Figure 1
A STEM ambassador and children connecting solar cells

STORIES AND SCIENCE stirring children's imagination

Keywords:
Creativity
Literacy

Claire Seeley and Sarah Gallagher share how stories can stimulate science and bring it to life

The world isn't just the way it is. It is how we understand it, no? And in understanding something, we bring something to it, no? Doesn't that make life a story?
(Yann Martel, *Life of Pi*)

Stories are a place where magical things happen, where ideas are challenged, where the imagination runs free and questions are asked. They are a safe place, where you can walk about with new identities, try new ideas, where you can process life's ups and downs and make new meanings. This makes stories the perfect place for creative learning.

Stories as a stimulus for science enquiry

There's always room for a story that can transport people to another place. (J. K. Rowling)

Our 10- and 11-year-olds loved stories with a fantasy theme and became totally absorbed in J. R. R. Tolkien's *The Hobbit*. So much so, that when we discussed the character Bilbo Baggins we even debated whether he was an 'eco hobbit' or not! (We concluded that he was.) We went on to think about his burrow and mused that with only candlelight to read by he may suffer from eye strain – a serious consideration and not good for hobbit well-being! We began to ask questions and consider the idea of bringing electricity to 'Hobbiton'. However, we could not imagine pylons snaking their way across Middle Earth. That would be preposterous, so perhaps a more environmentally friendly solution was called for! And so began our very own quest!

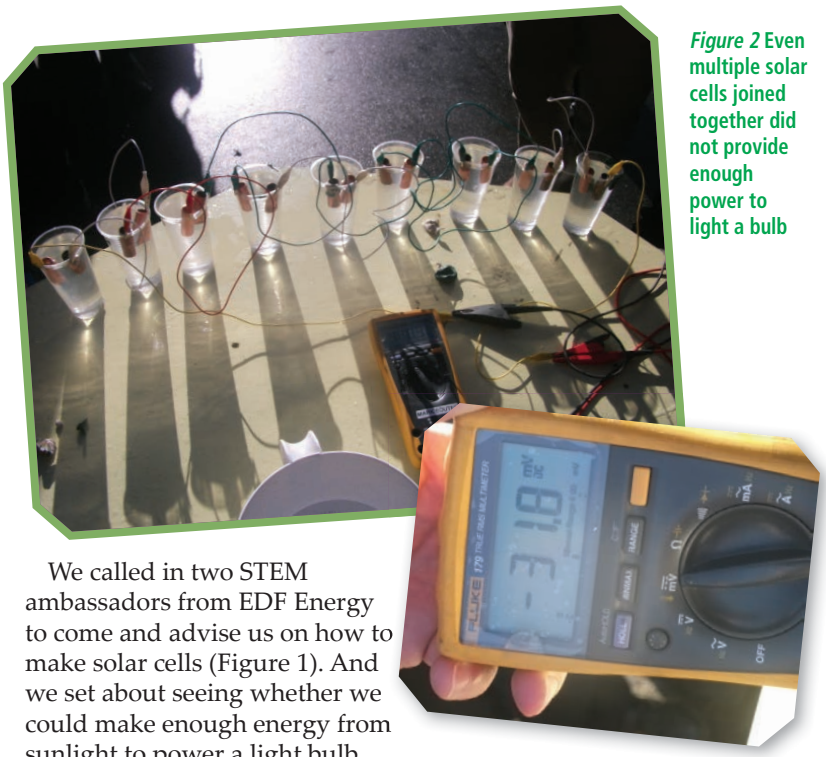


Figure 2 Even multiple solar cells joined together did not provide enough power to light a bulb

We called in two STEM ambassadors from EDF Energy to come and advise us on how to make solar cells (Figure 1). And we set about seeing whether we could make enough energy from sunlight to power a light bulb. Each of us made a solar cell from cuprous oxide and saline solution (see *Websites*). After joining all 20 cells to a voltmeter we realised that the early spring sunshine was not very powerful and that we could only successfully light up an LED (Figure 2). We would need a more subtle and sophisticated solution!

Next we tried making lemon batteries (see *Websites*). Again, by hooking up lots of lemons we succeeded in lighting up a small LED; however, we agreed this was not a practical use of a Hobbit's time!

The children then went onto research and design their perfect Hobbit burrows. They made models and thought about the circuits that they would need to put into their burrows. They wrote letters to Bilbo Baggins, reflecting on and communicating their learning around renewable energy (Figure 3). We found that the story provided an excellent context for the children to explore their scientific thinking: because they loved the story, they came up with the enquiry questions and they were motivated to seek possible solutions.

'What if …?' questions from stories

There are many ways in which stories can be used to develop thinking skills. Questioning is a vital tool in the teacher's toolkit and opens up children's thinking. Taking them away from the mundane, questions allow children to explore possibilities. When reading David Almond's stunning novel *Skellig*, we became really fascinated by the anatomical information about birds that features repeatedly throughout the book. This led to questions about *Archaeopteryx*, the transitional fossil between dinosaurs and birds. Inevitably, we were inspired to think about the character Skellig: What if … you have a creature that is half man and half bird? What would their bones be like? This phenomenal novel talks about the pneumatic bones in birds, so the children wanted to know: Do humans have them? We went on to talk about what it would be like if humans could fly – and the children's imagination took flight.

Stories to promote aspirations

Curiousity is the engine of achievement. (Ken Robinson)

Sometimes, there appears to be a divide for our children and, interestingly, for our teachers, between arts and sciences. And sometimes that message permeates through whole school communities and we see these areas as so distinct that the paths that children take are almost predetermined from a young age. Interested in science? You can't be interested in stories or fiction then! Are we polarising these subjects by the way we teach?

Do children think science is creative? Do we think of our scientists, engineers and doctors as creative? We should. If we keep drawing these distinctions in our teaching, we are narrowing children's learning and this must not happen. To develop our future scientists and engineers we have to encourage our children to think, to dream and to imagine. How else will they be able to create their future? How did George Stephenson, Marie Curie, Thomas Edison, Rosalind Franklin, James Watson, Francis Crick and Maurice Wilkins discover and invent? They dreamt, persevered, let their minds wander and asked 'What if?'

Neil Gaiman, the author of *Coraline* and the rather fabulous *Fortunately, the milk*, made a marvellous speech to the Booktrust, which has been well publicised (see *Websites*). He reiterates the importance of children reading fiction: it gives children glimpses of other worlds, of other possibilities, empathy with characters, and discussion points *and* it inspires imagination. It also enables them to try things out in imaginary settings or roles; it may be easier to make mistakes in a supported,

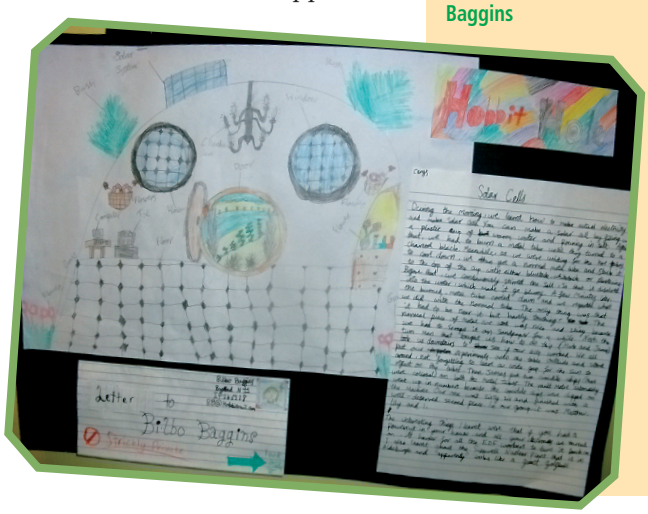


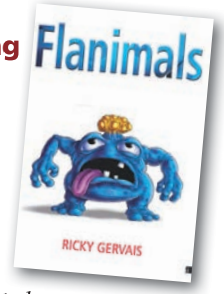
Figure 3 The children's ideas on solar power shared with Bilbo Baggins

Box 1 Word games to play with a set of flashcards on your topic

- **Vocabulary check**. Sort through the flashcards. Can you define these words? Are there any you don't recognise?
- **Sorting and classifying**. Sort these words into groups. Explain your choices. (Can extend to Venn or Carroll diagrams with more able children.)
- **Articulate.** How many words can you describe to your group in a minute?
- **Taboo**. Make your own taboo cards, putting a word at the top of the card and listing four common words associated with it underneath (the taboo words). Then describe the word to your team without using the taboo words.
- **Pictionary.** How many words can you draw in a minute?
- **Bingo.** Draw bingo grids using the keywords from the flashcards. As someone describes the words, cross off the keyword if you have it on your grid.
- **Science charades.** Mime the word on the flashcard to your team. Can they guess which word you are miming?

safe setting. Children need to read stories as well as information books to inspire their science work, to make them want to read on, to dream on, to help them make sense of the world and deepen their knowledge and understanding of it.

Stories as a window into children's understanding



I am enough of an artist to draw freely upon my imagination. Imagination is more important than knowledge. Knowledge is limited. Imagination encircles the world. (Albert Einstein)

When children put their scientific learning into stories, they engage with their learning using higher-order thinking skills. When they create their own stories you can see whether they truly understand the vocabulary and can apply it correctly. This has proved invaluable in assessment.

For example, we were learning about microorganisms and began by exploring the real world of viruses, fungi and bacteria (see *Websites*). We had been inspired by the characters in the *Flanimals* books by Ricky Gervais and the children wanted to invent their own Flanimals. Their writing was rich in the language of living things as they imagined their Flanimal's diet, its habitat and life cycle. They thought about how the Flanimal reproduced or spread and how it might affect people who came into contact with it.

When some children misused scientific vocabulary, it signposted that they would benefit from guided activities to enable them to broaden their scientific vocabulary. Specifically teaching vocabulary to small groups, using a combination of focused practical tasks and language games such as those in Box 1, is a really useful strategy, especially for children who have special educational needs or English as an additional language. Following this investment, the children then access whole-class activities more confidently and are better prepared to access the wider science curriculum.

Stories with a science theme

All grown-ups were once children … but only few of them remember it. (Antoine de Saint-Exupéry, *The Little Prince*)

It is our job to engender curiosity and create learning environments where we can entice children into learning and making discoveries for themselves. Using the wonderful wealth of children's fiction that is at our fingertips today is one way of immersing children in an exciting learning culture, instilling that 'what's in it for me' feeling, and finding 'ways in' so that all our children can gain a love of science. Our world is made of stories: the story of us and the story of the children themselves -– this is a way of helping them make their own story.

We have prepared a book list that contains some recommendations for a jolly start to a range of science topics. It includes some very well-known titles, such as J. K. Rowling's *Harry Potter*, fantastic for a way into plant growth (remember the

re-potting of the Mandrakes?) and kitchen science, including mixing potions and observing changes. The timeless *The Lighthouse Keeper's Lunch*, by Ronda and David Armitage, provides a context for setting up ropes and pulleys, construction and water play as children explore how the very important lunch is transported – the 'whys' and the 'hows'. Tanya Landman's *Flotsam and Jetsam* series is less well known but no less delightful, ideal for ages 6 to 8. Two characters live under an upturned boat, using what is washed up by the sea and having gentle adventures. In Simon James's *Baby Brains* and Frank Cottrell Boyce's *Cosmic* both characters (for different reasons) end up in space. What was it like for them? Did they like it? What was the atmosphere like? Why are they dressed like that? Why did they have to train?

Creating a setting in your classroom around a fiction book is a way to captivate children's imagination. When they are immersed in that world they will want to find out more and that is where you as a science teacher come in. It is not just about teaching science in primary school, it is about the future of science and about encouraging our children to enjoy and want to do it, rather than squeezing them into narrow channels that exclude it. Helping children to imagine is important: we need to imagine we can make a difference as scientists, as engineers, as chemists, as teachers, as pupils and as human beings.

As Neil Gaiman says:

But the truth is, individuals change their world over and over, individuals make the future, and they do it by imagining that things can be different.

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For a copy of the book list mentioned, go to: **www.ase.org.uk/primary**

Websites

Learning about fungi, viruses and bacteria: **www.e-bug.eu**

Making solar cells: **http://scitoys.com/scitoys/scitoys/echem/echem2.html**

Making lemon batteries: **www.energyquest.ca.gov/projects/lemon.html**

Neil Gaiman speech: **www.theguardian.com/books/2013/oct/24/neil-gaiman-face-facts-need-fiction**