COMMON MISCONCEPTIONS

Can Science and Fiction coexist?

Jules Pottle, PSTT College Fellow, explores how reading fiction might generate or reinforce misconceptions in science

sciencethroughstory@gmail.com

Once, in ancient Greece, there was an inventor, called Daedalus, who worked for a king. He created an impregnable maze to imprison a fearsome beast – a minotaur – a creature who was half man, half bull. When it was finished, the king, fearing this inventor would give away the secrets of this maze, had poor Daedalus and his son, Icarus, imprisoned in a tower. But Daedalus was a clever man. He devised a means of escape. He lured birds with his food and used the feathers and candle wax to create wings to fly away. Icarus was delighted by his wings and loved flying around. He took off, flying higher and higher. Despite his father's warnings, he flew up towards the sun. The wax melted and Icarus fell into the sea and was drowned.

Stories are there to help us to learn: our brains are hardwired to receive information in the form of a story. The Greeks knew that stories are a very powerful educational tool and this story clearly warns us of the folly of showing off and not heeding the warnings of a wise father. But what does this story teach us about science?

- *Wax melts when it is heated – true!*
- *The sun is hot – true!*
- *High in the sky, it is hot*
- *The relatively tiny pectoral muscles of a human are sufficient to beat wings which will lift the relatively huge weight of a man into the sky*

Not all these of these statements are true. Maybe the Greeks didn't know that it is cold when you reach high altitudes (unlikely as there are mountains in Greece which would have been snowy) or that bird skeletons are very light as they are largely hollow (again, unlikely as they would have eaten birds). Or maybe stories don't have to be completely true: they are born of imagination and anything we can imagine can happen in a story.

However, children pick up all kinds of information from stories to help them understand the world and sometimes this might be misinformation in terms of science. Thus, a false model of how something works may be constructed in the mind of a child, as a result of the story.

My son, until the age of four, bewildered us all by insisting on calling traffic cones 'watermelons'. It was only when I revisited 'The Very Hungry Caterpillar' with his younger sister that I saw where he had picked up this idea. Check out the centre page. The slice of watermelon is an orange triangular shape, with white stripy bits and a green line for the base! It looks very much like a traffic cone. It happens: children form strong ideas from something they have seen or heard in a story and those ideas can be wrong, leading to misconceptions.

But does that mean we shouldn't read scientifically incorrect stories to our children in case they pick up a scientific misconception? Or that we should point out the errors? Should we pause in our reading of the story to correct the science?

In order to answer this question, I think we need to see the issue from different points of view.

Firstly, as a storyteller, you don't always need to join all the dots. A story can move on without explaining how or why something happens and it doesn't seem to matter in the process of enjoying the story. We are imaginative beings and can visualise a bear making a rocket from cardboard boxes and taking off on a journey to the moon. We go with the story and imagine the bear's excitement or the view from the porthole window. We don't stop to think about how a bear, with no opposable thumb, cut a hole in the cardboard. This is how storytelling works. We imagine the possible and the impossible with equal ease.

Furthermore, as an actor telling a story in a play, we actually require the audience to suspend its disbelief and engage in fantasy. They can see that the people on stage are actors and that they are not really magic, or flying, or dead but they choose to be swept along in the story, imagining every detail. Clinging too hard to reality will destroy the fantasy.

However, as a science teacher, I do feel uneasy when I tell the story of Icarus and say he flew higher and higher and closer to the sun and the wax began to melt. In my head, I'm thinking, "How far did this man fly? How did he manage to get so close to the sun in the three minutes before he lost consciousness due to lack of oxygen?" I have also seen pictures where impossible things are drawn and sometimes I wonder if the artist has a misconception that needs tackling. For example, I have often seen water vapour, which is invisible, depicted as a cloud of visible liquid water droplets. If we can see the water then it is no longer a water vapour gas - it is a liquid in tiny droplets. But how can an artist draw something that is invisible? Thankfully, many authors are very careful to research the science involved in their stories and avoid writing (or drawing) incorrect science but too much focus on explaining it correctly can stop the flow of the narrative and make it clunky. There's a fine balance to hit.

Lastly, as a writer of science books for the non-specialist teacher, I know how important it is to not overcomplicate the science. It is really hard, however, to simplify the science without it becoming sort of incorrect by generalising or analogising. So, it is not easy to weave in a quick explanation of a scientific idea into a story without noticeably changing the mode of the writing from narrative fiction to a non-fiction explanation text. The science may have to be glossed over or explained in very basic terms to make it fit naturally into the narrative.

So how do we deal with these conflicting views?

The way I have dealt with it is to tell the story as it is written, faults and all. Then I tackle age appropriate misconceptions afterwards. After telling the story of Icarus, we discuss what it is really like when you fly in an aeroplane/go up a mountain and note that it is, in fact, very cold. Then, we discuss how far away the sun is and how close Icarus could have flown. If the children are aged eight and over, they can often spot these misconceptions for themselves. My experience is that, before the age of seven, most children don't have much concept of the very large, the very small, the very far away or the far, far back in time. Space, and the size of it, blows their minds in Year 3 and many of them still can't imagine anything that big, even after we've studied it and modelled it. So, if a picture book for five year olds suggests that you would pass the stars on the way to the moon, for example, explaining that stars are really far away whereas comparatively the moon is much closer, to a small child, is probably of limited value. They can't really picture either distance in their heads.

My school is full of very scientific children who know some highly technical words like atom, proton, dark matter etc at the age of five or six. They have been to see laboratories and science exhibitions or a parent's workplace. Do I believe that they really understand these big concepts just because they can say the words? No. But maybe they'll be a step ahead in finding out what they mean when their brains are ready for that information. In the same way, some concepts are just too big to tackle with small people, even if they appear in a book aimed at them but they can get to know the words and be ready to understand them when they're older.

So, I think misconceptions in fiction are inherent. To be imaginative we need to be able to ignore what is actually possible and visualise impossible things as reality. That is the nature of fantasy and playful writing for children. We cannot avoid the possibility of children picking up misconceptions without losing something that is fundamentally human. Nor can we insist that every picture book ever written is edited by a scientist. But I do think it is worth tackling any incorrect science in the story if the child is old enough to understand that particular science concept. So, celebrate the story. Fly with Icarus! And when the story is over, take the opportunity to explore the scientific conundrums it generates.