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# Extracellular matrix: without it, we would be just a shapeless mass of cells

A Science Outreach Project by Piccinini lab, University of Nottingham

A report by Dr Anna M. Piccinini



# Introduction

This project was developed at the University of Nottingham, School of Pharmacy, by Dr Anna Piccinini and Miss Grace Needham (second year PhD student in Piccinini lab). The activity was enhanced by our close collaboration with Dr Hilary Collins (our outreach co-ordinator) and supported by Mrs Helen Baird, a year 6 teacher at Middleton Primary and Nursery school. Furthermore, to enhance the long-term impact of the project, we collaborated with the British Society for Matrix Biology (BSMB).

This half-day event was our first science outreach project of this kind, aimed at year 6 pupils (90 children) at the Middleton Primary and Nursery school in Nottingham. We spent one hour with each of three classes captivating the children with engaging activities and interactive elements. During a second visit, the children showcased their own models of the extracellular matrix that they had made at home after the first session. The Biochemical Society funding I received was used to supply sensory and colourful resources for the models and to provide a certificate and cash prize which were awarded to enable the school to buy science books and resources for children in year 6.

## What motivated us to do this?

We wanted to:

- 1) Fascinate children about science.
- 2) Inspire young people underrepresented in STEM to love STEM subjects and motivate them to carry on their study in a STEM subject.
- 3) Educate the public that the extracellular matrix is not just about collagen drinks and cosmetics.
- 4) Inspire other scientists in the field, especially early career researchers, to reach out to children and talk to the public about this topic.

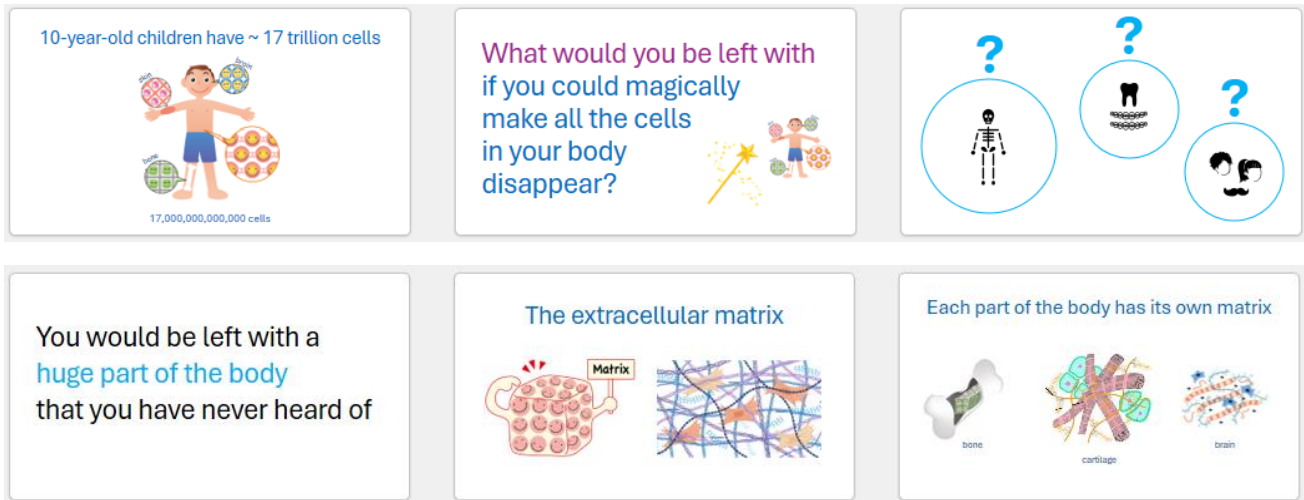
## What did we achieve with this project?

### **1) Fascinate children about science.**

We achieved this aim by providing diverse activities and interactive elements helping pupils engage in and enjoy a science workshop. We believe that these hands-on, creative activities can generate a lifelong impression in children.

To break the ice and boost children's self-confidence, we used visuals illustrating the fact that our body is made of many, many cells, a concept familiar to them. Soon the children were buzzing with excitement as they were answering the question "[what would you be left with if](#)

you could magically make all the cells in your body disappear?”. With most children’s hands up high, it was very rewarding to listen to their answers and witness their natural curiosity and innate drive to understand how things work as they learned about the extracellular matrix, a fascinating (and huge) part of the body they have never been told about!



**Visuals used to introduce the extracellular matrix.**

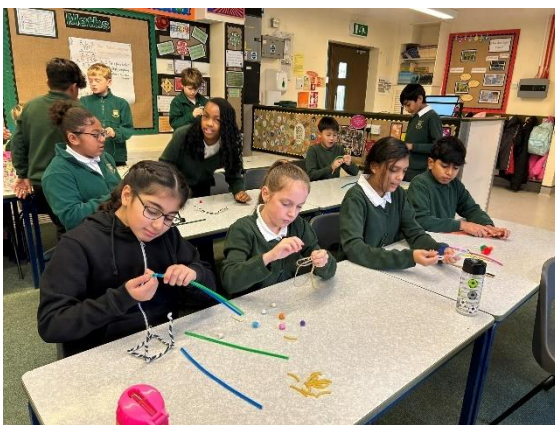
The children went on learning that the matrix is different in different parts of their body. By touching their own knuckle bones and a chicken bone, they noticed that in the bone the matrix is strong, rigid and hard. By bending the tip of their nose and their ears, they realised that in the cartilage the matrix is strong but flexible. And by observing some jelly with pieces of fruit in it, they learned that in the brain the matrix is very soft and flexible.

To help the children understand why the matrix is important, we involved them in hands-on activities. Brittle chicken bones wowed the children as they realised that if bones lacked collagen, they would break easily. Then, bendy chicken bones made children’s jaw drop and appreciate that the bone loses its strength if calcium is removed from the bone matrix.



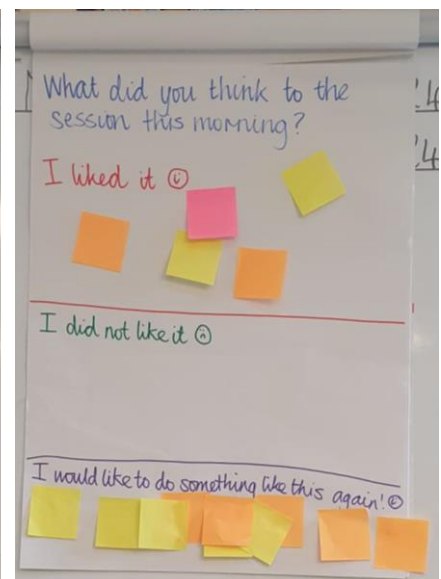
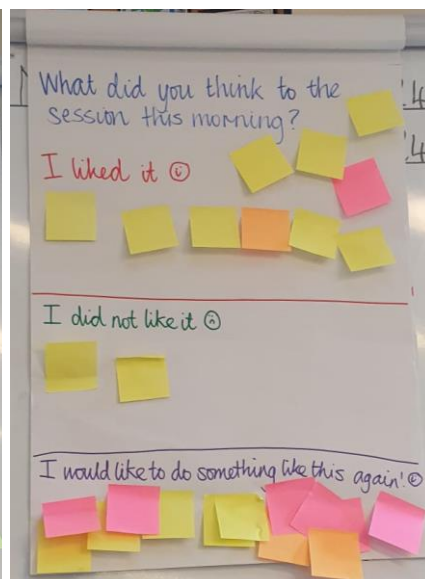
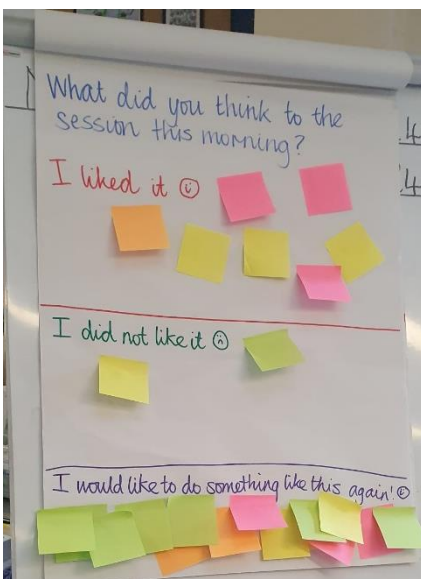
**Bone matrix visual and photographs of children exploring, bending and breaking bones.**

For the final part of the science workshop, children were invited to build their own matrix models. Some children created “dynamic” 3D models of the matrix by working in groups of ~5 to make 3D networks of collagen fibers (using wool knitting yarns) around cells (the children) that interconnect them. All children, in pairs, created 3D models using pipe cleaners and other craft resources of different colours, textures and shapes.



Photographs of children creating 3D models of the extracellular matrix and examples of materials used to make triple-helical collagen fibers (wool knitting yarns, top; pipe cleaners, bottom), polysaccharide chains (macaroni pasta) and cells (clay and googly eyes).

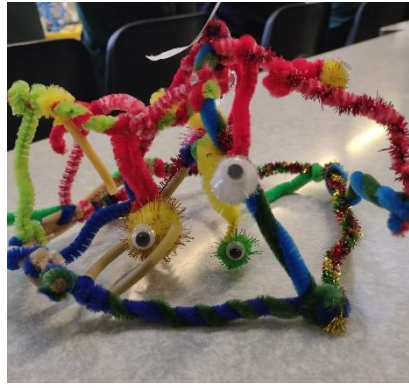
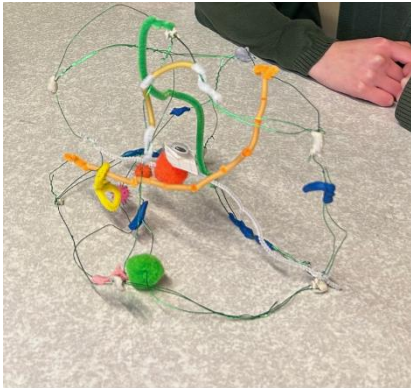
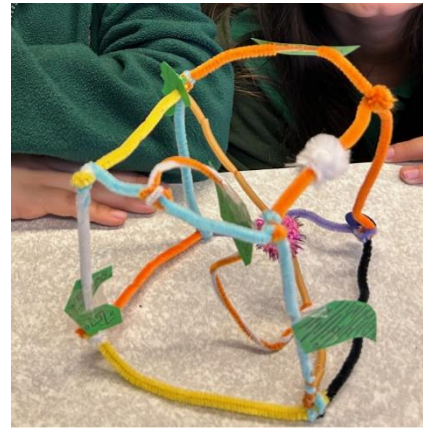
Feedback from the children:



73 out of 90 children gave feedback at the end of the session. We were pleased that over 64% of the children “*would like to do something like this again*”.

Feedback from the teachers who were sent a short survey after the session:

- 1) Was the session interactive?
  - *It was a very interactive session, and the children enjoyed being able to handle the jelly and the chicken bones.*
  - *My class enjoyed the session and it was good that they were actively involved and not just sitting and listening for an hour.*
  - *The children really enjoyed the workshop.*
- 2) Please comment on children engagement in learning and activities.
  - *The children were all involved in the activities and this was great because it allowed children of different abilities to work together.*
  - *My class learnt new things this sessions - it was great to see them making links with their prior learning and the completely new things being introduced during this session.*
  - *We all went away from the session having learnt something new and exciting.*
- 3) Was the session pitched at the right level to year 6 children?
  - *I felt that the session was pitched at the right level for Y6 children. Even the children with lower abilities were able to engage and understand.*
  - *The ideas being taught were quite complex but were presented in such a visual and interactive way that all the children could understand clearly.*
- 4) Would you host this session again?
  - *We would be very happy to host this session again in school. The children enjoyed it and benefitted from it.*
  - *It's an invaluable experience for them to have this kind of specialist input to add to the science curriculum.*
  - *We would very much like to repeat the sessions next! That will be great to include in our planning for Science next academic year.*
- 5) How did/will the children benefit from this session?
  - *Children will go on to learn about the circulatory system and nutrition later in Y6. This session will add to their understanding of the working of the human body and when we come to talk about cells the children will have some existing knowledge.*
  - *Children are now more aware of the role of the extracellular matrix in supporting cells in place and connecting them to each other. They will be able to put cells in some context.*
  - *Meeting real-world scientists will help children move away from common tropes about scientists and see that scientists are people like them. They will be more likely to consider a career in science.*



Examples of 3D extracellular matrix models made by the children at home.

### **6) Inspire young people underrepresented in STEM to love STEM subjects and motivate them to carry on their study in a STEM subject.**

Our audience included female children from different backgrounds living in the East Midlands and neurodiverse and disabled children who are underrepresented in STEM. Children living outside London tend to have less opportunities to interact with scientists and science and technology events. To help steer females towards STEM, we have provided them with the invaluable opportunity to meet two female scientists (the PhD student and I), and to help inspire all children to love STEM subjects, we have provided fun and hands-on activities allowing pupils to engage in and enjoy a science workshop.

We designed our activities in a way that every child could feel involved, including one child on a wheelchair with cerebral palsy and five children with diagnosed ASD and/or ADHD: we used diverse resources (from sensory objects to visuals) to ensure that children with vision problems and/or neurodiverse children could also feel included; we allowed children to decide whether to work in small or larger groups depending on what worked best for them; we offered a “dynamic” activity for children who preferred to move around and/or struggled to work or focus in a sitting position, and a “static” activity where the children, including those on a wheelchair, could build their models in pairs at a table; we used vegan Jell-O to make a model of brain matrix as some children are not comfortable touching gelatin; and we run the activity in the school in the presence of their teachers (a familiar and accessible environment) rather than offsite to allow everyone to attend.

### **3) Educate the public that the extracellular matrix is not just about collagen drinks and cosmetics.**

We demonstrated the amazing things the matrix does in our body to the children. By doing this, we hit two birds with one stone - the teachers acknowledged that they did not know about the matrix! We also reached out to the children’s families both directly, through the school’s weekly newsletter for parents, and indirectly by asking children to make a matrix model at home. As a result, some parents reached out to me and one commented *“My daughter said it was amazing. She is really positive about it, thanks for doing it”*.

### **4) Inspire other scientists in the field, especially early career researchers, to reach out to children and talk to the public about this topic.**

We will showcase this outreach activity at the British Society for Matrix Biology Spring 2025 meeting (~120 delegates expected). The meeting will be held at the University of Nottingham and this work will be presented during the opening of the meeting and the poster sessions. Some children agreed for their models to be displayed at the meeting together with a poster with photographs picturing the children carrying out the activities. This will demonstrate that matrix biology is a subject that can successfully captivate children and hopefully inspire them to also engage young people in their science.

Furthermore, we plan to submit an article about the activity to The Biochemist which, together with this report, can help enhance the long-term impact of this outreach project.