between these two extreme positions would be a variety of other frameworks, such as biocentrism, a philosophical view in which respect should be afforded to all species, of which humans are but one and in no way superior to the others (except, I suppose, in their capacity to do harm).

Specific issues falling under the umbrella of environmental ethics might include the cultivation of genetically-modified crops, management of woodland ecosystems, decisions to switch from growth of food crops to production of biofuels, or the introduction of non-native species to control a particular biological menace (frequently, as in the case of Japanese knotweed, another non-native species introduced in an earlier era!).

Research Ethics

The case of disgraced stem cell scientist Hwang Woo-Suk is probably the most notorious recent example where significant failing in the ethical conduct of research has been brought into the glare of public attention. Hwang went from hero to zero in his native South Korea when it transpired that he had fabricated many of his ground-breaking results in therapeutic cloning (the plan to ‘personalise’ cells for treating a patient by removing the nucleus from an embryonic cell and replacing it with the nucleus from one of the recipient’s own cells).

Such obvious, and profound, deviations from acceptable practice may be rare, but there are a whole plethora of other issues which might be considered “research ethics”. As in other walks of life, ethical norms associated with research have generally been assumed rather than spelt out specifically and have tended to come into sharp focus only at times when they have been clearly violated.

Not Telling the Whole Story: along with the outright faking of experiments, there is the possibility that a scientist might make a conscious decision to selectively report only the results that fit with their pre-determined hypothesis and hide data that tells a different story. During the so-called ‘Climategate’ saga prompted by the leaking of previously private e-mails in November 2009, it was claimed that there had been a deliberate attempt to suppress publication of data that contradicted the majority view that human activity has influenced the temperature of the planet (Hickman and Randerson, 2009).

The conduct of scientific research is actually rather more complex than might initially meet the eye. Notice in the previous paragraph that I purposefully emphasised that the decision was *conscious* and *deliberate*. It is part of human nature to assume that results that fit our hypothesis are more likely to be ‘correct’ than those that go against our expectation. We may therefore subtly, and *subconsciously*, place greater emphasis on data that match the hypothesis and downplay results that do not. This kind of *self-deception* whilst not ideal is, I would suggest, a far cry from *knowing* that you have conducted an experiment ten times but only reporting the three cases where the data fitted your model and completely suppressing the existence of the other results. It is for this reason that strict rules on record-keeping and the storage of laboratory notebooks are increasingly being brought into force (Shamoo and Resnik, 2009).

Telling Someone Else’s Story: As a contemporary student, it is likely that you will have received dire warnings about the consequences of plagiarism. There are various definitions of plagiarism, but in essence they all boil down to taking the ideas or writings of somebody else – perhaps a textbook author, another student or someone paid to write an essay on your behalf – and passing it off as though it was your own original work. This over-dependence on someone else’s work may arise deliberately or may occur by mistake (for example as the result of poor note-taking habits) but either way it is seriously frowned upon.

From time to time, academics also get caught out peddling other people’s wares as their own. One recent UK case involved celebrity psychiatrist Raj Persaud who was suspended from practice for three

months after admitting he had plagiarised sections in his 2003 book *From the Edge of the Couch* and other articles (Dyer, 2008). If you keep an eye out when reading scientific journals you will sometimes spot retraction of articles that turned out not to be quite as original as the corresponding authors had implied. One apology that caught my eye was in the journal *Trends in Biochemical Science* (TIBS) which noted that an article they had published a few months earlier “contains large tracts that have been copied from a previously published *Nature Cell Biology* News and Views article” (Wilson, 2002). My curiosity was sufficiently aroused to dig out both the offending article and the source document. The editors of TIBS weren’t kidding when they said “large tracts” had been copied – a side-by-side comparison showed that most of the more recent paper had simply been cut and pasted from the original.

Although wholesale and blatant copying of this kind is unusual, the example given is not, unfortunately, an isolated case. In the same way that many universities are now using computer programmes to scan student work for plagiarism, scientific journals have been trialing a service “CrossCheck” for checking whether submitted articles contain material previously published elsewhere. During the trial it is reported that one journal found 23% of submissions, that they were otherwise prepared to accept, turned out to contain plagiarised text (Butler, 2010).

Telling the Same Story Again: Several cases identified by the new CrossCheck service were not guilty of copying other people’s work, but rather of *self*-plagiarism, that is seeking to repackage material that the author(s) have already published elsewhere. Universities, Government and other research funders carefully scrutinise the number of publications that scientists produced in order to justify giving them money to carry out their research and/or valuable lab space in which to do their experiments. In this context, self-plagiarism is an attempt to boost the number of articles the authors have produced since the last time someone checked up on them. If you are using Web of Knowledge or PubMed (or similar) to try and source articles for an essay or dissertation you will sometimes uncover evidence of this sort of thing – for example, two (or more) articles published by the same three authors (possibly with the order of their names swapped around) with very similar (but slightly different) titles coming out just a few months apart in different journals. Duplicate publication of this kind is not big and it’s not clever, but if someone just wants to know how many papers you’ve produced then it can look like you’ve generated more data than you actually have.

Telling a Different Story: Scientific research is an expensive business. Money to conduct research is usually generated via application to various government bodies or charitable groups in which you explain what you intend to do with their money. The figures involved can be substantial; many university scientists, for example, will have a total budget in excess of a million pounds with which to pay for their research.

In most cases, when a funding body has weighed your application and decided to give you money, there is a not unreasonable expectation that you are going to carry out the experiments that you promised to conduct. It would be fraudulent for you to take their cash and use it either to pay for expensive holidays and luxury items or, less dramatically, to bank-roll an entirely different research programme. Interestingly when Hwang was eventually given a prison sentence (suspended) it was for embezzlement of South Korean government money, since he was deemed not to have done the research for which he received funding (Bae, 2009).

Conduct Unbecoming?: Even before the Hwang Woo-Suk scandal grabbed headlines around the globe, there was sufficient concern about research misconduct for governments, professional bodies

and scientific societies to put in place a variety of rules and safeguards. In the United States, allegations of scientific fraud at a variety of research institutes during the 1980s led to the establishment in 1989 of the Office of Science Integrity and the Office of Scientific Integrity Review, later amalgamated into the current Office of Research Integrity (ORI). Individual learned societies, such as the American Society for Microbiology (1988) and the American Society for Biochemistry and Molecular Biology (1998), adopted codes of ethical conduct to which they expected their members to adhere.

Within the United Kingdom, progress towards codes of conduct has been a little slower. In 2003, the House of Commons Select Committee on Science and Technology urged “*scientific learned societies to consider introducing an overt ethical code of conduct as a prerequisite of membership and back this up with programmes to heighten awareness of the issues involved*” (Parliament, 2003). In so doing, they were adding their weight to the call already made by Nobel laureate Sir John Sulston for a universal code analogous to the ‘Hippocratic Oath’ (or later equivalents) affirmed by medical doctors (Briggs, 2001).

Following a period of consultation, the clamour for a universal code of ethics for science led to the publication in 2007 of the UK Government document “Rigour, Respect and Responsibility” (DIUS, 2007), which emphasised a seven points code for the conduct and communication of scientific research (see Box 1). In truth, the striking thing about each of these items is how ‘obvious’ and ‘sensible’ they are, calling into question whether they add any meaningful depth or guidance to the normal working of scientists.

The opposite perspective, of course, would be to see the need to emphasise such straightforward principles as an indication of the seriousness of the malaise within the practice of science.

Box 1: A Universal Code of Conduct for Scientists

- Act with skill and care in all scientific work. Maintain up to date skills and assist their development in others.
 - Take steps to prevent corrupt practices and professional misconduct. Declare conflicts of interest.
 - Be alert to the ways in which research derives from and affects the work of other people, and respect the rights and reputations of others.
 - Ensure that your work is lawful and justified.
 - Minimise and justify any adverse effect your work may have on people, animals and the natural environment.
 - Seek to discuss the issues that science raises for society. Listen to the aspirations and concerns of others.
 - Do not knowingly mislead, or allow others to be misled, about scientific matters. Present and review scientific evidence, theory or interpretation honestly and accurately.
- (Taken from *Rigour, Respect and Responsibility* (DIUS, 2007))

Adding Stick to the Carrot: The major criticism of the Government’s Code of Conduct has actually been its lack of teeth; there is no obvious mechanism by which breach of any of these key principles would lead to penalty or consequence. In July 2009, Research Councils UK, the umbrella organisation representing the seven government-funded research councils in the United Kingdom, published “Integrity, Clarity and Good Management” (RCUK, 2009) setting out more fully the necessary standards of research conduct, governance and training expected of institutions and individuals.

Although (at time of writing) the details of sanction procedures have yet to be confirmed, the direct link between RCUK and funding should make it harder for scientists to ignore their obligations to ensure that research is conducted in accordance with appropriate ethical standards.

PUTTING THE CASE FOR ETHICS EDUCATION

Assuming that your science course includes a component of bioethics, you may well find that your lecturers elect to approach the main issues via a series of case studies. By way of illustration, consider the following scenario:

Craig and Jennifer Wyatt have been married for eleven years. They would love to have children. Unfortunately, Jennifer had breast cancer when she was 24 and although the chemotherapy has brought total remission from the disease it also caused damage to her ovaries which has left her infertile. The Wyatts have been on the waiting list at their local IVF clinic for several months awaiting donated eggs to try and have a baby. At present, however, there are 200 potential mothers seeking each donated egg and the couple know that realistically they may never receive a donated egg via the normal channels.

Researchers at the hospital attached to the IVF clinic have recently been granted permission to carry out experimental procedures using eggs harvested from aborted fetuses. The technique relies on the fact that female fetuses already contain all of the undeveloped eggs that would ultimately mature during their adult lives. The researchers are looking into ways to artificially ripen these eggs as a way to overcome the shortfall in other available eggs. Her gynaecologist suggests to Jennifer that she may want to volunteer as one of the recipients of the newly-developed eggs. Unsurprisingly, this approach is controversial, but for Jennifer it may represent her only chance to receive a donated egg.

You are a friend of Jennifer and Craig. Take a few moments to think about the range of issues raised by this case. Try to consider the situation from a variety of perspectives, including reasons for and against their involvement in this research.

I've used this case as part of an introductory lecture on bioethics for a number of years; it's fictional, but only marginally so (the statistic about 200 people wanting each donated egg is real, and researchers are genuinely considering the potential to utilise eggs from fetuses (Hutchinson, 2003), but this work has not yet proceeded into any clinical trials).

So what issues did you come up with? Although students frequently impress me by bringing fresh insight, there tend to be a consistent core of observations made each time this case is discussed. A lot of people raise the issue of rights: does the woman who had the abortion, and is biologically the 'grandmother' of any new child, have any say in whether this research is permitted or any right to future contact with the child? Does the foetus itself have any rights? They also question the right of scientists to manipulate nature in this way. For some this development just sounds disgusting – the very

notion of it elicits a “yuk” response. These views all have something in common, which we’ll discuss in a moment, but for now let’s call them Type A.

Other people find themselves wondering about the likelihood that the process will be a success. What happens if the experimental treatment goes wrong and, for example, the new baby survives but is severely handicapped? Although this is a different technology, they may argue, for example, that there were 277 failed attempts before Dolly the Sheep was successfully cloned (Arthur, 2003) and there may be similar difficulties whilst perfecting this new approach. Can Craig and Jennifer sue the clinic, or disown the baby, if they are presented with a malformed infant (even if it was produced using Craig’s sperm)?

Suppose the process is successful and a child is produced – will it be told about the unusual circumstances of its conception? What will be the psychological impact of discovering at a later stage that their biological mother never existed as an independent being, that they had (for whatever reason) been rejected by *their* own mother before birth?

What if the technique is a runaway success and becomes common? Since the whole purpose of this approach was to overcome a shortfall in the availability of eggs, it is reasonable to presume that several children will be produced from the eggs within any one foetus. What, therefore, are the potential genetic consequences of the foetuses’ DNA becoming over-represented in the gene pool? What safeguards would or could there be to stop two people who are biologically derived from the same foetus marrying each other and producing, unbeknownst to them, children who may share a significant number of recessive alleles and have an increased risk of manifesting inherited conditions? If the latter scenario seems far-fetched there is unfortunate precedent in the real example of a brother and sister, twins conceived naturally but both put up for adoption, who were reported in 2008 to have had their marriage annulled after inadvertently ending up together (Yeoman, 2008). Again each of these arguments shares something in common, so let’s call them Type B.

The case involving Craig and Jennifer may seem peculiar, but it actually serves as a very useful launch pad for considering the philosophical aspects of bioethics and ethical decision making. If we take a step back and think in general terms about how we can decide if a certain course of action is right or wrong then there are essentially two places where we can start our deliberations; either we can put emphasis on the underlying principles and duties, the *a priori* framework that we bring to the question, or we can focus on the potential consequences and outcomes of the action. Looking back at the previous two paragraphs, you may have noticed that the “Type A” arguments were grounded on first principles, rights and duties, whereas the “Type B” arguments placed greater significance on the results and effects of the procedure.

Do You Want Moral Philosophy With Your Bioethics?

You can actually add quite a lot to your understanding of the ethical significance of developments in biology and biomedicine simply by knowing that there are these two general criteria, i.e. rights/duties and consequences/outcomes, for evaluating whether a new procedure ought to be permitted. A good student of bioscience, however, ought to be willing to take their consideration of these ethical positions to a rather deeper level.

It would be possible to fill an entire book of this length with discussion of bioethics alone; indeed several excellent and accessible books on the subject already exist (works by Bryant *et al* (2005) and Mepham (2008) are especially recommended). Within the constraints of the present, more broad-

ranging, volume however, it is valuable to at least offer an introduction to some of the major strands of ethical thinking which started to emerge in the case study.

We have seen thus far, that ethical decision-making can place emphasis on duties/first principles or on the anticipated outcomes of an action. You will also recall that we started this chapter by imagining a lecture in which the tutor had launched into reflections on the philosophies of Immanuel Kant and John Stuart Mill. If, having thought about Craig and Jennifer's dilemma, I add that the distinction between what I termed "Type A" and "Type B" responses effectively describes the major differences between the philosophical thinking of these two great minds then I hope you may begin to see why I suggested that some reflection on moral philosophy may have more direct relevance to bioscience than was initially apparent.

Kant, for example, argued that our decisions ought to be governed by an over-riding responsibility which he termed the Categorical Imperative, and which can be phrased as "do your duty". Arguments starting from this position are termed "deontological". On the other hand Mill, one of the founding fathers of utilitarianism, argued that actions were right if their outcome led to a net increase in happiness. Arguments based on outcomes are said to be "teleological" or "consequentialist" and utilitarianism is probably the best known consequentialist philosophy (although others do exist).

Deontology

There are strengths and weaknesses with both pure deontological and consequentialist positions. The emphasis on fundamental rules can make deontological arguments seem very black and white and therefore easy to apply. The reality of life, of course, tends to be a lot messier. Where, for example, do we obtain our rules? Religion is sometimes thought of as the source of rules but it is self-evident that adherents to different religions have different emphases and many people would argue that they personally are not followers of any religion. Do we get rules then from something more innate and universal, conscience say or something within our genetic heritage? Even though we have a shared humanity, our "moral compasses" are not uniformly aligned. Kant, as we have already noted, tried to get around this difficulty by reference to his Categorical Imperative to do your duty, but this just shifts the question to "how do we know what our duty is?"

There are other difficulties with a deontological approach. How, for example, do you decide what to do if two or more general rules appear to be in conflict? Let's imagine it is 1943 and you are pottering about in your Amsterdam home when there's a knock at the door. You go to answer it, and find in the street outside members of the German security police. After a curt greeting, their commanding officer asks you if there are any Jews hiding in the house. What are you to do? You have always been brought up to tell the truth, yet you know full well that there are two families living in your loft. Do you say "yes there are; if you push the wardrobe in the front bedroom to one side you'll find a secret staircase – you can't miss it"? This sounds like an absurd response; you would almost certainly weigh preservation of life above truth-telling in this case. In doing so, however, we are essentially saying that the rule to tell the truth can sometimes be trumped; in which case, can it be considered an ethical norm at all?

Consequentialism

Aware of these kinds of issues when trying to start with rules and duties, Jeremy Bentham, John Stuart Mill and others argued that *outcomes* were more appropriate criteria to judge the appropriateness of an action. Our conduct would be right if it led to the greatest balance of good over evil. This initially sounds appealing, and utilitarian models in particular are employed broadly in, for example, healthcare policy-making.

As with deontological approaches, however, strict application of consequentialist philosophy soon meets problems. In the first instance, does the end justify the means? “*Suppose we could slightly increase the collective happiness of ten men by taking away all happiness from one of them*”, asked philosopher A.C. Ewing, “*would it be right to do so?*” (Ewing, 1953). According to some strict utilitarian models this would be fine. This scenario may not be quite as abstract and theoretical as we’d like to think, with accusations made that political prisoners in China have frequently been killed in order for their organs to be donated to more ‘worthy’, or more wealthy, recipients (Thomasma, 1997).

Secondly, consequentialist models suffer from the inevitable difficulty that the real outcome of an action can never be guaranteed in advance; we may have a *good idea* about what will happen but the *reality* may prove to be quite different. The litany of disasters in which attempts to control biological pests, via the introduction of non-native predator species, have gone devastatingly awry should be warning enough that outcomes can deviate from expectation (e.g. Simberloff and Stiling, 1996). One of the best known examples involves the introduction to Queensland, Australia of the cane toad. Imported from Hawaii during the 1930s in order to suppress the population of beetles living amongst the sugar cane, the toads not only manifest a preference for eating birds’ eggs, rival frogs and insects *other than* the intended beetles, but also proved fatally poisonous to various native predators, including crocodiles (Coady, 2009).

Virtue Ethics

Partially as a result of the difficulties apparent with both deontological and consequentialist approaches, there has been a recent resurgence of interest in a different approach. Virtue Ethics places greater emphasis on individual character and, as such, draws its heritage from both classical Greek thinkers, especially Aristotle, and from a Judaeo-Christian worldview. In some sense, virtue ethics can be seen as an “*ethics of being*” rather than an “*ethics of doing*” (Eriksson *et al*, 2007). When push comes to shove, however, even a virtue ethicist needs to decide how they are going to act under given circumstances and therefore some tool or tools for formulating a response remains important.

Beauchamp and Childress’ Four Principles

One widely used decision-making strategy is termed **Principlism**, or the Four Principles. Originally drawn up by Tom Beauchamp and James Childress in the context of biomedical ethics, their model is now finding use in wider contexts. As the name implies, Beauchamp and Childress (1979, and later editions) argue that a set of four key principles ought to guide any action; **non-maleficence** (as far as is possible avoid doing harm), **beneficence** (as far as is possible do good), **autonomy** (maximise the freedom of the individual(s) affected to make their own decisions) and **justice** (be as fair as possible; treat equal cases equally).

The value of Principlism can to some degree be seen by the enthusiasm with which it has been adopted. Rather than slavishly following either deontological or consequentialist criteria, at its best this approach provides a balance between more rules/duties based principles (autonomy, justice) and more outcomes based principles (non-maleficence, beneficence).

Like any generalised scheme, of course, it is still flawed; critics argue that by shifting the emphasis you place on each of the four principles you can actually arrive at whatever pre-determined answer you were seeking. If, for example, you were opposed to voluntary organ trading (in which someone was willing to sell one of their own kidneys), then you might emphasise the potential harm to them (either as a direct complication of the operation or in future years should their one remaining kidney fail) and

to others (e.g. people being forced by family to “volunteer” a kidney). If, on the other hand, you were in favour of voluntary organ donation you might accentuate the importance of autonomy (“the organ is theirs, if they want to sell it then that’s their business”) and the benefit to the organ recipient.

Another concern voiced about the four principles approach is the apparent dominance of autonomy in decision making and especially that a very individualistic notion of autonomy has become ‘first amongst equals’ (e.g. Dawson and Garrard, 2006). Whilst it is helpful to be aware of these caveats, the four principles approach nevertheless remains a useful structure upon which others, as we shall see below, have built.

DEVELOPING INSIGHT INTO ETHICAL ISSUES

It would be unreasonable and unrealistic to expect a bioscience major to become an expert in philosophy. There are, however, a series of straightforward practical steps that you can take that will equip you to have a much better grasp of key ethical and social issues associated with innovations in biology and biomedicine.

Turning on Your Bioethical Radar

The first thing you can do is simply to have an expectation that bioethics is already there as part of the contemporary world. Once you get into the habit of listening out for reports of ethically-relevant news reports you’ll discover that stories of this kind are very widely discussed in the media. Recognising the pervasiveness of bioethics is a bit like being introduced by a friend at a party to somebody else that they know but whom you initially believe you have never met. Once you’ve been introduced, however, you discover in subsequent days that this ‘new’ acquaintance is actually frequently around in the same circles as you; it was just that you were never previously attuned to their existence. Over time you speak to them on a more regular basis, and perhaps get to know them pretty well as a friend in their own right.

Getting acquainted with bioethics can be a very similar process. Once you initially become aware of an issue, you’ll start to recognise familiar themes being discussed in the popular media. You can approach this familiarisation process in both a *reactive* and a *proactive* way. The reactive way would simply be to keep your bioethical radar switched on when you are reading a newspaper, watching the news on television or surfing the web. The more proactive way would be to deliberately bring bioethics stories into your world. In this day and age, there are a number of services that will deliver aggregated bioethics information directly to you. There are several very helpful website at which you can sign up for regular e-mail and/or twitter feeds. These include Bionews www.bionews.org.uk (@bionewsUK), www.bioethics.com (@bioethicsdotcom) and my personal favourite www.bioedge.org (@bioedge). If you are RSS-savvy¹ you can also set up your own feeds, or take advantage of those set up by others (e.g. the website www.bioethicsbytes.wordpress.com has a news side-bar fed by an RSS feed).

Taking it further

Having an awareness that a topic exists is, of course, only a beginning. At the risk of over-stretching my earlier analogy, it is little more than recognising that the person in the queue for the photocopier is

¹ If you are not familiar with RSS, there are helpful introductions on the BBC website (<http://www.bbc.co.uk/news/10628494>) and at <http://www.squidoo.com/rss-explained>. Alternatively, you may want to watch this short video http://www.commoncraft.com/rss_plain_english

the one your friend introduced you to at the party but not stopping to say hello; what we want is for you to become good mates and that, as we know from our relationships, takes both time and effort.

If you find that bioethics really starts to grab you there are, of course, a plethora of books and journals devoted to the topic (some of which are highlighted in the Additional Resources section, below). One important issue you will need to consider is the extent to which you want to get to grips with the philosophical background to ethics, in other words whether you want to be an ethically-interested biologist or an ethicist with an interest in biology. Some resources will anticipate that you have much firmer foundations in philosophy that is probably the case; we have tried to indicate within the Additional Resources section where this is true.

New topics, New Perspectives

One of the exciting, but challenging, aspects of bioethics is the regular appearance of new issues and quandaries. Technologies which were science *fiction* only a few years ago are beginning to become science *fact*, and there is no reason to imagine that this trend is going to end any time soon.

This constant emergence of fresh innovations drives home the fact that forming an opinion about any one issue, for example regarding the appropriateness of research involving embryonic stem cell research, is not necessarily going to equip us to reflect upon a different issue, such as the potential to create synthetic life or the rights and wrongs of taking non-prescription medicines to improve your concentration and wakefulness during the exam season. In consequence, it is important that each of us develops some form of generic approach or framework which will provide an effective start-point for evaluating the ethics of novel developments.

At the same time, an appropriate framework will facilitate serious consideration of the views held by different stakeholders and individuals with different perspectives. It is easy to write off someone who holds a different opinion to your own on the grounds that they are *de facto* an unprincipled libertarian or a bigoted conservative (delete as applicable), but it will pay dividends in the long run to make a serious effort to understand the worldview underpinning their views.

It is important that the previous statement is not misconstrued. An appeal to the appropriateness of *giving a fair hearing to different viewpoints* is absolutely not to say that *all perspectives are equally accurate or equally valid*. Naive relativism of that kind can surface in a variety of different contexts. For example, some scientists, schooled in the robust testability enshrined within the scientific method, are dismissive of bioethics since, as they see it, ethics is merely a matter of opinions not facts. I have even heard colleagues for whom I otherwise have great admiration saying things such as “of course there are no right answers” in relation to bioethics in a way that they would never speak of scientific experiments, even if the mechanism of a particular process had yet to be effectively elucidated.

Another arena in which there has been undue deference to the equal merit of different views has been the popular media’s handling of contentious issues in science. Wary of accusations of bias, editors of news programmes have pursued a policy of strict balance between rival viewpoint, however bizarre or unorthodox they may be. In consequence, maverick individuals obsessed with a causal link between the MMR vaccine and autism, or unwilling to accept the role of HIV in AIDS, have been given equal air-time alongside scientists reflecting well-validated evidence to the contrary (Ben Goldacre’s book *Bad Science*, and regular *Guardian* newspaper column of the same name, have been particularly candid in pointing out the inappropriateness of this editorial policy).

On the other hand, however, *appropriate* weighing up of the arguments for and against any particular development is an intrinsic part of rational reflection. Aside from the possibility that greater consideration may occasionally cause us to undertake a volte face regarding an issue, undertaking structured reflection can enable us to develop deeper evidence in support of our own position.

Introducing the Ethical Matrix

What framework can we use to facilitate fair reflection on a topic from a variety of standpoints? The simplest approach is to formulate an argument in support of your view on an issue and then require yourself to come up with a coherent train of thought with the opposite conclusion. An exercise of this kind certainly has value, but it also has limitations; the principal weakness being a failure to adequately reflect on the implications for other stakeholders, i.e. to give adequate consideration of the issue as viewed by someone with an opposing perspective.

It is here that the **Ethical Matrix** can be an invaluable tool. Devised in the 1990s by Ben Mepham, the Ethical Matrix is not intended to be a simple algorithm through which data can be cranked in order to come up with the “right” ethical solution. As Mepham himself puts it “*The matrix is designed to facilitate, but not determine, ethical decision-making by making explicit the relevant ethical concerns and providing a reasoned justification for any decisions made*” (Mepham, 2008: 63).

The matrix, then, is a structured way to consider the potential implications of, for example, a new biomedical innovation from the perspective of various interested parties (rows of the grid) with reference to a number of ethical principles (the columns). The principles in question are at root the four principles drawn up by Beauchamp and Childress (and discussed above). Since, however, the Ethical Matrix is intended to be a help not a hindrance it is important that neither the number of stakeholders nor the number of principles becomes unwieldy. Mepham therefore recommends that no more than four interest groups are generally considered in any one matrix and, in the other dimension, he combines two of Beauchamp and Childress’ original categories “non-maleficence” and “beneficence” into one principle “Well-being” which, alongside “Autonomy” and “Fairness”, provide three columns. A typical matrix would therefore consist of a 4 by 3 grid. A number of worked examples of the Ethical Matrix in action are available online (the interactive exercises on aspects of animal farming at <http://www.ethicalmatrix.net/> are particularly recommended).

| Stakeholder | Well-being | Autonomy | Fairness |
|-----------------|------------|----------|----------|
| Stakeholder (1) | | | |
| Stakeholder (2) | | | |
| Stakeholder (3) | | | |
| Stakeholder (4) | | | |

Importantly when utilising the ethical matrix, stakeholders need not be limited to human participants; animals involved in research would clearly be included, but wider consideration of animal and plant species (possibly grouped as “biota”) may sometimes be applicable. It may not be obvious to see how the notions of well-being, autonomy and fairness can be applied to the broader biotic community but, Mepham argues, these can serve as reminders of the need to factor respectively “conservation”, “biodiversity” and “sustainability” into the ethical evaluation process.

By utilising the ethical matrix, it should be more difficult for us either to inadvertently miss or, worse still, to deliberately dismiss consideration of a significant dimension. The latter ought to be as unacceptable as the selective reporting of only the experimental data that supports a given hypothesis.

Exercise – using the ethical matrix: before reading on, let’s take another case study and see if we can get a feel for the key issues raised by the scenario through use of the ethical matrix approach.

Carl is a twenty-one year old builder. He is engaged to Julie, and she has recently discovered that she is expecting their first child. In 2004, Carl’s maternal grandfather (i.e. his mum’s dad) died from Huntington’s disease (HD), a late-onset degenerative disease of the nervous system. HD is inherited in an autosomal dominant fashion; in other words it is equally likely to affect men or women and if you *do* have HD then you have a 50% chance of passing it on to your children. Carl’s mum Maureen has decided not to take the test to find out if she got the faulty copy from her father. However, now that he is expecting to be a father himself, Carl is keen to find out if there is any risk that he has passed on the condition.

Using the ethical matrix, consider how Carl’s decision about whether or not to take the test affects the well-being, autonomy and fairness for each of the stakeholders (Carl, Julie, Maureen and the new child).

The following matrix outlines some of the issues that may have a bearing in this case.

| Stakeholder | Well-being | Autonomy | Fairness |
|---------------------------|---|---|---|
| Carl, the builder | <p>If the test says Carl <i>does</i> have pre-symptomatic HD then he can plan his life to minimise the impact of the disease (e.g retraining for a job where physical strength is less important than in construction.</p> <p>There may be psychological issues if he tests positive. If the test says Carl does <i>not</i> have the mutant gene this may prove to be a psychological boost, but he may experience guilt if his mum (or a sibling) subsequently tests positive.</p> | Carl is within his rights to request a test, but he may equally decide not to – his autonomy is maintained either way around | There may be insurance implications arising from taking the test – he moves from an “at risk” category to either being “unaffected” or “definitely affected”. In the latter case he may be barred from insurance. |
| Julie, his fiancée | Carl taking the test will remove the uncertainty that hangs over their relationship at present – there are therefore issues associated with Julie’s psychological and | Armed with the knowledge that Carl <i>has</i> the HD gene, Julie may decide she cannot go through with the marriage and/or commit to caring for Carl in later | Julie may end up being keener than Carl that he has the test because it offers to clarify their situation. |

| | | | |
|-------------------------|---|---|--|
| | emotional well-being. | life. She may also seek a termination. | |
| Maureen, his mum | If Carl tests negative (i.e. he does <i>not</i> have the mutation causing HD) this does not prove that Maureen is also in the clear, but if he tests positive then she will almost certainly have the mutation herself and may start showing symptoms quite soon. | Maureen has elected not to have the test, so her autonomy will be infringed if Carl takes the test, and especially if he tests positive, which means she almost certainly has the faulty gene as well. | Knowing she has chosen <i>not</i> to be tested, Carl must conceal the outcome from his mum if he is to honour her wishes. Will he be able to do this once he knows his situation? Should she be actively involved in his decision? |
| The new baby | If Carl <i>does</i> have HD this will potentially impact Carl and Julie's attitude towards the baby and they may even seek a termination. | At present the discussion has only been about testing <i>Carl</i> not prenatal testing of the baby for HD. Even if Carl does have the faulty gene, there is a 50% chance that the baby does not. Knowing the result of Carl's test will not directly alter the situation for the baby. No additional testing on the baby should be done until he/she is old enough to decide if they want the test. | The baby has inherent value as a human being and Carl's test ought to have no bearing on his/her life at this stage. |

As this example demonstrates, the use of an ethical matrix has not dictated whether or not it would be right for Carl to take the Huntington's Disease test. It does, however, serve to make sure that the interests of all stakeholders are clearly laid out.

ADDITIONAL RESOURCES

As mentioned previously, books on Bioethics by Mepham (2008) and Bryant *et al* (2005) are intentionally written with ethically-interested bioscientists in mind, and are an excellent next step for biologists wanting to read more widely on the ethical dimensions. As far as journals and academic magazines are concerned, the *Journal of Medical Ethics*, the *American Journal of Bioethics* and the *Hastings Center Report* are amongst the most accessible in terms of content (though, sadly, may require a personal or institutional subscription in order to read them). Other general science periodicals such as *Nature*, *Science*, the *British Medical Journal* and *New Scientist* frequently discuss the ethical and societal significance of recent innovations. Provided you bear in mind the usual caveats about the uncertain authority and expertise of the writer, *Wikipedia* can sometime include quite detailed discussion.

Some resources have a higher expectation of your background in philosophy. For example an anthology of readings by several major authors (e.g. Harris, 2001) or single-author volume (e.g. Holland, 2003) will reward the persistent student, but would not be a good place to start your deliberations.

A Special Mention for Reports by the Nuffield Council on Bioethics

In terms of materials available via the Internet, I'd like to pick out one website for particular mention. Since 1991, the Nuffield Council on Bioethics have on average produced one substantial report per year on a bioethical issue. These reports are thorough (often 200 pages or more in length) but accessible to the non-specialist (there's also a user-friendly summary version of each report). The Nuffield reports are all available as free downloads from their website www.nuffieldbioethics.org

CONCLUSION

Scientific research has a crucial role to play in contemporary society. Given both the substantial budgets involved in the research process and the dramatic impact discoveries in biology and biomedicine can have for humans, non-human species and the planet as a whole it is essential that very serious consideration is given to the ethical conduct of researchers and the potential ramifications of their work. Students and staff alike will find their grasp of science enriched by reflection on bioethics and it is hoped that this chapter has provided helpful pointers for the beginning of a rewarding journey into deeper understanding of these dimensions.

NOTES FOR THE TUTOR

In all probability, most academic scientists reading this book will have had no formal training in bioethics and fewer still will have taken courses in philosophy. Bioethics as a discipline sits at the interface of a variety of more traditional fields, including sociology and economics alongside biology and philosophy. Whereas a few years ago practitioners of 'bioethics' were likely to have started with a background in ethics and applied this to biological scenarios, there are now increasing numbers of biologists approaching the subject from the other direction.

In my experience, two 'old chestnuts' are regularly debated by staff seeking to teach bioethics to students who are first and foremost bioscientists. Firstly, how much moral philosophy should we realistically expect students of biology to take on board? Secondly, should we be assessing ethical thinking and, if so, how should we go about it? I will briefly tackle each of these issues, before adding a few additional recommendations.

How much philosophy ought a bioscientist to know?

As I hope the earlier text of this chapter has illustrated, students can certainly enrich their understanding of the social relevance of developments in biology and biomedicine through relatively straightforward reflection on the rationale(s) underpinning innovations. On many levels it would certainly be inappropriate for academic staff to give the impression that consideration of ethics was unimportant for the contemporary bioscientist.

We are all, nevertheless, aware of the tensions as we try to design a balanced curriculum for an undergraduate programme. The pace of research advance in bioscience, perhaps moreso than any other discipline, means that the distance between cutting edge discoveries and the background knowledge one might reasonably expect of an eighteen year old fresh from school or college becomes ever greater. There is therefore more science content to fit into a course. Alongside this there are drives to add more skill-development activities to the curriculum to enhance the employability of graduates. How much philosophical theory can we realistically add into this already crowded landscape?

My personal view is that we ought to see provision of a framework for ethical reflection on both current and, importantly, future innovation in bioscience as a fundamental aspect of any contemporary

life science programme, even if some of the other molecular or organismal content needs to be omitted to make room. We cannot, and should not, expect to turn bioscience majors into professional philosophers but analysis, at least as deep as that covered in this chapter ought to be feasible for any course. If you have sufficient flexibility within the curriculum and access to the necessary expertise (perhaps via involvement of colleagues from a philosophy, sociology or theology faculty on campus) it may be possible to introduce both an introduction to bioethics within a core module and deeper analysis in an optional unit.

How should we assess ethics?

A second concern for bioscience staff relates to assessment of ethical activities. Scientists tend to be more familiar, in general, with awarding credit for re-presentation of factual content and marking of ethical thinking can place them outside their comfort zone. Faced with this dilemma, one route is essentially to ‘cheat’ and base the assessment on more familiar criteria such as accuracy of science within the content and on presentation skills. We ought, however, to get beyond this and ensure that marks are being given for genuine engagement with the ethical process.

Here I think the QAA benchmarking statements, noted at the beginning of the chapter, are helpful. In particular the aspiration that a good honours graduate ought to “*be able to construct reasoned arguments to support their position on the ethical and social impact of advances in the biosciences*”. Marks can be awarded for the clarity of logical thought and reasoning (even, importantly, if the student’s conclusion differs from our own view, provided they have offered appropriate justifications). Credit can also be given for serious consideration of an issue from more than one perspective and for the extent of engagement with core ethical philosophies.

How should we introduce bioethical topics?

As the earlier scenario involving Craig and Jennifer Wyatt (and their potential involvement in a trial using foetal eggs for IVF) was intended to illustrate, case studies can serve as excellent vehicles for opening up complex issues. Approaching bioethics from the philosophical ‘end’ with a class whose primary interest is bioscience is unlikely to engage the majority of the group; case studies demonstrate the relevance of ethical thinking and allow real-world framing of otherwise abstract ideas.

Choice of cases to discuss is important; they can be genuine or fictional, though the latter work best when as close to real situations as possible. Real cases arise naturally and frequently in news stories – these accentuate the relevance of bioethics but the fact that they relate to the lives of real people means that they may involve specific details that add unnecessary complexity. Fictionalised versions of cases can ensure that the key issues surface more naturally as a result of details you have omitted and/or added to the scenario.

The degree to which details and twists are introduced into your case studies may depend upon the ways you intend to use them. For example, interaction with a scenario might be limited to “here’s a short report from last night’s news. Having watched the clip, turn to your neighbour and discuss whether you would allow this treatment to occur and why”. At the other end of the spectrum, you might use the case to launch a full-blown role-playing activity lasting for an hour or more. Alternatively, I have seen effective engagement achieved by asking participants to act as the ethics committee deciding if a development ought to be permitted (Mark Goodwin, personal communication) and via a more rapid-fire “doughnut debate” (Macer, 2008). During the latter, two rings of chairs are set out, with the occupants facing each other, such that two individuals can have a one-to-one conversation. Students sitting in one of the rings, e.g. the one facing outwards, can be asked to argue for one minute in favour

of the development posed in the scenario (regardless of their personal beliefs on the matter). The student facing them can then be asked to offer evidence in support of the alternative viewpoint. This approach has a number of attractions: it requires all members of the group to become engaged in the task, but in a relatively non-threatening manner; it forces students to think about other perspectives on a topic; and the circular layout makes it easy to shuffle the groups for a further activity by asking members sitting in one of the rings to move one seat to their right.

How can you achieve your potential in bioethics?

- Watch television news and read newspapers with an active expectation that you will see accounts of controversial developments in biology and biomedicine
- Reflect about what you think about the ethical and societal consequences of these developments
- Use the ethical matrix model as a tool for reflecting on other opinions about a topic
- Read journal articles that discuss the ethics of developments in biology and biomedicine
- Read introductory books on bioethics. If you are serious about the subject, broaden your reading to include philosophical and legal perspectives.
- Form a discussion group where you meet regularly with friends to talk through the ethical implications of a development in biology or biomedicine

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