Figure 1 One of the inventions: *The Family Scooter* by Wendy, age 9

LITTLE INVENTORS: imagining futures through creative science, art and design

Katherine Mengardon highlights how with some creative thinking children are solving the issues of the future

Ken Robinson (2006) once suggested that schools kill creativity and it is argued that in England, since the introduction of the most recent iteration of the National Curriculum (2013), creative subjects are in danger of being marginalised in favour of spending time preparing for high-stakes testing in maths and English. We also know that children may experience brief forays into science through prescriptive, confirmatory tasks, leading to obvious results, rather than engaging and child-led enquiries. Oliver (2006) makes the assertion that a teacher's role is to stimulate scientific curiosity and encourage creativity in children, which is crucial in developing the scientific culture of a country.

Meet Little Inventors! It is a simple idea: we invite children to think about and draw invention ideas, with no limits. The most ingenious and thought-provoking ideas are then brought to life with the help of artists, makers and designers. This is for all teachers looking for novel ways of bringing creativity and the 'wow' factor into children's science lessons.

The Little Inventors approach

Davies (2011) reminds us that it is not enough to leave children's creative development to the arts; rather the fusion between science, art and design has real potential in helping children to experience the interdisciplinary nature of inventions. We know that creativity and problem solving are some of the core tools that the future generation needs, and Little Inventors believes there is huge value in taking children's ideas seriously. It is about nurturing their confidence, giving them the freedom to explore STEAM subjects (science, technology, engineering, arts and maths) and the world around them playfully, instilling this curiosity in every part of life. In short, we think inventing should be on the curriculum!

To do this, Little Inventors creates fun, themed challenges to capture children's imaginations, together with

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Figure 2a,b Gruff's no-pollution jacket

resources for teachers to provide lessons to support the challenge. All the resources are developed with simple step-by-step guides, learning outcomes and differentiation, linked to the curriculum. The aim is to make the activity as flexible as possible for every teacher. Challenges are also set online via the littleinventors.org website.

All submitted invention drawings are reviewed and children are given positive feedback (sometimes from VIPs too!). This shows children that their ideas really matter and encourages them to continue thinking in creative ways. Some of the most ingenious inventions are then taken forward and actually made by makers, artists and engineers, involving the children who designed them as much as possible.

Here are some of those inventions as inspiration for your own Little Inventors.

Figure 2c,d Gruff's jacket being made

The No Pollshon Jacket (no-pollution jacket)

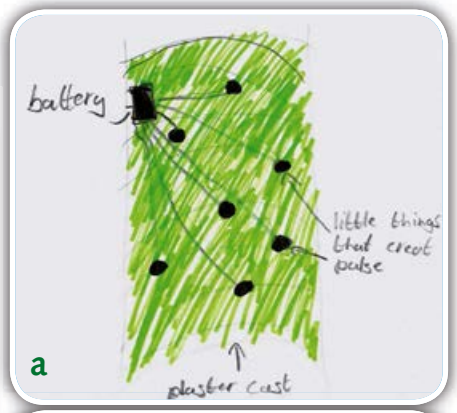
Gruff, age 6, in London, decided to design a jacket for tackling air pollution (Figures 2a,b). Gruff explained:

It keeps car fumes away from the person wearing it. It is made of waterproof fabric (polyester) and has a filter over the face that you can see through. The jacket sleeves are reflective so people can see you. This is for people who want to keep away from the car fumes and people with asthma like me.

Gruff's idea was made real by textile designer Barley Massey using recyclable materials and including air filters in the hood (Figure 2c). Once made, we took it to Zoe Laughlin, Director of The Institute of Making in London. She added a little bit more science to Gruff's jacket by spraying it with titanium dioxide, a substance that is known to break down pollutants in the atmosphere (Figure 2d). Gruff's jacket has been exhibited in several museums and is heading to the Triennale Design Museum in Milan, in spring 2019, to be part of the Broken Nature exhibition.

The Pulser Caster

Andrew, aged 9, in Wylam, UK, wanted to help people with broken limbs. He came up with his idea after his granny had an accident that left her in a cast for six weeks and led to her spending a long time doing physiotherapy to rebuild her strength. The NHS Innovations Lab in Sunderland offered to help Andrew bring his idea to life. Staff in the Medical Physics Department and the Fracture Clinic team joined forces and



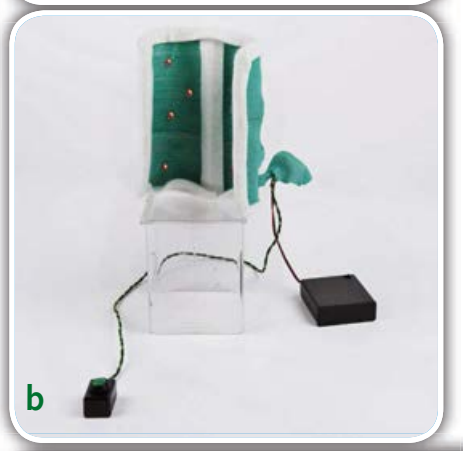


Figure 3 Andrew's invention for helping people with broken bones

used their expertise to help Andrew create his invention (Figure 3). They loved his idea and thought it has the potential to really help patients recover faster from a broken bone. You can see a film of Andrew talking about his invention on littleinventors.org. Andrew commented:

My machine keeps people's muscles strong around a broken bone. It is for people with broken bones because normally the muscles become weak, but with my machine they don't.

A Smarter House

Adriana, age 10, lives in Newcastle Upon Tyne, UK. Her father explained that one of his friends had a serious accident and was in a wheelchair, and that Adriana had designed this house for them (Figures 4a,b). Adriana almost didn't submit her invention idea, as she thought it looked too scruffy. Thankfully it didn't stop her in the end. Adriana's design really impressed architectural firm FaulknerBrowns, who decided to develop it as a model. They thought it cleverly combined sustainable technological innovations alongside inclusive design solutions. They were also impressed with her attention to detail, as she incorporated a series of small-scale inventions such as rainwater harvesting, waste recycling, photovoltaic glazing and water recycling to make sustainable living a convenient choice in this home. Adriana wrote:

My invention recycles food waste into energy, is eco-friendly and is solar-panel powered. My invention has staircases that turn into ramps so disabled people can access every part easily. The smart house is a triangle, the strongest engineering shape, and is made from my invented lightning-proof glass that absorbs heat from the Sun.

Adriana was put at the heart of the model-making process on several visits to the firm, where she was able to discuss her design and influence the making while gaining first-hand experience of all the skills and careers within architecture (Figure 4c). She got to meet and explain her invention to Mark Carney, the Governor of the Bank of England, and to DCMS Secretary of State, Jeremy Wright MP, during the Great Exhibition of the North in June 2018, as well as taking a star turn on the BBC *Breakfast* show alongside three other Little Inventors in front of 8 million viewers!

Figure 4a,b Adriana's design for a smart and accessible home

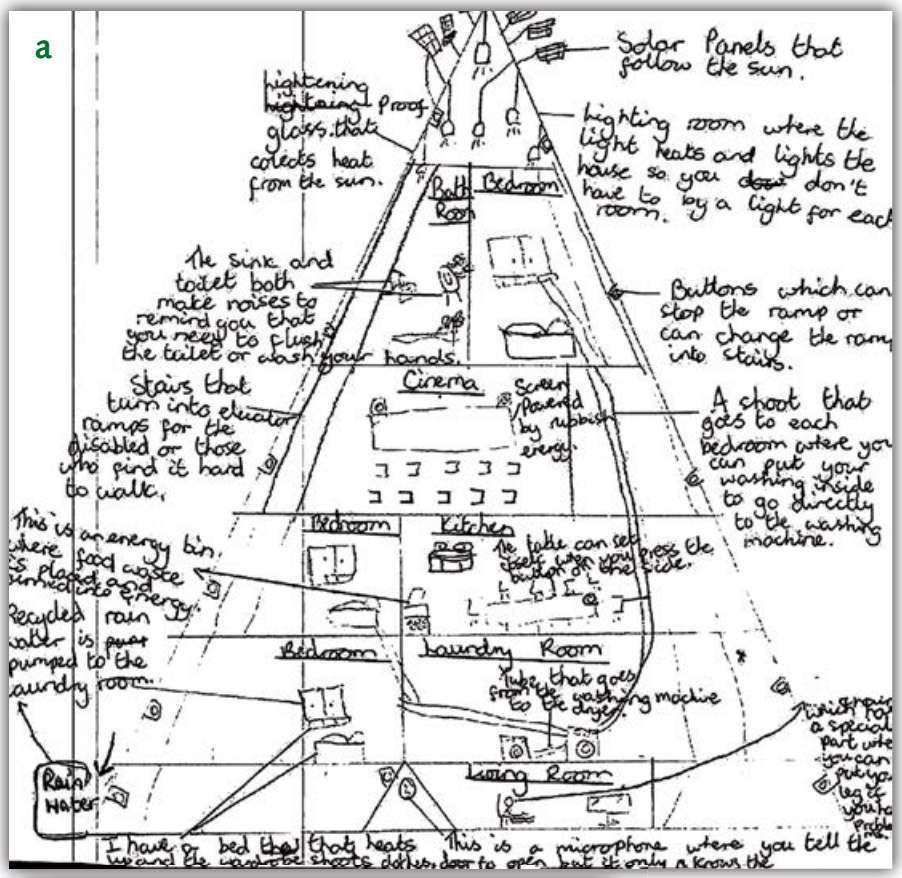


Figure 4c Adriana gets down to learning about architects' models

Little Inventors across the globe: *GassPasser 3000*

Over the past few years, Little Inventors has been busy setting up events and opportunities across the world for children and young people to get inventing. For example, the space challenge inventions were developed in partnership with the Natural Sciences and Engineering Research Council (NSERC), the governmental body that promotes science and fosters innovation across Canada, and the Canadian Space Agency. The challenge looked at how to improve the life of astronauts in space, while exploring specific aspects and challenges of life in the International Space Station, ahead of astronaut David Saint-Jacques' trip in December 2018. The resources have already been downloaded over 2000 times and used all across Canada and beyond. 13 invention ideas have been made and are currently touring in exhibitions in museums around the country, with

more inventions underway in 2019!

One of the great ideas designed in Canada came from Emily (aged 12), who lives in Kingston. She imagined the *GasPasser 3000* (Figure 5). Emily wrote:

Ever hate having to make the area you are in stink because of having to pass gas? Well GasPasser 3000 is handy for that. All you have to do is, when you feel ready, take the GasPasser and put the green sucker near your rear end and fire (aim). Oh, don't forget to press the yellow button. This will turn your gas into rose-smelling scent!

Far from turning its collective nose up at Emily's invention, the Canadian Space Agency (CSA) was impressed. Mathieu Caron, one of their senior operations managers, said:

This is a clever idea when you work in a confined space with a team! It's also smart that your invention doesn't use water as water supplies in space are very limited. Performing any personal hygiene task requires resourcefulness and ingenuity, just like your invention!

The invention was prototyped by CSA graphic designer and model builder, Diane Minier, who thought it was as simple as it was important. She picked this saying only a child would have this sort of idea! It seems the invention really struck a chord with the space experts. Two inventions from the space challenge will also be exhibited in the International Space Station and the inventors will take part in a downlink from space with astronaut David Saint-Jacques in May 2019!

Figure 5 Emily's *GasPasser 3000* serves a vital purpose in space!

Bloomin' marvellous! *Supergrow 11000*

In the UK, Arthur, aged 8, from Stockton-on-Tees is a keen gardener. He wanted to maximise plant growth and knew that energy plays a key part:

Sick of your plant getting only half a day's worth of sunlight? Well, with Supergrow 11000 your plant will be able to grow twice as fast. It is built so that you place the growing plant on a moving platform which follows the Sun throughout the day and therefore provides the plant with a whole day's worth of sunlight. This invention is built for Monty Don and other gardening enthusiasts!

The brilliant thing with Arthur is that he truly means business. Since his invention was brought to life by the G Scale society, a model railway society in north-east England,

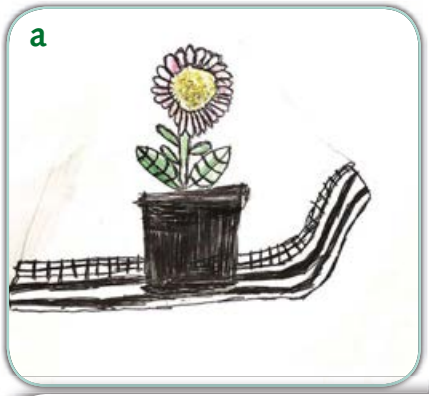


Figure 6a,b Arthur's *Supergrow 11000* invention maximises the sunlight needed for growth

Arthur naturally got in touch with his favourite television show to tell them about his invention! Lo and behold, the hugely popular BBC television show *Gardeners' World* decided to pay Arthur and his family a visit to talk to him about his love of plants and see his invention in action (Figure 6c). Arthur's other love is astronomy and *Supergrow 11000* was his way of bringing his two passions together.

Discreetly quiet! *Silent Ear Covers*

One of the most valuable aspects of invention through imagination is that we can bring our own special perspectives into our creations. Emily

Figure 6c Arthur has a visit from *Gardeners' World*

(aged 8) in Sunderland, UK, certainly did this with hers. Emily can suffer from sensory overload, and she likes to find quiet places and spaces when she can, so her invention (Figure 7) is very personal.
She explained:

The Silent Ear Cover is a rubber ear that fits over your ear to block out noise. It looks like your own ear so people don't notice. It is for people who don't like noise when noise can upset and stop them doing activities; useful for people with autism and sensory problems.

Emily's idea showed a great deal of thoughtfulness and artist Bethan Maddocks was invited to create the ears for her. Far from noise cancelling, they garnered quite a buzz and Emily got to mix with royalty when Prince William and Kate came to visit Sunderland, where she showed them her idea. She was invited to become judge of honour too for competitions! But the best thing was really the following message from her parents:

We would like to thank Little Inventors for all the opportunities you have given Emily. Emily works hard at school and is always well behaved, despite the anxiety and sensory overload she encounters each day. She is also very caring and the younger children often come to her when they need help or are upset. However, she disappears into obscurity within the class because she is not the highest achiever academically and doesn't cause disruption. This can be frustrating for her when she is not recognised for her effort and sees other children awarded repeatedly for high scores or for 'behaving that week'. However, her involvement with Little Inventors has massively helped her confidence and means a great deal to her as she feels that she is part of something bigger.

Figure 7a,b Emily's *Silent Ear Covers*

Figure 7c Emily receiving her award

So get inventing!

This is the whole point: Little Inventors is a way to give children a voice about how they view the world and how they approach it. Teachers are finding out things they may not have realised about their children too! Recently, while delivering a school workshop, young pupils were described as 'low on imagination' before the session. However, within the hour they proved to be anything but, producing a plethora of beautiful drawings depicting fun, thought-provoking and innovative invention ideas. Indeed, some proved so good that they were chosen to be made real. This showed that, when given a bit of breathing space and freedom to play, children can truly embrace their natural creativity and do inspiring work both in the classroom and beyond.

Would you like your children to have a chance to become Little Inventors? All resource packs are free and available from littleinventors.org. *The Little Inventors handbook* is a step-by-step guide to inventing published in October 2018 by HarperCollins. And you can also subscribe to the Little Inventors newsletter to find out about new challenges and workshops coming up!

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