Common Misconceptions

Evolution

Beth Budden, PSTT College Fellow, shares some of her experiences of teaching **evolution.**

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What children need to know:

- *There are similarities and differences between living things and they can be grouped according to specific characteristics*
- *Animals and plants live in habitats to which they are suited*
- *Living things produce offspring of the same kind, but normally offspring vary and are not identical to their parents*
- *Living things have changed over time and fossils provide information about living things that inhabited the Earth millions of years ago*
- *Animals and plants are adapted to suit their environment in different ways and adaptation may lead to evolution*

Common misconceptions – often children may think that:

- *Environmental change can be inherited, e.g. if a sheep loses its tail, its lambs will be born without a tail*
- *Humans used to be monkeys*
- *An individual can evolve during its own lifespan*
- *Evolution produces living things perfectly adapted to their environment*
- *Natural selection is an active process, ie an individual or a species can try to adapt*
- *Natural selection is always good for the species*
- *Evolution and religion are incompatible*

Last year I attended an excellent lecture at the Institute of Education by Professor Martie Sanders on teaching evolution to young children, which provided me with ideas to share.

As evolution now has to be taught in Key Stage 2, I think it's really important for teachers to think carefully about how to do this, and do it well. In this article, I bring together resources that teachers may find helpful when tackling this topic.

To begin with I'm going to use a quote Martie used:

"Nothing in biology makes sense except in the light of evolution."

(Dobzhansky, 1973:125)

You could also watch a quick YouTube clip about why evolution is important explaining this in a snappy set of clips, but in essence, life processes and living things begin and end with evolution. If children understand the basic concept of evolution it will mean they have a fundamental foundation for understanding all other biological concepts. Even if children don't become scientists, understanding evolution brings the individual a clearer sense of the relationship between living things and the environment and this helps them become an informed citizen. For example, take the over-use of antibiotics causing bacteria to become resistant to common drugs, then developing into 'super bugs'. This is evolution!

WORRIES ABOUT TEACHING EVOLUTION

Martie shared her studies carried out in South Africa and found that when confronted with teaching evolution, teachers were most worried about their own subject knowledge and also about conflicts with their own or children's religious ideas. However, her quote 'knowledge is power' really made sense here. The best thing to do then is not to shy away from teaching it but jump right in and try to understand what's going on.

It is important to make a distinction between *scientific explanations* and *religious beliefs* and not to set them against each other, even if they seem contradictory. For me, it's a mistake to present both religious and scientific ideas as theories because we are then using 'theory' in a very causal way and not a scientific way. A theory comes about when a hypothesis has been tested using evidence. A theory is not a belief; a theory is a viewpoint arrived at using all the evidence presented so far; theories themselves can also evolve and change depending on the evidential base. So – I would say, please don't call beliefs theories; you need evidence to have a theory.

So, once you're comfortable with presenting these scientific explanations, and have not set these against any 'beliefs' in the room, then it's all about getting to grips with the subject knowledge and how best to teach it.

SUBJECT KNOWLEDGE

Let's start with **variation in a population** (a group of the same species living in a particular area). A farmer wants to breed sheep with thick curly brown fleeces. They have a herd of sheep with different kinds of fleeces: grey, brown, black etc. What do they do? They select two sheep with the thickest, curliest, brown fleeces and breeds them. This is selective breeding. The two curly, brown sheep have a few lambs. Of these the farmer only allows the ones with the curliest brown coats to breed. The farmer continues like this so that over the generations, more and more offspring have the thick, curly brown feature and any other colour or texture is bred out.

Now, what Darwin thought was, 'maybe this happens in nature too?' Maybe somehow, there is a process of natural selection so that certain attributes become more prevalent? He was right, but here comes a problem and a potential misconception for children!

ANTHROPOMORPHISM AND EVOLUTION ON DEMAND

The trouble is that the way we talk about living things often sends the wrong message and forms the basis of misconceptions for young children. When we say things like 'some plants ***prefer*** more light' or 'roots ***try to find*** water' we are implying that these living things possess decision making abilities. They don't. So as teachers we need to be really careful how we say things. Most of biology is process driven and not decision driven, and we need to use language to indicate this.

The point here is that living things do not ***choose to evolve*** - that's why Darwin used the word 'natural selection'. A polar bear did not at one time choose to grow thicker hair in order to live way up North, just as a tiger did not choose to grow a stripy coat so it could hide in the leafy jungle and hunt. Instead, these were naturally selected attributes that became more prevalent over generations. In fact, let's use Martie Sanders' definitions to make the three key areas clear:

- ***Evolution:*** *"Changes in a population, resulting from the increase of certain features in the population over many generations."*
- ***Natural selection:*** *"The mechanism by which evolution occurs."*
- ***Adaptations:*** *"Evolutionary results of natural selection in a population."*

Let's take the tiger and its stripes. We take a population of big cats with plain coloured fur. A genetic variation means that some of the cats are born with a stripe or two. It turns out that when they are hunting the stripes give them a slight advantage over the plain coloured cats. They are better camouflaged and as a result they are better at catching food and so have a better diet. This gives them more energy to breed and to reproduce. Their offspring are born with the same kind of stripes because they share the same genes. These tigers also have an advantage over the less stripy cats, and they hunt more and reproduce more.

So now there are more stripy cats and fewer non-stripy cats. The stronger stripy cats are more likely to mate with another stripy cat. Eventually, this goes on over many generations and each generation includes more stripy cats because the adaptation of 'stripy fur' has been naturally selected. Remember, the tiger didn't decide to get more stripes, or decide to choose a stripy mate even, but they might reproduce with the fittest mate, who was stronger because he had stripes and was more successful at hunting – see 'survival of the fittest'. Even this term can be misinterpreted, like living things having some big kind of fight and the strongest one winning – as you can see, it's not quite like that. It simply means that the living being with attributes best suited the environment is more likely to survive and reproduce than one that doesn't. Remember, no decision making – just process.

Children rightly love stories with animals, but this can sometimes create or reinforce misconceptions about them and about evolution. Please don't stop reading wonderful stories to children but do choose carefully which ones you use to support and enrich your science lessons!

EVOLUTION IS LEARNT MOSTLY THROUGH OBSERVATION

Just as Darwin arrived at his theory of evolution through observing living things and recording evidence, children's understanding of evolution can be developed in the same way. They need to be provided with lots of opportunities to 'play at evolution' themselves. Martie Sanders suggested using the attributes of insects to investigate camouflage and survival. For example, on a leafy green plant, which beetle is more likely to be spotted by a predator? And what are the consequences for this beetle?

There are lots of games children can play like this. You could darken the room, like a deep jungle, cut the beetles out, lie them on a green leafy background and give the children ten seconds to pick up as many as they can (playing the role of predator). Because they will naturally find it easier to pick out the black and

then yellow beetles against the green, they will see how more of the green beetles will be left to survive and reproduce with other green beetles. What I find fascinating here is that this shows the localised nature of evolution. Children often think all polar bears came at once or all tigers, or green beetles suddenly appeared. The point is that if evolution begins with variation in a population, this is referring to groups of living things living nearby each other. In this way, the adaptations are local to the population, which of course might be so well adapted to where they are that they get bigger and bigger leading to migration and larger, more global populations. All this is at the heart of the great 'tree of life' and the huge variety of life on earth. Amazing!!!

Here's another great activity which uses different utensils to model bird beaks and how they pick up different types of food:

Bird beak activity and speciation

The Open University has an excellent interactive 'Tree of Life' poster which ou may find interesting and helpful:

Tree of Life