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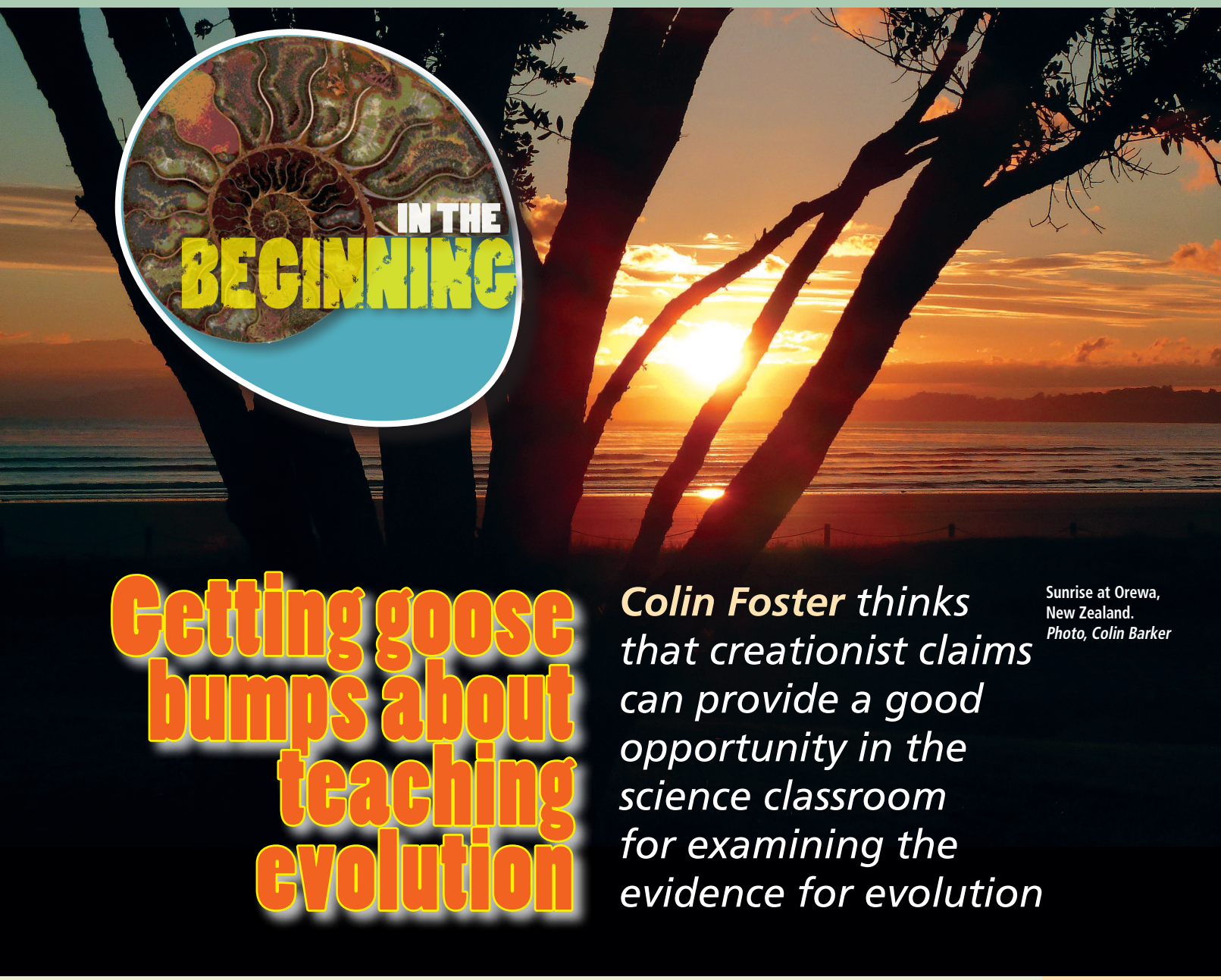



# Getting goose bumps about teaching evolution

*Colin Foster thinks that creationist claims can provide a good opportunity in the science classroom for examining the evidence for evolution*

Sunrise at Orewa, New Zealand. *Photo, Colin Barker*

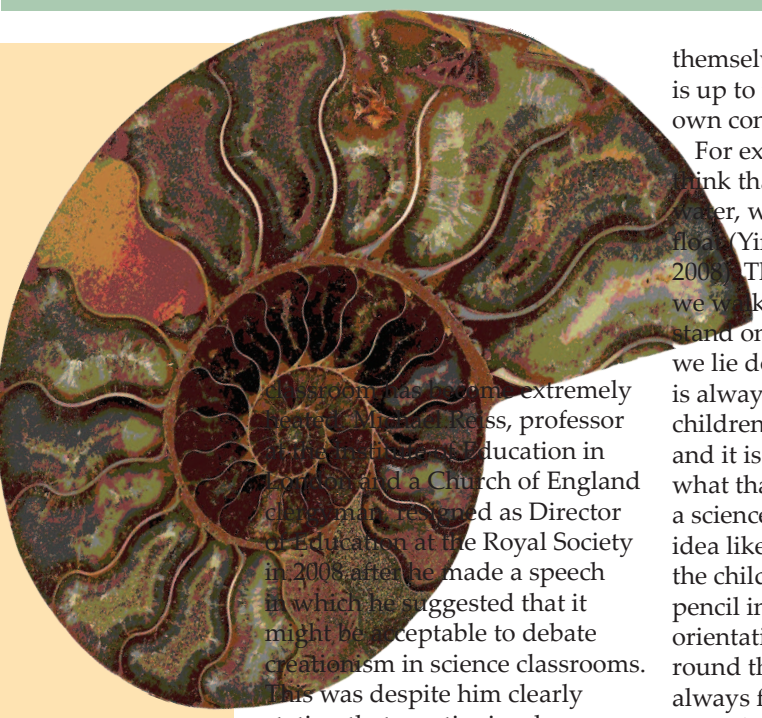
**Key words:**
Types of activity
Life processes

How do you feel about addressing the topic of evolution in school science lessons? Do you feel excitement at sharing with children a fundamental and unifying concept underpinning all of modern biology? Peter Medawar said that '*For a biologist, the alternative to thinking in evolutionary terms is not to think at all*'. Evolution offers an intellectually satisfying and extremely well-supported explanation for the diversity of life in the natural world, its similarities and differences, how changes occur and how new life forms have developed. There are plenty of reasons to anticipate the teaching of evolution with exhilaration.

## A controversial topic

But perhaps instead, or as well as this, you feel a little apprehensive? It would be hard to find a more controversial topic within the school curriculum, particularly if your school happens to lie in an area where many of the children come from strongly religious backgrounds. What is the science teacher supposed to do if a child rejects the idea of evolution because they have been taught to believe in creationism? Is it the science teacher's place to take on parents and local religious leaders? Of course, not all children from religious families will take such a hard-line view, but if such opinions are expressed how might the teacher respond? Young children may well simply be repeating what they have heard around them, so is it appropriate to spend classroom time on a detailed critique? Is it fair to disagree with their parents' views when they are not present, especially if these views are supported by a significant proportion of the local community? Perhaps it would be better just to categorise such remarks as 'religious' and relegate them to another part of the curriculum?

In recent years, the issue of creationism in the science



Robert Winston has become extremely [illegible] Michael Reiss, professor [illegible] education in [illegible] and a Church of England [illegible] man, resigned as Director of Education at the Royal Society in 2008, after he made a speech in which he suggested that it might be acceptable to debate creationism in science classrooms. This was despite him clearly stating that creationism has 'no scientific basis'. For many people, the idea of even allowing discussion was a step too far. Discussing creationism was equated with promoting it.

## Managing misconceptions

In a recent paper (Foster, 2012) I drew attention to the fact that creationism is by no means the only misconception that children bring to their science lessons, and yet it seems to be treated in a very different way from other scientific misconceptions. What science teachers normally do with children's misconceptions is address them, and I think that creationism should be treated in the same way. One of the most tried-and-tested techniques for handling scientific misconceptions is to offer *cognitive conflict*. Science teachers do this all the time. Just as in creative writing, when we ask children to 'show not tell', in science also it is far more powerful, whenever possible, for children to come face-to-face with evidence for themselves. They are being challenged by the way the world is, which is exactly the position that scientists place themselves in every day. Then it is up to the children to draw their own conclusions.

For example, children often think that vertical things sink in water, whereas horizontal things float (Yin, Tomita and Shavelson, 2008). This may be because when we walk into shallow water we stand on the bottom but when we lie down we float. There is always a good reason why children develop a misconception and it is important to think about what that could be. What would a science teacher do about an idea like this? They might ask the child to put a short wooden pencil into some water in various orientations. Whichever way round they put it in, it will always float. That experience provides cognitive conflict: a clash between what they thought and what they see. The child has to find a way to resolve this and to consider why this doesn't happen when a person steps into a swimming pool. Learning happens as the child makes sense of the conflicting ideas.

## Sowing the seeds

For me, the process of modifying your views to account for conflicting evidence is exactly what science is all about. This is not to say that all we have to do is find one dramatic piece of unassailable evidence for evolution and we can just stand back and watch children change their minds. People are resistant to changing deeply held beliefs, and for good reason. No one would throw out the idea that solid steel objects sink in water because of one floating needle, but they might need to expand their thinking by bringing in ideas of surface tension. So one piece of cognitive conflict is unlikely to lead to immediate belief change – sometimes it can even go in the opposite direction and, for a time, make children *more* entrenched in their views. A single conversation or lesson is very unlikely to move a child from complete rejection of evolution to cheerful acceptance. More realistically, there will be stages such as uncertainty, peripheral belief change and belief decrease, and an initial discussion might merely sow some seeds of doubt. However, that is in itself a valuable initial outcome.

People sometimes say that it is much too difficult to expect young children to understand the evidence for evolution, and that teachers should just tell them that evolution is right and expect them to accept that. However, if children simply accumulate correct facts in science lessons, without taking part in the process of *concluding* that they are correct, they are not really experiencing what science is all about. Religious dogma is criticised for being taken on trust from an authority, so it would be rather ironic if science lessons were to operate on the same basis. For me, it is no good if children accept evolution simply because their teacher tells them that it is true. As soon as somebody else presents creationism to them in a more attractive way, they may switch to that. We need to help children to make choices based on evidence and not accept things blindly. To expect children to suspend their critical faculties in science and just passively assent to whatever we tell them would be the antithesis of what science is all about. The stance underlying the Royal Society motto '*On the word of no one*' is critical to the very existence of science.

## Children think for themselves

Children are often great sceptics. Myths tend to raise more questions than they appear to answer and this does not escape children. We underestimate them if we think that they cannot see the problems with things that they are told. Children are well able to think for themselves and are always questioning what adults tell them. Christopher Hitchens begins his book *God is not great* (2007) with an anecdote

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from his days at primary school. He recalls how his teacher said: '*So you see, children, how powerful and generous God is. He has made all the trees and grass to be green, which is exactly the colour that is most restful to our eyes*' (p. 2). Hitchens describes how, as a 9-year-old, he just *knew* that the teacher had it all wrong: '*The eyes were adjusted to nature, and not the other way about*' (p. 3). Obviously it is the job of the science teacher to get things the right way round and to give children access to accurate knowledge about the world, but it is also vital that children see that this is not just an alternative point of view but one that is supported by compelling evidence.

## Changing ideas

So what sorts of experience might help a child to begin to accept the theory of evolution? Dawkins (2010) presents mountains of evidence that can be understood

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by children if their teachers will help them to do so. One place to start could be with human vestigial organs – parts of the body that, through the course of evolution, have lost all or most of their original function. For example, children could be asked about when they have experienced goose bumps and why they think it occurs. Because our ancestors were normal mammals, covered all over with hairs, the involuntary reflex that raises or lowers hairs enabled them to regulate their body temperature. It also allowed them to raise their hairs as a response to fear, making the animal seem larger and scarier to a predator. For a porcupine, for example, this is extremely useful, but not really for a modern human being! The action is not much use to us because we are not hairy enough for it to make much difference, so it is unlikely that anyone would design this feature in to a human being. It makes sense, though, if you see it as a hangover from our distant ancestors, pointing to where we have come from in evolutionary terms.

What would a creationist say about goose bumps? They might say that goose bumps do have a purpose but we just don't know what it is. So children could think about which explanation they think is better.

## Open the debate

I think that if we try to censor all talk of creationism in the classroom, we risk inadvertently elevating it in children's eyes to something forbidden and exciting. This is not going to help them see the truth of evolution. If children cannot talk openly about creationism in science lessons, they will talk about it elsewhere instead, whether that is in the playground, in religious studies lessons, at home or in religious meetings, where it is much less likely to be challenged as effectively as it might be by a science teacher. Science does not operate by silencing its opponents: it welcomes debate and uses evidence to discover what is true. Learning to think critically is a vital part of science education - some would say the most important part. We cannot cultivate this unless we give children opportunities to consider competing explanations for facts and to come to conclusions about why one theory is a better explanation than another.

Throughout science, theories always stand in opposition to alternatives, and children need to see how science debunks false views of the world. It is just as important in science to teach the negatives – what is not true – as it is to teach the positives. The two belong together. To argue in favour of discussing creationism in science lessons is not to be in favour of *promoting* it. On the contrary, by talking about competing ideas, children are given the opportunity to develop their critical scientific faculties so that they can weigh up the evidence for themselves.

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