Beliefs and the value of evidence

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Background

Science, above all, is about the production and testing of empirically grounded theories that have objective validity and generate knowledge which is of value both for enhancing our understanding of the material world and for enabling us to control and harness aspects of it. Such a straightforward notion, though, led almost inevitably to the deficit model of misunderstandings of science which, while rejected in the science communication community (Holliman *et al*., 2009), continues to be the first port of call for many scientists and for the general public alike.

At the same time, the continuing influence of religion on public life has led many in the science community to seek to distance science from religion. A common refrain among such scientists is to state that belief has no part in science, being instead a peculiar and unimpressive element of the religious life (e.g. Dawkins, 2006).

The theory of evolution provides a distinctive stage on which to investigate the importance of belief in science. By examining why some individuals find the scientific consensus concerning evolution attractive while others reject it so decisively, one can study the extent to which objective evidence is sufficient to persuade people of the truth of the standard scientific account. My intention is to produce an analysis that benefits all those concerned with science communication about evolution in today's diverse societies whether in schools, in science museums or in religious settings.

The importance of belief for religion and for science

The word 'belief', as with almost all words that are worth exploring in any depth, has a number of related meanings and uses (cf. Wittgenstein, 1953; Austin, 1979; Kenny, 1992). Fundamentally, though, it is about acceptance (both intellectually and in terms of implications for practice). 'I don't believe it is going to rain today' means that I do not accept that such an event is at all likely to occur and that I am unlikely to take precautions against wet weather. Of course, a belief may be held with varying degrees of conviction. Although, as I write this (14 January 2012 in Cambridgeshire, UK), I do not, in fact, believe that it is going to rain today (it is a sunny afternoon and the BBC weather forecast predicts no rain), I wouldn't wager my academic reputation on the assertion whereas I would with regards to the propositions 'Fairies do not exist', 'There is no validity in horoscopes' and 'All humans are the descendants of much simpler and smaller organisms that lived over a thousand million years ago'.

Consider now the statement ‘God exists’. This is not (really) a scientific statement. Although some people uttering such a statement might be prepared to accept that certain empirical circumstances (a life of continued misery, an absence of any personal divine revelation or answers to petitionary prayers, a growing conviction that there is nothing before, behind or beyond that that is material and self-evident) would eventually lead to its refutation, others uttering such a statement would continue to hold it whatever evidence failed to support it or apparently refuted it (cf. the dark night of the soul). Now consider the statement ‘The Quran was revealed to Muhammad by the angel Gabriel’. In principle this statement, as with any historical statement, admits of empirical support or refutation. The reality, though, is that the events in question lie so far back in time, from 610 to 632 CE, that there is no real chance of their veracity being objectively tested, so acceptance of the truth of the statement tells us more about people’s Muslim beliefs than whether or not the events actually occurred.

We can conclude from this that the words ‘belief’ and ‘believe’, as in ‘I believe in God’ and ‘I believe in the theory of evolution’, are used in non-identical ways in science and in religion, even if there may be some overlap (the overlap being the reason why ‘(really)’ appears in my assertion above that ‘God exists … is not (really) a scientific statement’). This is hardly surprising. Indeed, statements of belief in other areas of knowledge often cannot be reduced to scientific statements. I believe that the internal angles of any flat triangle add to 180^{o} but the truth of this statement is arrived at differently in mathematics (i.e. through logical proof – cf. Euclid’s *Elements*, Book 1, Proposition 32) than it would be if it were a scientific statement along the lines ‘All vertebrates have four limbs’, to test which one would look at large numbers of vertebrates. In mathematics, it doesn't help (except when teaching pupils about the truth of the proposition) to corral large numbers of triangles and then carefully measure and sum their internal angles. Moral philosophy is another example of a discipline where conclusions are arrived at non-scientifically. While science plays the central role in determining the age at which a developing human fetus can feel pain, science alone doesn't enable one to determine the best abortion policy.

> *Student activity 1.* Would it be better if scientists avoided using the word ‘belief’ and ‘believe’ as in, for example, ‘I believe in the theory of evolution’?

The scientific consensus concerning evolution

As with any large area of science, there are parts of what we might term ‘front-line’ evolution that are unclear, where scientists still actively work attempting to discern what is going on or has gone on in nature. But much of evolution is not like that. Evolution is a well-established body of knowledge that has built up over 150 years as a result of the activities of many thousands of scientists. The following are examples of statements about evolution that lack scientific controversy:

- All of today's life on Earth is the result of modification by descent from the simplest ancestors over several thousand million years.
- Natural selection is a major driving force behind evolution.
- Evolution relies on the inheritance of genetic information that helps its possessor to be more likely to survive and reproduce.
- Most inheritance is vertical (from parents) though some is horizontal (e.g. as a result of viral infection).
- The evolutionary forces that gave rise to humans do not differ in kind from those that gave rise to any other species.

For those, such as I, who accept such statements and the theory of evolution, there is much about the theory of evolution that is intellectually attractive. For a start, a single theory provides a way of explaining a tremendous range of observations; for example, why it is that there are no rabbits in the Precambrian, why there are many superficial parallels between marsupial and placental mammals, why monogamy is more common in birds than in fish and why sterility (for example, in termites, bees, ants, wasps and naked mole rats) is more likely to arise in certain circumstances than in others. Indeed, I have argued elsewhere that evolutionary biology can help with some theological questions, including the problem of suffering (Reiss, 2000).

> *Student activity 2.* Research so-called 'scientific creationism' (also known as 'creation science'). Do the arguments against the theory of evolution have any scientific validity?

Rejecting evolution

The theory of evolution is not a single proposition that a person either wholly accepts or wholly rejects. Consider, for example, the issue as to whether all of today's life arose from inorganic precursors. I have no doubt (my language is intentional) that it did but I suspect (we lack decent social science survey data) that worldwide this is a minority opinion. Comparably, creationists accept microevolution (the genetic changes that happen over time within populations) but may not accept macroevolution (genetic changes that happen at and above the level of species).

There are a whole set of non-religious reasons why someone may actively reject aspects of the theory of evolution. After all, it seems to defy common sense to suppose that life in all its complexity has evolved from non-life. And then there is the tremendous diversity of life we see around us: it hardly seems reasonable to presume that koala bears, great white sharks, earthworms, grasses, flesh-eating bacteria and the editors of this book all share a common ancestor – yet that is what mainstream evolutionary theory holds.

It is, though, for religious reasons that many people reject evolution. Creationism exists in a number of different forms but something like 50% of adults in Turkey, 40% in the USA and 15% in the UK reject the theory of evolution and believe that the Earth came into existence as described by a literal (i.e. fundamentalist) reading of the early parts of the Bible or the Quran and that the most that evolution has done is to change species into closely related species (Miller *et al*., 2006; Lawes, 2009). Christian fundamentalists general hold that the Earth is nothing like as old as evolutionary biologists and geologists conclude – as young as 10,000 years or so for Young Earth Creationists. For Muslims, the age of the Earth is much less of an issue.

Allied to creationism is the theory of intelligent design. While many of those who advocate intelligent design have been involved in the creationism movement, to the extent that the US courts have argued that the country's First Amendment separation of religion and the State precludes its teaching in public schools (Moore, 2007), intelligent design can claim to be a theory that simply critiques aspects of evolutionary biology rather than advocating or requiring religious faith. Those who promote intelligent design typically come from a conservative faith-based position (though there are atheists who accept intelligent design). However, in their arguments against evolution, they typically make no reference to the scriptures or a deity but argue that the intricacy of what we see in the natural world, including at a sub-cellular level, provides strong evidence for the existence of an intelligence behind this (e.g. Meyer, 2009). An undirected process, such as natural selection, is held to be incapable of explaining all such intricacy.

How should science communicators respond? Lessons from BSE and GMOs

The response by science communicators to the range of positions held about evolution needs, I assert, to take account of the following:

1. Among scientists, the theory of evolution is held to be a robust, well-established and, at its core, a scientifically uncontroversial theory.

2. Within biology, evolution occupies a central place. There is much in biology in the absence of evolution that is worth studying and has been discovered but an evolutionary framework is what enables biologists to give meaning to the diversity of life that we see around us and to situate today's life in an historical context.

3. In common with many scientific theories, evolution is not easy to understand. It has contra-intuitive elements and, in addition, is actively rejected by many people for religious reasons.

In making recommendations as to how evolution might be communicated (whether on television, in museums, in schools or elsewhere), we can learn from communication efforts about BSE (bovine spongiform encephalopathy) and GMOs (genetically modified organisms).

BSE is a disease of cattle. Causing progressive degeneration to the brain and spinal cord, so that infected animals eventually have trouble standing, it is commonly known as 'mad cow disease'. The disease became particularly prevalent in the UK in the early 1990s. Eventually, this was shown to be because cattle infected with the causative agent, a type of prion (a misfolded protein), were included in food fed to other cattle. Initially this merely provoked widespread feelings of disgust – cattle are not only not cannibalistic but herbivorous – and that this was all a waste of money – farmers of destroyed cattle were reimbursed. However, concerns about human health were soon raised.

Initially, such concerns were dismissed by the UK government. In what is now seen as a classic instance of how not to handle public communication about science, civil servants, advisors and government ministers determined that the best way forward was to reassure the public that it was still perfectly safe to eat meat from cattle. Attempts by scientists and others to argue that there might be a risk were rebuffed (Irwin, 2009). A 1990 photograph of the Minster for Agriculture, Fisheries and Food, John Selwyn Gummer, attempting to feed his four year-old daughter, Cordelia, a beefburger has become an enduring visual icon.

This tidy way of dealing with the problem unravelled when, as sometimes happens with science, the science changed. The government was force to admit that there was a possibility that the rise in the number of cases of a horrible disease, new variant Creutzfeldt-Jakob disease (nvCJD) might be due to BSE. Indeed, this proved to be the case, and for a number of years there were worst-case scenario predictions of the deaths of hundreds of thousands of people from nvCJD in the UK.

The main lesson for communication about evolution that can be drawn from the BSE affair is that public trust is easily lost when over-confident assertions are made about the conclusions of science. The lesson to be drawn from GMOs might be thought to be the same but is subtly different in that in addition to near-inevitable uncertainties about safety given the rise of a new technology, there were other objections to genetic engineering.

The typical form of genetic engineering entails moving the DNA from one species to a second species so that the cell machinery of the second species makes the gene product of the first. A widespread application entails moving genes for herbicide resistance into crop plants. When the growing crop is then sprayed with the herbicide in question, the crop plants survive whereas competing weeds are killed. As agronomists have been altering the genes of crop plants for many decades via a whole range of technologies, many crop scientists were bemused as widespread objections to GMOs, particularly in Europe, became evident in the 1990s.

Aside from safety concerns – and, unlike BSE, time has not so far shown such fears to have been realised – other reasons why many objected to GMOs centred on the unnaturalness of the technology. Even those of no religious persuasion sometimes referred to the use of the technology as 'playing God'. Interestingly, while there were those who objected to genetic engineering on theological grounds, there were many who argued the opposite (Reiss & Straughan, 1996). It was also perhaps unfortunate from the perspective of those in favour of the technology that the first major battle in Europe was fought over bovine somatotropin (bST).

bST is a naturally occurring hormone, produced in the pituitary glands of cows. Back in the 1930s it was known that injecting cows with bST could boost milk yields. In the early 1990s Monsanto brought a genetically engineered form of bST to market. This was shown to boost milk yields, typically by about 10%. However, its use outside of the USA was fiercely resisted and, to this day, its use is not permitted in the European Union. While there were some concerns about possible risks to human health, more important were perceived risks to the health of the cows (they are more likely to develop mastitis) and, perhaps most importantly, a view, first, that milk is 'natural' and such naturalness is contaminated by genetic engineering and, secondly, that consumers have a right to choose whether or not they wish to consume genetically modified foods and that once bST became widely used in Europe it would be virtually impossible to keep it out of the food chain.

My experience of giving large numbers of talks in the 1990s on genetic engineering (to farmers' groups, women's institutes, church groups and others) and participating in public debates was that a whole concatenation of objections to genetic engineering came together: a presumption that the countryside, and so farming, was and should be natural; concerns about human health; distrust of government, big business and commercial science; concerns about animal welfare and the environment; resistance to the USA way of life; and a fear that things were simply moving too fast with today's realities increasingly resembling science fiction. My experience of participating in the UK National Consensus Conference on Plant Biotechnology (1994), the Advisory Committee on Novel Foods and Processes (1998-2001) and the GM Science Review Panel (2002-04) was that as time went on many of the participating scientists became increasingly exasperated. I have some sympathy with this point of view but the part of me that is a school teacher knows that there it is generally counterproductive to blame learners for not learning what one wants them to learn. Effective science communication is more about providing the appropriate environs within which learning can take place than it is blaming people when they don't learn what one wishes they would.

> *Student activity 3.* Draw up a short list of principles for effective science communication in the light of BSE and GMOs.

Communicating evolution in school science

Few countries have produced explicit guidance as to how schools might deal with the issues of creationism or intelligent design in the science classroom. One country that has is England (Reiss, 2011). In the summer of 2007, after months of behind-the-scenes meetings and discussions, the then DCSF (Department of Children, Schools and Families) Guidance on Creationism and Intelligent Design received Ministerial approval and was published (DCSF, 2007). The Guidance points out that the use of the word ‘theory’ in science (as in ‘the theory of evolution’) can mislead those not familiar with science as a subject discipline because it is different from the everyday meaning, when it is used to mean little more than an idea. In science the word indicates that there is a substantial amount of supporting evidence, underpinned by principles and explanations accepted by the international scientific community.

The DCSF Guidance goes on to state: “Creationism and intelligent design are sometimes claimed to be scientific theories. This is not the case as they have no underpinning scientific principles, or explanations, and are not accepted by the science community as a whole” (DCSF, 2007) and then goes on to say:

> Creationism and intelligent design are not part of the science National Curriculum programmes of study and should not be taught as science. However, there is a real difference between teaching ‘x’ and teaching *about* ‘x’. Any questions about creationism and intelligent design which arise in science lessons, for example as a result of media coverage, could provide the opportunity to explain or explore why they are not considered to be scientific theories and, in the right context, why evolution is considered to be a scientific theory. (DCSF, 2007)

This seems to me a key point and one that is independent of country, whether or not a country permits the teaching of religion (as in the UK) or does not (as in France, Turkey and the USA). Many scientists, and some science educators, fear that consideration of creationism or intelligent design in a science classroom legitimises them. For example, the excellent book *Science, Evolution, and Creationism* published by the US National Academy of Sciences and Institute of Medicine asserts “The ideas offered by intelligent design creationists are not the products of scientific reasoning. Discussing these ideas in science classes would not be appropriate given their lack of scientific support” (National Academy of Sciences and Institute of Medicine, 2008, p. 52).

As I have argued (Reiss, 2008), I agree with the first sentence of this quotation but disagree with the second. Just because something lacks scientific support doesn't seem to me a sufficient reason to omit it from a science lesson. Nancy Brickhouse and Will Letts (1998) have argued that one of the central problems in science education is that science is often taught ‘dogmatically’. With particular reference to creationism they write:

> Should student beliefs about creationism be addressed in the science curriculum? Is the dictum stated in the California’s *Science Frameworks* (California Department of Education, 1990) that any student who brings up the matter of creationism is to be referred to a family member of member of the clergy a reasonable policy? We think not. Although we do not believe that what people call ‘creationist science’ is good science (nor do scientists), to place a gag order on teachers about the subject entirely seems counterproductive. Particularly in parts of the country where there are significant numbers of conservative religious people, ignoring students’ views

> about creationism because they do not quality as good science is insensitive at best. (Brickhouse & Letts, 1998, p. 227)

Subsequently, Thomas Nagel (2008) argued that so-called scientific reasons for excluding intelligent design (ID) from science lessons do not stand up to critical scrutiny. With reference to the USA he concludes:

> I understand the attitude that ID is just the latest manifestation of the fundamentalist threat, and that you have to stand and fight them here or you will end up having to fight for the right to teach evolution at all. However, I believe that both intellectually and constitutionally the line does not have to be drawn at this point, and that a noncommittal discussion of some of the issues would be preferable. (Nagel, 2008, p. 205)

It seems to me that school biology lessons should present students with the scientific consensus about evolution and that parents should not have the right to withdraw their children from such lessons. Part of the purpose of school science lessons is to introduce students to the main conclusions of science – and the theory of evolution is one of science's main conclusions. At the same time, science teachers should be respectful of any students who do not accept the theory of evolution for religious (or any other) reasons. Indeed, nothing pedagogically is to be gained by denigrating or ridiculing students who do not accept the theory of evolution.

My advice for science teachers is not to get into theological discussions, for example about the interpretation of scripture. Stick to the science and if you are fortunate enough to have one or more students who are articulate and able to present any of the various creationists arguments against the scientific evidence for evolution (e.g. that the theory of evolution contradicts the second law of thermodynamics, that radioactive dating techniques make unwarranted assumptions about the constancy of decay rates, that evolution from inorganic precursors is impossible in the same way that modern science disproved theories of spontaneous generation), avoid getting into a ping pong debate with such students. Instead, use their contributions to get the rest of the group to think rigorously and critically about such arguments and the standard accounts of the evidence for evolution.

My own experience of teaching the theory of evolution for some thirty years to school students, undergraduate biologists, trainee science teachers, members of the general public and others is that people who do not accept the theory of evolution for religious reasons are most unlikely to change their views as a result of one or two lessons on the topic, and others have concluded similarly (e.g. Long, 2011). However, that is no reason not to teach the theory of evolution to such people. One can gain a better understanding of something without necessarily accepting it. Furthermore, some studies suggest that careful and respectful teaching about evolution can indeed make students considerably more likely to accept at least some aspects of the theory of evolution (Winslow *et al.*, 2011).

> *Student activity 4.* Read the guidance for English maintained (state) schools on dealing with creationism and Intelligent Design (DCSF, 2007). Suggest improvements.

Communicating evolution in science museums

Science museums have long had exhibits about evolution. Tony Bennett (2004) examines the history of museum displays about evolution. He looks at nineteenth century studies in geology, palaeontology, natural history, archaeology and anthropology and “trace[s] the development, across each of these disciplines, of an ‘archaeological gaze’ in which the relations between past and present are envisaged as so many sequential accumulations, carried over from one period to another so that each layer of development can be read to identify the pasts that have been deposited within it” (Bennett, 2004, pp. 6-7). Bennett concludes that evolutionary museums “are just as much institutions of culture as art museums” (p. 187).

In one sense this is obvious – museums and galleries have to make selections about what to display and how to narrate such displays and these are clearly cultural decisions whether one is referring to art, evolution, mathematics or any technology. However, whereas a visitor to an art gallery is unlikely to presume that what is being viewed is the only reading possible, a visitor to a science museum might presume that they are being presented with objective fact.

Monique Scott too has produced a book about evolution in museums (Scott, 2007). Scott’s work, unlike Bennett (2004), is more to do with the now than with history. Using questionnaires and interviews, she gathered the views of nearly 500 visitors at the Natural History Museum in London, the Horniman Museum in London, the National Museum of Kenya in Nairobi and the American Museum of Natural History in New York. Perhaps her key finding is that many of the visitors interpreted the human evolution exhibitions as providing a linear narrative of progress from African prehistory to a European present. As she puts it:

> Progress narratives persist as an interpretive strategy because they still function as a conceptual crutch. They are nearly ubiquitous in popular culture (can you imagine human evolution without imagining the cartoonish images of humans evolving single-file toward their destiny?) and they stand largely unchallenged in museum exhibitions which conventionally move case-by-linear-case from Africa to Europe. Many museum visitors, particularly Western museum visitors, rely upon cultural progress narratives – particularly the Victorian anthropological notion that human evolution has proceeded linearly from a primitive African prehistory to a civilized Europe – to facilitate their own comprehension and acceptance of African origins. Overwhelmingly, museum visitors relate to origins stories intimately, and in ways that satisfy or redeem the images they already have of themselves. (Scott, 2007, p. 2)

So what might one hope that science museums would consider when putting together exhibitions about evolution? Even if we presume that a museum decides to concentrate on the mainstream scientific account of evolution, eschewing any debates with creationism or intelligent design, there are still a myriad of decisions (conscious or otherwise) that those putting together an exhibition to make:

- To what extent does one favour mammals and birds (beloved by many visitors) over the less spectacular but sometimes more informative invertebrates and other species?

- How much does one oversimplify (e.g. over the story of the evolution of the horse)? Too little oversimplification and the typical visitor is going to learn almost nothing, overwhelmed by difficult detail. Too much oversimplification and what our visitor learns may be no better than a reinforcement of error (cf. Scott's point above about a linear narrative of progress).

- To what extent should the curator(s) concentrate on scientific consensus and to what extent should they address scientific controversy, for example over the importance of punctuated equilibria and Lamarckism in evolution, and the relationship between micro- and macroevolution?

- To what extent should the social and cultural contexts of evolution be addressed (e.g. the reception by Victorian society and in France of Darwin's *On the Origin of Species* in 1859)?

- Can sensitive topics like intelligence, race and sexual behavior be examined?

- How can today's digital technologies and dialogic possibilities (e.g. Science Museum, 2012) enhance learning for visitors both in the museum and away from it?

- How can museums use concepts such as 'upstream engagement' (Stilgoe & Wilsdon, 2009) to inform their provision in this area?

Of course, comparable decisions are made by school teachers all the time but science museum exhibitions and other presentations of science cannot, unlike classroom teachers of science, rapidly alter their presentations to take account of the particular learners in front of them (Reiss, in press).

> *Student activity 5.* If at all possible, visit a museum that has an evolution display / exhibit. If you are unable to make such a visit, consult the relevant part of the website of a suitable museum (e.g. www.nhm.ac.uk/nature-online/evolution/, http://australianmuseum.net.au/Human-Evolution). How suitable do you consider the materials and messages to be for a diversity of audiences?

Communicating evolution in religious settings and in RE lessons

There is much to be said for scientists, clergy and others in religious settings talking positively about the theory of evolution. Such conversations can go some way to counteracting the perception in some people's minds that religions are inevitably against evolution – a perception that has some persistence, despite frequent denials from many religious leaders, and is buttressed by creationist museums (e.g. http://creationmuseum.org/) and zoos (e.g. www.noahsarkzoofarm.co.uk/).

Indeed, perhaps somewhat optimistically, I would ask those running creationist places of learning to make one concession to evolution. I do not expect them to promote evolution but it is reasonable to ask them to make it clear that the scientific consensus is that the theory of evolution and not creationism is the best available explanation for the history and diversity of life. Of course, it is perfectly acceptable for those running creationist institutions to critique evolution and to try to persuade those visiting such institutions that the standard evolutionary account is wrong. But just as science teachers with no religious faith should respect students who have creationist views, so creationists should not misrepresent creationism as being in the scientific mainstream. It is not.

Finally, we can consider how evolution and creationism might be addressed in religious education (RE) lessons, for countries that have such lessons (or address at least some of the issues in history, social studies, humanities, citizenship or whatever). In England, the DCSF and QCA (Qualifications and Curriculum Authority) published a non-statutory national framework for RE and associated teaching units that include a unit asking 'How can we answer questions about creation and origins?' (QCA, 2006). The unit focuses on creation and the origins of the universe and human life, as well as the relationships between religion and science. This is a carefully written 23-page guide. Along with its non-evaluative stance towards the various positions, what strikes me as a science educator is the high expectations of students it has. For example, in answer to the question 'Is the universe designed? Who could have designed it?', it is suggested that teachers of 13-14 year-olds should:

> Give the pupils opportunities to explore, through a website, DVD or written text (see 'Resources'), a range of different answers to these questions, including answers given by members of different faiths. These answers should include the views of creationists, evolutionists, advocates of intelligent design and philosophers of religion, such as Anselm, Thomas Aquinas, Blaise Pascal and Francis Bacon. (QCA, 2006, p. 16)

We can note that this non-evaluative stance towards the various positions takes place in a context where, since the late 1950s in England and Wales, teachers of religious education in schools have abandoned a form of religious education where the inculcation of Christianity was a central aim and in which Christianity was often presumed to be the sole framework within which life found meaning and moral direction. Nowadays a more pluralist vision is adopted (e.g. Jackson, 2004) in which students are enabled to develop, clarify and refine their own views about matters religious, while being introduced to a range of positions. This is very different to the position in science where the presumption, whether implicit or stated, is nearly always that the scientific understanding of the world is either a valid one or the valid one (e.g. Atkins, 2006).

Conclusion

The theory of evolution lies at the heart of modern science. By considering how evolution might be communicated in a range of settings, including school science lessons, science museums and religious settings, we can explore how science communication can tackle issues of belief and the value of evidence. Sensitive teaching about evolution can serve as a fine introduction to the practices of science and the extent of scientific knowledge.

In communicating the science of evolution, it should be made clear that there is a strong scientific consensus, and has been for many years, that the Earth is several billion years old, that life arose though natural processes from inorganic matter and that all organisms are related by virtue of common descent. In some settings this is all that need be said. In others, it will be appropriate to deal with objections to the theory of evolution. Some such objects are nothing to do with religion but the most frequent ones are. As the history of shortcomings in dealing with public reaction to BSE and GMOs shows, it is not effective science communication to blame people when they don't learn what one wants them to. It is possible to communicate evolution in a way that is both true to science and respectful of those who do not accept it.

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