Introducing your class to female scientists and engineers: getting started

Joy Parvin shares the stories of four female scientists working in industry

Figure 1 *(above)* **Vanessa presenting to multiple science, engineering and production teams within Johnson Matthey, Herts**

Figure 2 *(left)* **Yulia is a senior formulation chemist at Thomas Swan, Co. Durham**

In preparing this article, I engaged the help of four wonderful scientists and engineers working in industry today. I have been humbled by the conversations I have had with them and the stories they have shared with me, and that I can now share with you.

Let me introduce Yati and Vanessa, who trained and worked as engineers before becoming senior managers for Johnson Matthey in Hertfordshire, and Reyan and Yulia, who are chemists at Thomas Swan in County Durham. Their stories have been gathered in a way that teachers could recreate themselves, but of course they can be shared directly in the classroom. I found Yati's story particularly moving, and therefore wanted to share it in full, whereas I have quoted the others throughout this article to exemplify the importance of sharing their voices to cover different aspects of women in STEM professions. But before I get in to 'how' to introduce these women in to primary classrooms, let's start with 'why?'

Combatting stereotypes

Did you know that in 1919, around 10% of UK engineers were women, and 100 years later, we have reached the dizzy heights of 12%? We therefore have a lot of work to do, not only to overcome stereotypes but to encourage girls to think that careers in science and engineering could be for 'people like me' (WISE, 2020). For too long, we have focused on 'dead white men' who were 'really clever', which masks the opportunities that are available to girls of all ethnicities in the 21st century, from university study to apprenticeships. Even the current National Curriculum for Science in England only mentions white scientists, and only a handful of these are women.

Yati outlines her family's reaction to her wanting to become an engineer (Box 1), as this was not the expected route for a young Indian woman, and Reyan describes her family's shock below. By introducing children to these positive role models, as 'real people' who have been determined to follow their dreams and aspirations, a world of possibility starts to open up, and the thoughts are seeded.

Reyan's advice to young girls is: *Don't let anyone tell you that you can't do something. If you really want something in life then you just have to go for it, and give it your all.*

Developing children's science capital

Enriching children's experiences of science beyond the curriculum increases their own personal 'portfolio' that they will carry with them through life (ASPIRES Research, 2020) and

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Figure 3 Reyan weighing milligrams of solids, almost like tiny grains of sand or crystals of salt, before analysing the data on her computer, at Thomas Swan, Co. Durham

which can help them make informed choices about subject and career choices when the time comes.

Conversations with family are vital to children's thinking, aspirations and decision-making processes, and those lucky enough to have a range of professions represented in their family can access these conversations readily. However, others rely on the spark created in school settings to seed these thoughts, and for *them* to start the conversations at home. Our research at the Centre for Industry Education Collaboration (CIEC, 2020) has found that interactions with STEM professionals do just this, as two year 6 girls (ages 10–11) told us in 2019:

My parents said they were glad that I liked my experience and my brother said he would like to do the same lessons and trips I have.

They said that was really cool and my dad told me about his past job as an engineer in a chemical factory.

The memories of Reyan and Yulia reflect these differing but important conversations:

My family was very shocked when I wanted to be a scientist called a 'chemist' and kept asking me if I would be working in Boots Pharmacy! After a long conversation, everyone started to understand a bit more. My parents are very proud that I decided to go to university when I was 10 years old, and they were so proud that I was the first in my family to go to university. (Reyan)

My mother was the head of a lab in a hospital and always could explain difficult science in an easy way. (Yulia)

Yati's experiences were different again, and it was her determination and resilience that were crucial to her following her chosen career path (Box 1).

Developing essential skills

Developing essential skills in primary schools is commonplace across all subjects, and the primary science classroom provides the perfect environment in which to do so, but have you ever considered discussing with children the importance to employers of skills such as teamwork, problem solving and communication? These skills form important criteria for scientific and technical apprenticeships, and are beautifully summarised for teachers in the Skills Builder Universal Framework (Skills Builder Partnership, 2020).

The idea that scientists work in teams is often a surprise to children, who envisage the lone scientist working at a lab bench day in, day out – and girls in particular can find this notion quite unappealing. Reinforcing the idea of teamwork in industry can be achieved by replicating these teams in the classroom by giving children roles that are similar to those used in the workplace, such as Health and Safety Officer, Communications Manager, and so on. In addition to replicating the roles in industry, this also provides a great way of organising your class.

The importance of teamwork was mentioned by all of the STEM women in their stories – with 13 mentions in all – with all of them leading or being part of a team:

I lead research and development projects for my team, which involves carrying out new experiments and developing new materials that can be used as ingredients to improve plastics, glues, paints, etc. I work as part of a team and on my own initiative. (Yulia)

I test samples from the factory when there has been a problem, so other scientists and engineers in the team can quickly put it right. We work as a team, and I help, support and train other scientists, making sure that all the scientific machines in our labs are working properly. (Reyan)

I bring together teams of people from different parts of the company, to ensure they understand our common purpose to make us better at achieving our goal – a bit like teachers making sure you understand learning objectives. I need to be comfortable at not being an expert in everything to support a team of experts in subjects I don't always understand. (Vanessa)

I have received a lot of feedback over the years from my team members thanking me for the difference I have made to their careers and working life, and this is an amazing feeling. (Vanessa)

Of course, good communication skills are important in teamwork, and discussion of ideas and problem solving relies on these:

I need to be able to listen to and understand a lot of information. I then need to be good at sharing this information clearly and briefly so everyone doesn't get bored and stop listening! (Vanessa)

When I was factory manager, our new computer system went wrong. I led my team through the crisis, taking responsibility for solving the problem and working long hours to do so. We fixed the problem and my team and my bosses thanked me for what I did. (Vanessa)

So what can you do next?

Have you asked your governors, parents and carers if there are any STEM professionals among them? Send them a questionnaire, asking the kinds of questions I asked Yati and colleagues (please get in touch with me for a full list of questions), and share their answers with children in school. Always include questions that emphasise the humanity and normality of these scientists and engineers ('people like us'), by asking about their favourite *primary* school subjects, hobbies and interesting facts. Here are some of the responses I received:

When I was a kid I loved to play with Barbie dolls, Lego and going out on my bike. When I got older I ditched these for Taekwondo and swimming, and I've since taken back up playing Lego with my dad and playing board games with my friends. I also love to bake every weekend. (Reyan)

Box 1 Profile of Yati Varshneya, senior manager at Johnson Matthey

Yati Varshneya is European Region Prototypes and Samples Business Manager at Johnson Matthey in Hertfordshire.

That's a long job title – what does that mean you do?
Our company uses science to create innovative products that massively reduce polluting gases from car engines, and our scientists are always improving these products. I am responsible for a team that makes 'prototypes' to show customers all over Europe our latest ideas.

What or who inspired you to want to do this?
I grew up in India and was born into an extended family with 40 people living under one roof. My dad had a factory that made menthol. I remember when I was 12 experimenting with solids, liquids and powders (chemicals), as I was inspired by my dad. We created a product that was used in medicine and food across the world. So, I became a chemical engineer, worked across three different continents at two of the world's leading companies, running different areas of Johnson Matthey in India, before moving to England in 2015.

What were your favourite subjects at primary school, and what did you study as you got older?
I really enjoyed arts, science and mathematics at primary school. I chose chemical engineering at university, as I was interested in creating something that could make interesting experiments possible on a huge scale to improve people's lives.

What skills and qualities do you need for your job?
A good understanding of engineering and science! Passion and love for my job, a positive attitude and belief in the power of possibility.

How have you overcome any barriers you have encountered?
Through courage I have become resilient, learning from each experience and failure, never giving up, and by seeing challenges instead as stepping-stones – from being an unwanted female child, to becoming the first female to leave my home town. At times I have been the only woman in the manufacturing area and in management teams. Since being a young girl, I have wanted to be a business leader, breaking the Indian tradition for women to stay at home and marry young. I still remember the day I refused to eat as a final tactic to negotiate my way into university, and today, 17 years later, I am in the UK leading one of the business areas in a FTSE100 company!

Figure 4 Yati is checking the product that goes in a car's exhaust system to clean gases as they leave the engine

What advice would you give to girls wanting to follow in your footsteps?
Follow your dreams and work hard to get there. The world needs you to become a better place. Adapt, play around with different ideas, and stretch outside your comfort zone.

What is your biggest career achievement?
I will talk about the one that is very close to my heart: the completion of a state-of-the-art plant (factory) with new technology *and* new product. The reason I say this is my greatest accomplishment is because it resulted in many people developing into better professionals, our operators enjoyed moving from manual to fully automated operations, our engineers were developed into good managers and my team became better scientists.

What are your hobbies?
As a child, I loved painting, dancing and creating craft works. I loved doing science experiments with my dad and elder sister and enjoyed learning and working in my father's laboratory.

Tell us an interesting fact about yourself
I volunteer for the Heartfulness organisation, as I want to encourage others to get as much out of meditation as I do, and for others to feel 'the power of possibility'!

I live on the River Great Ouse in Cambridgeshire and we have a seal that swims in our river; last year the mummy had her baby on our garden – it was very exciting to see science in action! (Vanessa)

When I was 8 I was a model, but that didn't last very long, and now I like to run muddy obstacle courses where I end up bruised from top to toe for weeks! (Reyan)

At primary school I enjoyed all subjects but was drawn to science, and eventually studied 'chemical technology' in Moscow, including studying to become a Doctor of Science (not quite like Dr Who!) (Yulia)

Additional resources available through CIEC

- **Career cards** – significantly simplified similar information for four scientists and engineers, in a set of card games that children can play, with accompanying teacher guidance: **http://ciec.org.uk/primary/career-cards.html**
- **Videos** – female engineers ask children to carry out science problem solving relevant to their areas of work, developed to support home learning, but equally valuable as a classroom activity: **http://ciec.org.uk/industry-at-home.html**
- **Free printable role badges** and guidance on their use for supporting group work: **http://ciec.org.uk/resources/role-badges.html**

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Joy interviewed:
Reyan Clarey, Analytical Development Chemist at Thomas Swan
Yulia Dean, Senior Formulation Chemist at Thomas Swan
Yati Varshneya, European Region Prototypes and Samples Business Manager at Johnson Matthey
Vanessa Wu-Barker, Operations Programme Lead at Johnson Matthey

References/Weblinks

ASPIRES Research (2020) Longitudinal research project studying young people's science and career aspirations: **www.ucl.ac.uk/ioe/departments-and-centres/departments/education-practice-and-society/aspires-research**
CIEC (2020) Research & Publications: **http://ciec.org.uk/research-and-publications.html**
Skills Builder Partnership (2020) One universal framework for essential skills: **www.skillsbuilder.org**
WISE (2020) Inspiring girls: **www.wisecampaign.org.uk/what-we-do/expertise/inspiring-girls-with-people-like-me**