

CROSSOVER WORKSHOP

Workshops Report

STEM EQUALS **Co-Designing a Science Sustainability** **Summer School for Young People**

12th May & 3rd June 2021

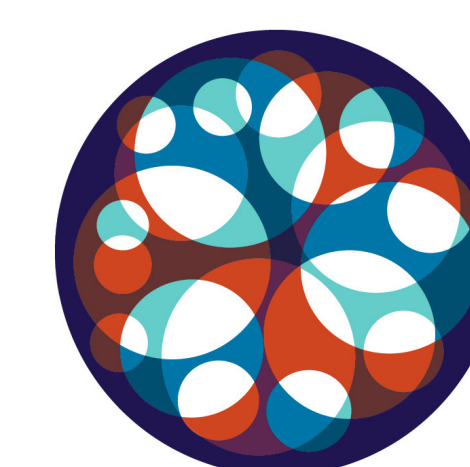
Organised by Elio Caccavale and Dr Michael Pierre Johnson,
Innovation School, The Glasgow School of Art

in collaboration with

Dr Jane Essex, Martyn Hendry and Dr Margaret Rose Cunningham
University of Strathclyde

INNOVATION
SCHOOL
THE GLASGOW
SCHOOL OF ART

University of
Strathclyde
Glasgow



BIOCHEMICAL
SOCIETY

INTRODUCTION

This report documents the collaborative role, activities and discussions from bringing multiple STEM Equals member disciplines together with creative disciplines in a designed process. Our collaboration supported the co-design of a programme of sustainability education days for young people with disabilities, their families and carers at Dolphin House, Ayr, during the summer school break in 2021.

Two workshops were conducted online over Zoom and facilitated using Miro on 12th May and 3rd June 2021. The first workshop allowed members to share their discipline-focused proposals for educational activities and explored connections and ideas to enhance these activities. The second workshop then enabled development of these ideas into a coherent five-day educational programme to prepare and deliver for July 2021.

As part of this process, we developed a storytelling approach by collaborating with a storyteller and an illustrator to collaborate on a fun and compelling 'sustainability' narrative to demonstrate the interconnectedness of STEM subjects in responding to sustainable futures. It is anticipated that these workshops and report will support the final delivery of the five educational days at Dolphin House in July 2021 through the development of learning support tools and creative activities.

ACKNOWLEDGEMENTS

We would like to express our gratitude for the support received by the Biochemical Society. In particular, we would like to thank Dr Pedro Ferreira, Education and Public Engagement Manager, for giving us the opportunity and confidence to set up and develop the Crossover project.

We are enormously grateful for the collaborative opportunity given by Dr Jane Essex, Martin Hendry and the project team to contribute to the Sustainable Impact by Design: A Pilot Study of Effective Stem Dissemination for Hard-to-Reach Audiences project.

We are also extremely grateful to Dr Margaret Cunningham for introducing us to the STEM Equals team and project. We are also thankful to storyteller Allison Galbraith and designer Gaston Welisch for their creative role and collaboration in developing stories and illustrations for the Summer School.



Credit: images provided by workshop participants

WHO ARE WE?

At The Glasgow School of Art (GSA), we suggest that innovation occurs at the spaces between fields of expertise. In the Innovation School at GSA, we want to identify how design practices, incorporating diverse societal perspectives, can complement, challenge and be challenged by scientific expertise and create meaningful processes and outcomes.

BACKGROUND

This work has built on an original Crossover Workshop collaboration in November 2019 between the Innovation School and the Biochemical Society, with support from Dr Pedro Ferreira, to explore the potential for exchanges between design and biochemical sciences. A video and downloadable PDF (<http://radar.gsa.ac.uk/7141/>) capture the experiences and outcomes from bringing together eight biochemical scientists and eight design researchers to share their forms of practice and inquiry.

Dr Jane Essex and Martyn Hendry were introduced to us by one of the attendees of this first Crossover Workshop, Dr Margaret Cunningham, as a prospective member of EPSRC STEM Equals project. We joined the project as collaborators to explore an interdisciplinary way of co-designing a Sustainability Science Summer School for young people.



Elio Caccavale

Reader in Transdisciplinary Design Innovation
The Innovation School, The Glasgow School of Art

“ My research investigates design and science partnerships, with particular emphasis upon collaborative research methods. Furthermore, it explores new visual and three-dimensional design vocabularies for thinking about ethical and social issues in the sciences, and it aims to contribute to the ongoing methodological debates in bioethics, science communication and the sociology of emerging scientific knowledge. For example, my research projects have featured prominently in national and international exhibitions (-e.g. MoMA NY, Dana Research Centre, Science Gallery Dublin and Royal Institution) aimed at increasing public understanding of design's interface with science and society, and introducing new design ideas, methods and approaches to the public.

My aim with the Crossover project is to create a dynamic network of transdisciplinary dialogue about science and society, facilitated through Design Innovation, to enable consistent crossover between different disciplines and a range of institutions, within the academic community, the public and the third sector.



Dr Michael Pierre Johnson

Innovation Leadership Fellow in the Creative and Digital Economy
The Innovation School, The Glasgow School of Art

“ My research uses design practices, such as visual mapping and modelling methods, to support and evaluate creative collaboration between different expertise, stakeholders and publics in the face of shared societal challenges. I'm a post-doctoral design researcher, with experience in ethnographic research and design-led approaches to inform product, digital, service and organisational innovation and in Jan 2019 I was awarded an AHRC funded Innovation Leadership Fellowship in the Creative and Digital Economy. By combining sociological principles of actor-network theory with qualitative modes of analysis, I use visual mapping methods to support reflexive discourse on the value of creative work and innovation.

My aim with the Crossover project is to support the design and evaluation of effective ways for science, societal and creative disciplines to come together, collaborate and make a difference, as well as evidence how 'transdisciplinarity' - a practice that transcends, challenges or renegotiates traditional disciplinary boundaries and in some cases reconstructs them in new positions - can be said to take place.



Dr Jane Essex

Senior Lecturer, School of Education
University of Strathclyde

“ Jane is a former chemistry teacher who has been preparing students to be teachers for the last 20 years. Her research focus is STEM (Science, Technology, Engineering and Mathematics) learning for those with disabilities, though she is very active in promoting all aspects of diversity and inclusion in STEM.

I have always been keen on working across disciplines, drawing on diverse perspectives to enhance learning and knowledge creation, and was enthusiastic about having external support to do this as effectively as possible. As the project leader, I was slightly nervous about how STEM academics might respond to the team's suggestions of using a story teller and illustrator as part of the outreach process. To my amazement, after some initial reserve, they saw the enhancement that these unfamiliar (to them) elements would bring to the project. I feel that the fresh perspectives have enriched our programme considerably.



WHAT DID WE DO?

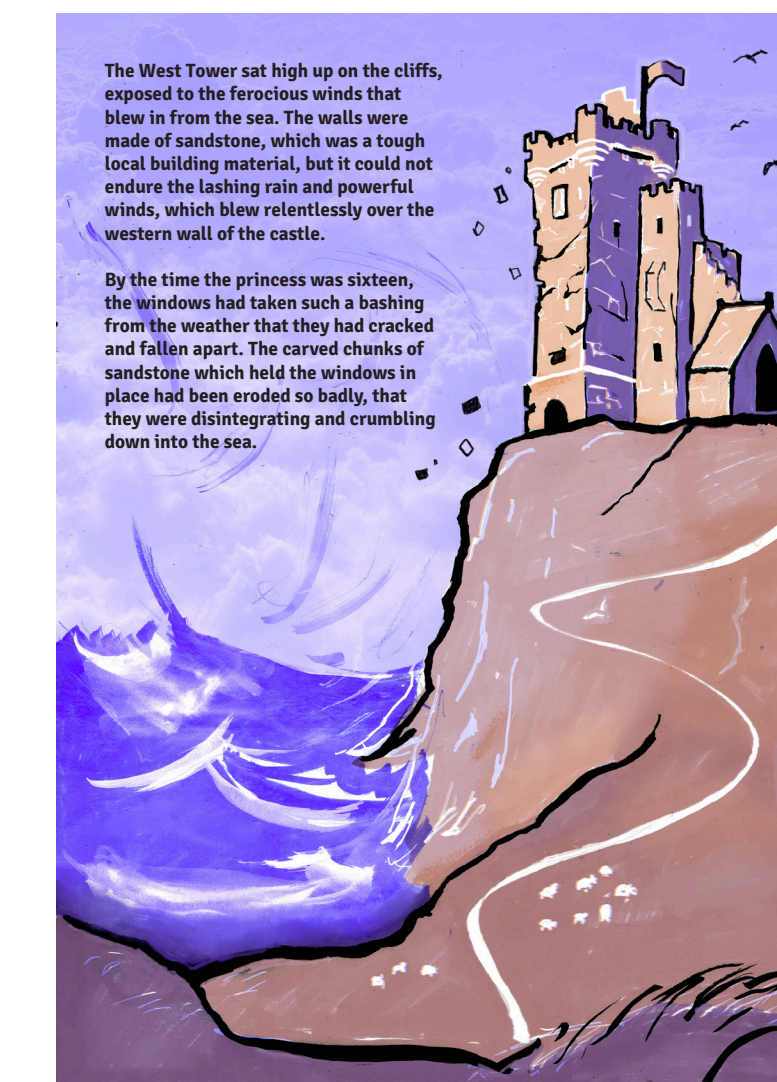
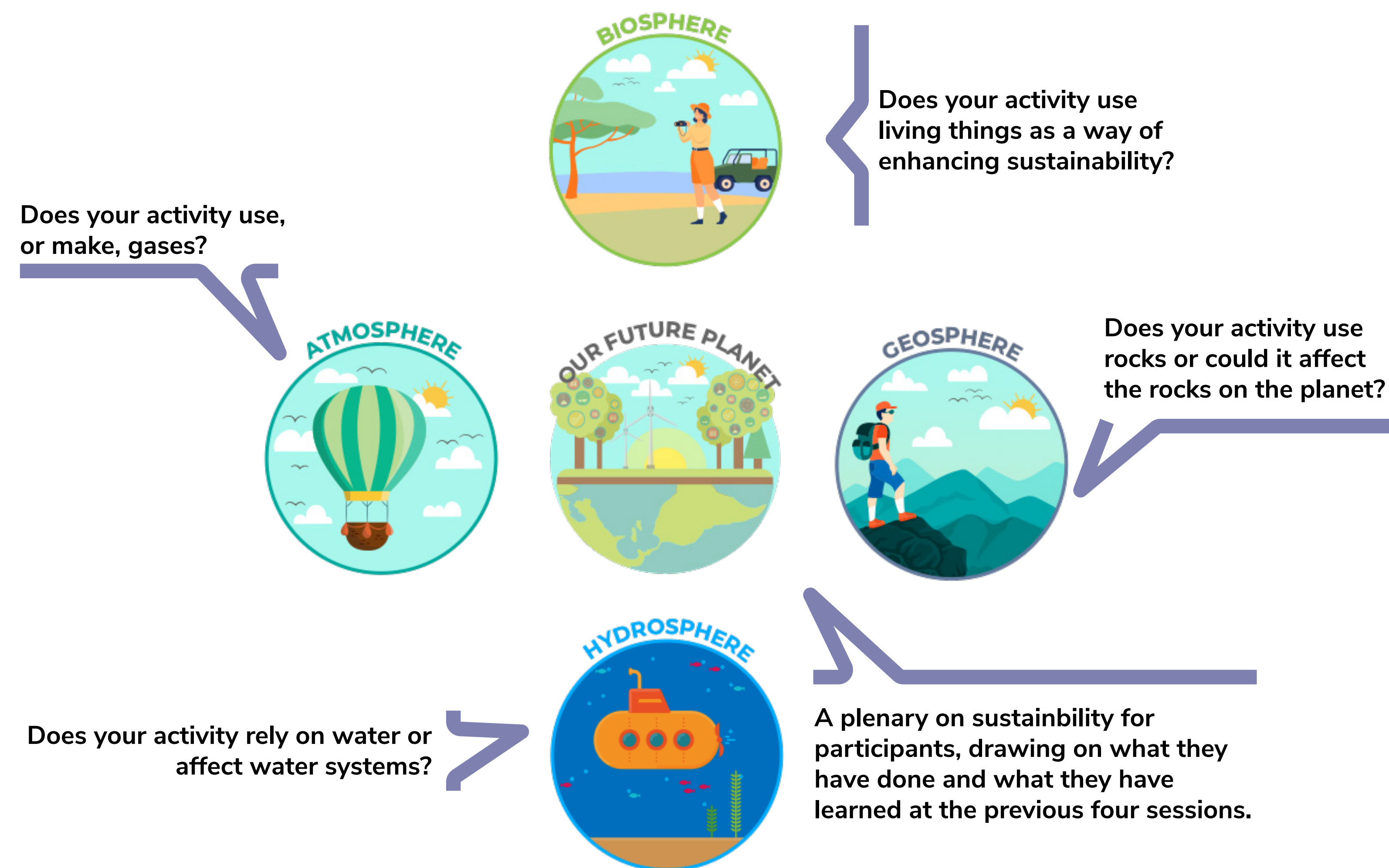
For the first workshop, six of the STEM Equals members from the fields of Electrical Engineering, Architecture, Biochemistry, Mechanical and Aerospace Engineering, Chemistry and Process Engineering were asked to present a playful 1-2 hour educational activity.

In preparation for the workshop, we developed a narrative framework to bring all educational activities together in a coherent, imaginative and engaging way. We used the geosphere (later changed to lithosphere), hydrosphere, atmosphere and biosphere subsystems that make up the planet Earth to allow each STEM Equal member to contextualise educational activities.

We co-designed the workshop by theming four proposed educational days as world 'spheres', asking each participant to select a sphere for their activity by answering the relevant prompt question (below).

For the second workshop, we collaborated with professional storyteller Allison Galbraith to write stories for each sphere that could sit alongside the proposed activities. Designer and Illustrator Gaston Welisch prepared illustrated panels to bring one of stories to life and exemplify how the stories intended to be presented as part of the educational days.

Following the workshop, Allison and Gaston worked together to finalise the stories and illustrations that will be used to support the STEM Equals members during their educational activities. The stories and illustrations will be collated in a small book format, which will also include the work produced by the students during the Summer School. The book will be distributed amongst students, families and participants. Allison and Gaston will participate during the Summer School to narrate the stories, and document the event and activities for the book.



WHAT WAS DISCUSSED?

For the first workshop, participants presented themselves and their activity by telling us what the children were going to learn and do. Following the presentations, we collectively discussed how storytelling could enhance or connect the activities.

For the second workshop, Allison shared each of the stories with the STEM members, who discussed how they thought it might link to their activity and what creative activities the intended young learners could do to build on the science and the stories.

These proposed activities, relevant feedback and key ideas are presented in the following pages based on the chosen format for the five Summer School days in July 2021. Please note that the three days for which STEM Equals members were chosen to deliver their education activities are presented first, with the remaining two days presented in summary at the end.

PARTICIPANTS

All STEM Equals Members from the University of Strathclyde

Dr Jane Essex and Martyn Hendry
STEM Education

Dr Agusti Egea-Gonzalez, Dr Rui Li
and Dr Hong Yue
Electrical Engineering

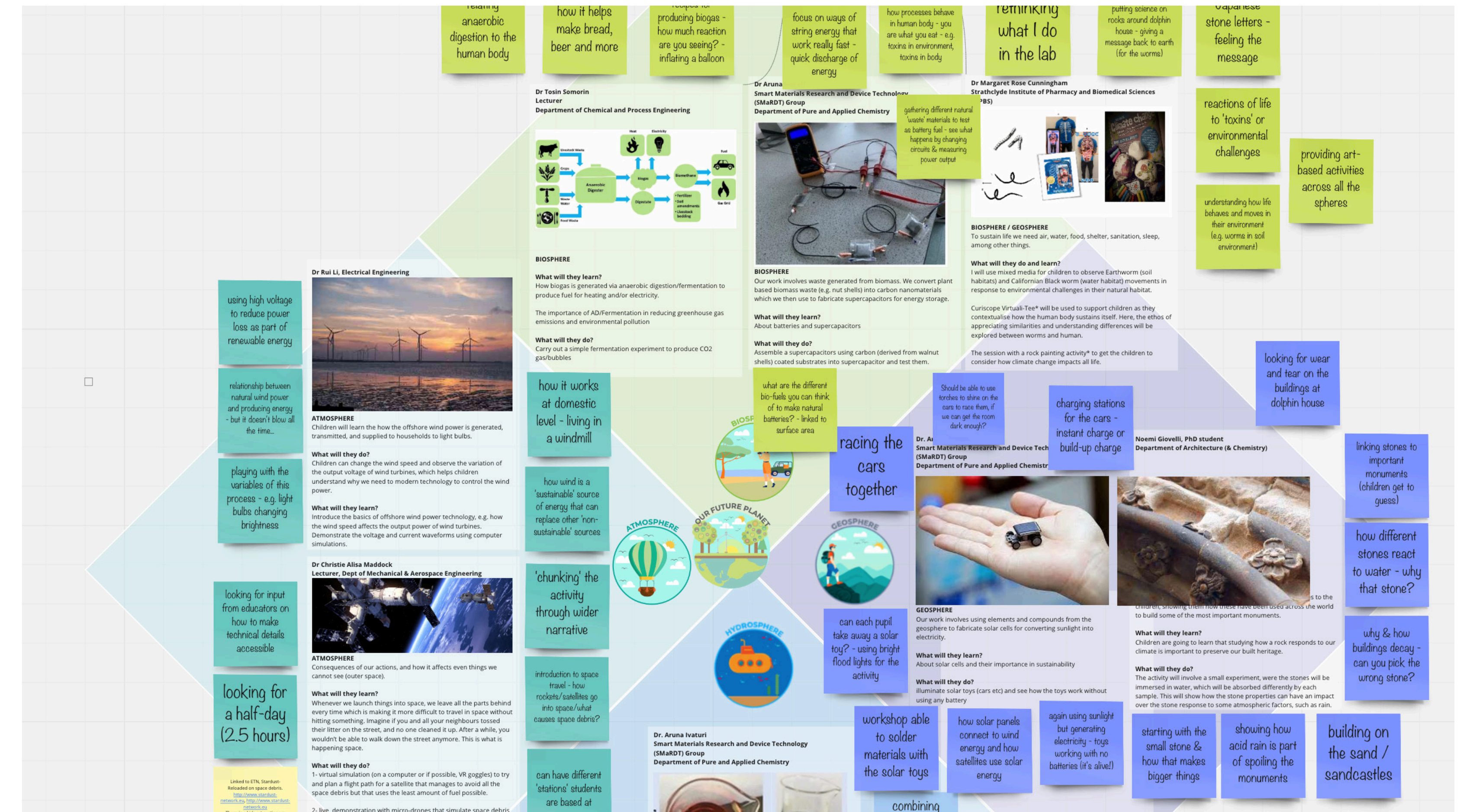
Dr Cristina Gonzalez-Longo
Architecture

Dr Margaret Cunningham
Biomedical Sciences

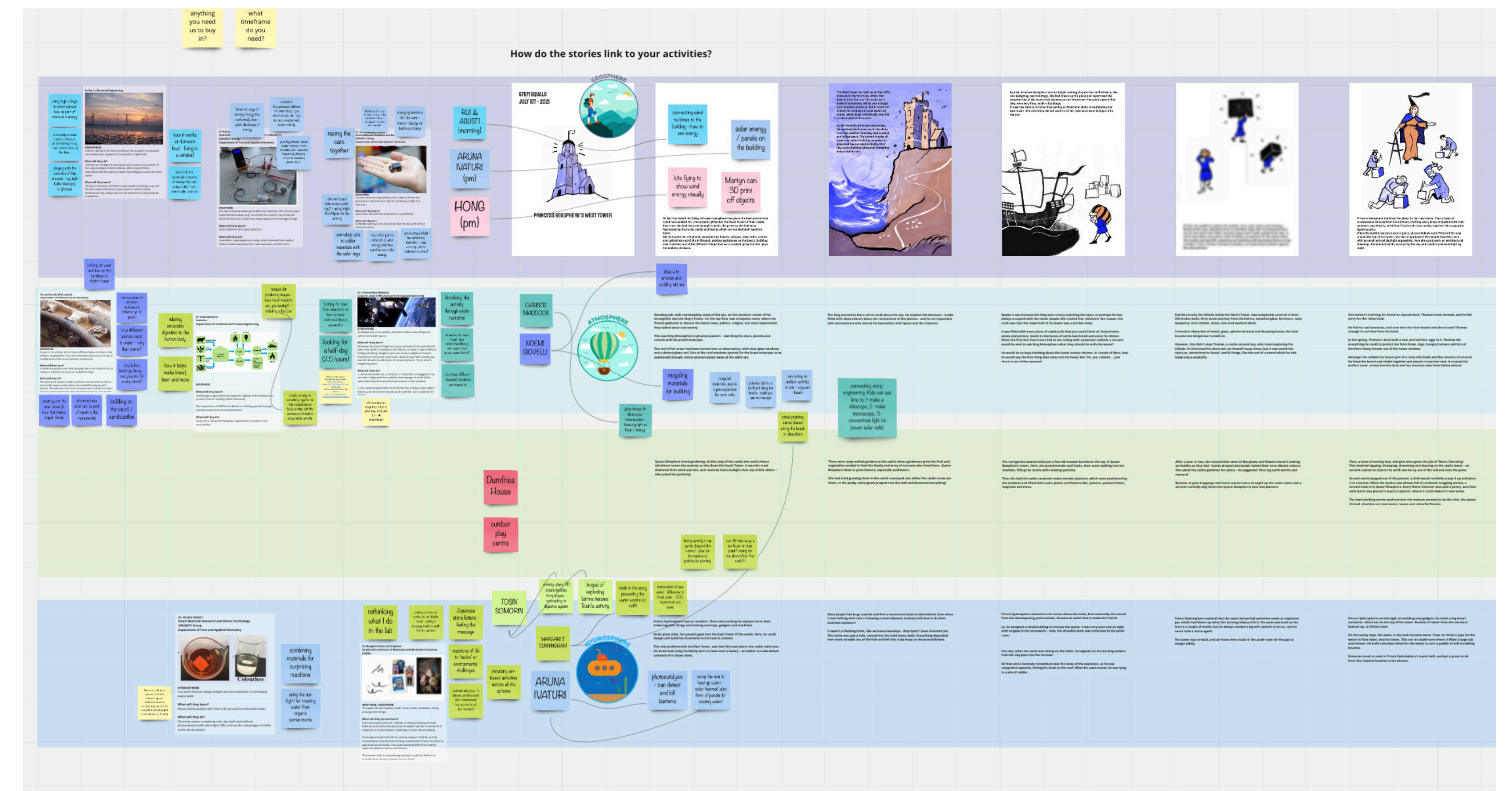
Dr Aruna Ivaturi
Chemistry and Smart Materials

Dr Christie Maddock
Mechanical and Aerospace Engineering

Dr Tosin Somorin
Chemical and Process Engineering



Workshop 1: participants present their activities and received feedback



Workshop 2: stories for each day are presented for creative discussion

WHAT WAS PROPOSED?

JULY 1st



RUI, AGUSTI & HONG Electrical Engineering

Young Learners will explore how offshore wind power is generated, transmitted, and supplied to households to light bulbs.

They will change the wind speed and observe the variation of the output voltage of wind turbines, which helps children understand why we need to modern technology to control the wind power.



Feedback & Ideas

Explore how wind is a 'sustainable' source of energy that can replace other 'non-sustainable' sources.

Play with the variables of this process - e.g. how light bulbs change brightness.

Kite flying to show wind energy visually.

Explore how you might connect wind turbines to the building.

ARUNA IVATURI Smart Materials

Our work involves waste generated from biomass. We convert plant based biomass waste (e.g. nut shells) into carbon nanomaterials which we then use to fabricate supercapacitors for energy storage.

Young learners will assemble a supercapacitor using carbon (derived from walnut shells) coated substrates and test them.

Feedback & Ideas

Focus on ways of storing energy that work really fast giving a quick discharge of energy.

Gather different natural 'waste' materials to test as battery fuel and see what happens by changing circuits & measuring power output.

Explore how you might connect solar panels to the building.

ARUNA IVATURI Smart Materials

Our work involves using elements and compounds from the geosphere to fabricate solar cells for converting sunlight into electricity.

Young learners will illuminate solar toys (cars, etc.) and see how the toys work without using any battery, learning about solar cells and their importance in sustainability.



Feedback & Ideas

Explore using torches to shine on the cars to race them, if the room can be dark enough.

Do you need charging stations for the cars - instant charge or build-up charge?

Can each pupil take away a solar toy?

Can you use the workshop to solder the solar panels onto different toys?

Proposed Story summarised

Princess Lithosphere and the West Tower

Princess Lithosphere loved building things from washed up materials on Ayrshire beaches

At 14 she was gifted the West Tower but by 16 the winds and rain had eroded so badly bits were falling into the sea.

The princess had become a respected architect, so would turn her attention to re-building her tower.

She traded barrels of whisky for white marble from Italy, as it was harder and would last longer than sandstone.

A team of stone masons crafted the marble to her designs, fitting together like jigsaw pieces, with glass windows placed all around the top of the tower.

Her windows used polished agate and jasper, reflecting colour all round her tower top studio, which many agreed was the most beautiful tower in Scotland.

JULY 8th



CHRISTIE MADDOCK Aerospace Engineering

Whenever we launch things into space, we leave all the parts behind, which makes it difficult to travel in space without hitting something.

Young learners will plan a flight path for a satellite that avoids all the space debris using a virtual simulation and enjoy a live demonstration with micro-drones simulating the space debris and satellite.



Feedback & Ideas

An introduction to how rockets and satellites go into space and what causes space debris?

You can have different 'stations' that the young learners are based at.

Link to glass lens telescopes, microscopes or ways of focusing light as heat or energy.

Looking for input from educators on how to make technical details accessible.

NOEMI GIOVELLI Architecture

Young learners will be introduced to different types of stones that are used to build important monuments and studying how rock responds to our climate helps preserve our built heritage.

The activity involves immersing different stones in water, each absorbing water differently, to show how stone properties can impact their response to weather, like the rain.



Feedback & Ideas

Show how acid rain is part of eroding buildings or link different stones to important monuments (young learners get to guess).

Could look for wear and tear on the buildings at Dolphin House.

Build on the sand (e.g. sandcastles) and show how small stones or recycling materials can go towards building things.

Proposed Story summarised

King Atmosphere and the North Tower

On the northern corner with commanding views was the King's Tower, where King Atmosphere pursued his greatest passion, watching the stars, planets and comets with his prized telescope.

The King would learn all he could about the night sky through old books and astronomers observing the planets, stars and galaxies.

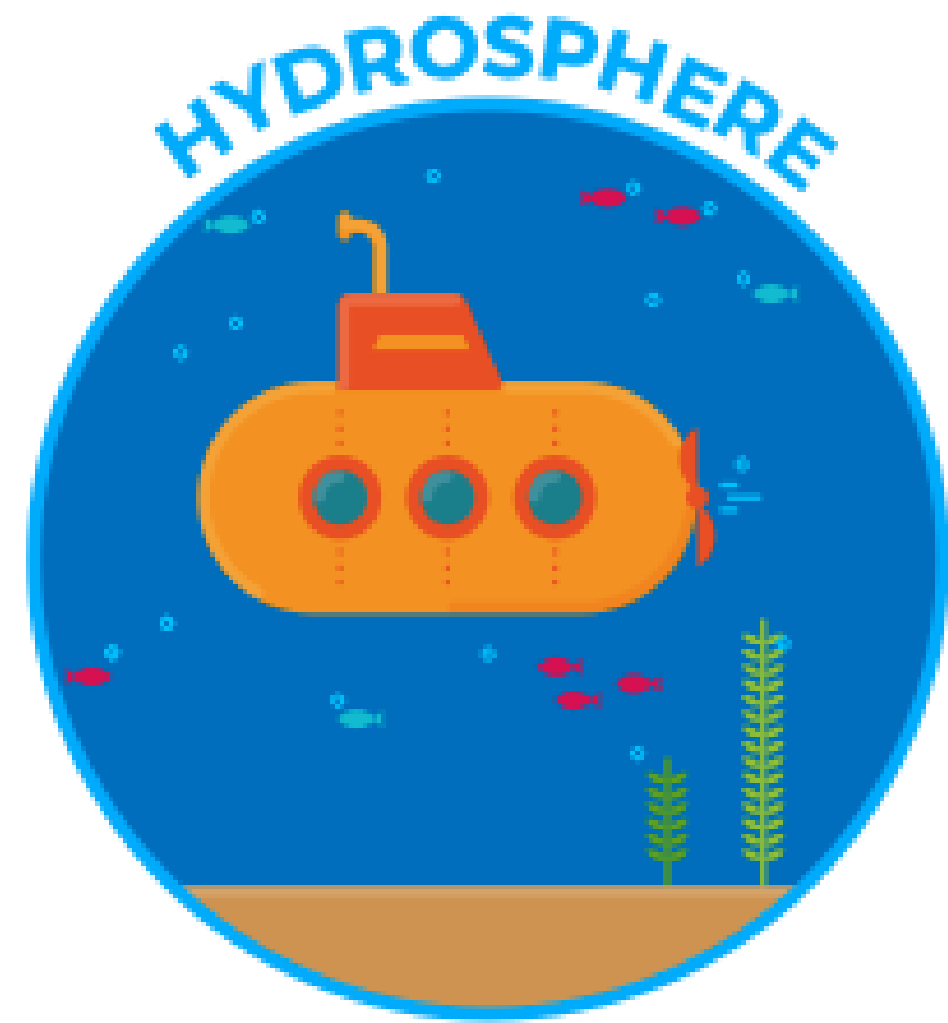
The King was so busy watching the stars that the lower floors of his tower became full to the ceiling with unwanted rubbish.

The hillside below the North Tower was completely covered in sharp bits of metal, glass, splintered wood and decaying bones.

This didn't stop Thomas, a castle servant boy, who loved exploring the hillside for useful things. He found a lame duck, who he would care for by building a nest and protective cover from an old barrel.

The King never did tidy his mess, content instead to share his knowledge of the universe.

JULY 22nd



Proposed Story summarised

Prince Hydrosphere and the East Tower

Prince Hydrosphere loved inventing and his parents gave him the East Tower to build his inventions, but it also had the castle toilet. It wasn't a flushing toilet; everything deposited here went straight out into a big heap on the ground below.

Eventually, the stench from outside became so awful that it made him feel ill, so he designed a small building to enclose the waste.

One day, his uncle tapped out the burning embers from his pipe into the loo hole and an explosion catapulted him upwards.

The Prince realised that the waste somehow made an explosive gas, so he rebuilt the tower with air-holes for gas to escape safely.

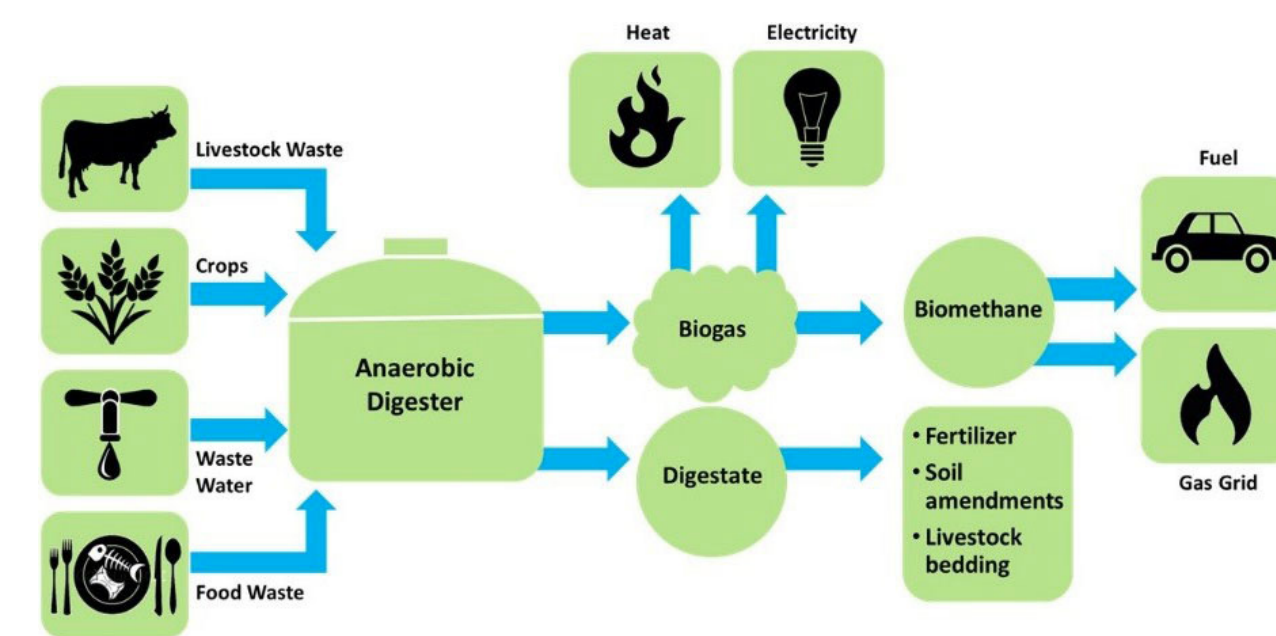
He built a metal water tank atop his tower that would heat up in the sun and flow for nice warm baths.

As the tank was filled with seawater, it was salty and often contained sea creatures, so he made a mesh grill to filter them out.

TOSIN SOMORIN Process Engineering

Young learners will carry out a fermentation experiment to produce CO2 gas bubbles.

They will learn how biogas is generated via anaerobic digestion and fermentation to produce fuel for heating or electricity and its importance in reducing greenhouse gas emissions and environmental pollution.



Feedback & Ideas

Can link to how such processes help to make bread, beer and more.

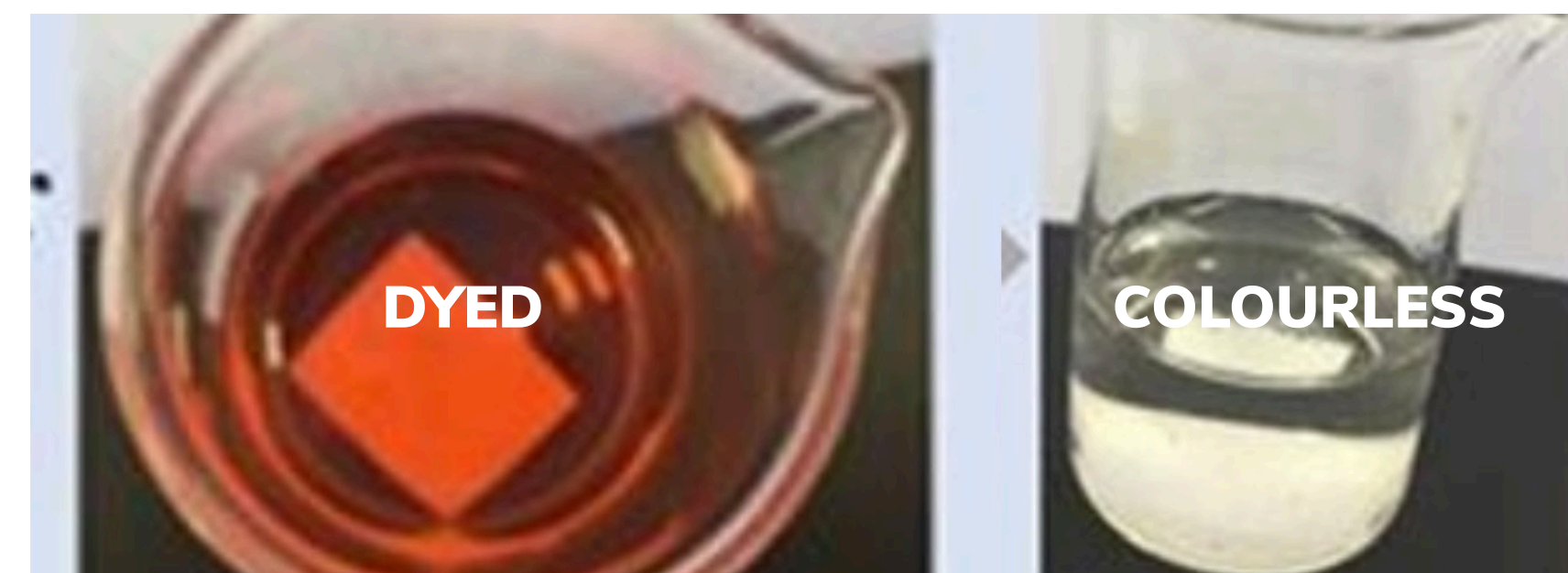
Could explore recipes for producing biogas and ask 'how much reaction are you seeing?' by inflating a balloon and link to latrine exploding in story.

Could connect activity to natural human body processes with the Curioscope Virtuali-Tee cross reality activity proposed by Margaret.

ARUNA IVATURI Smart Materials

Our work involves using sunlight and nanomaterials to remediate waste water through photocatalysis.

Young learners will illuminate water containing colour dye (with and without a photocatalyst) with white light LEDs and see the advantage of visible active photocatalysis.



Feedback & Ideas

From using the sun (light) for treating water from organic contaminants, can you combine materials for surprising reactions?

Is there a link to space and life aboard space stations, where everything needs to be recycled or brought back down to Earth?

Link to how we also use the sun through solar thermal panels for heating water.

MARGARET CUNNINGHAM Biomedical Sciences

Children will observe Earthworm (soil habitats) and Californian Black Worm (water habitat) responses to environmental challenges.

Curioscope Virtuali-Tee will contextualise how the human body sustains itself and understanding differences between worms and human.

A rock painting activity will get children to consider how climate change impacts all life.



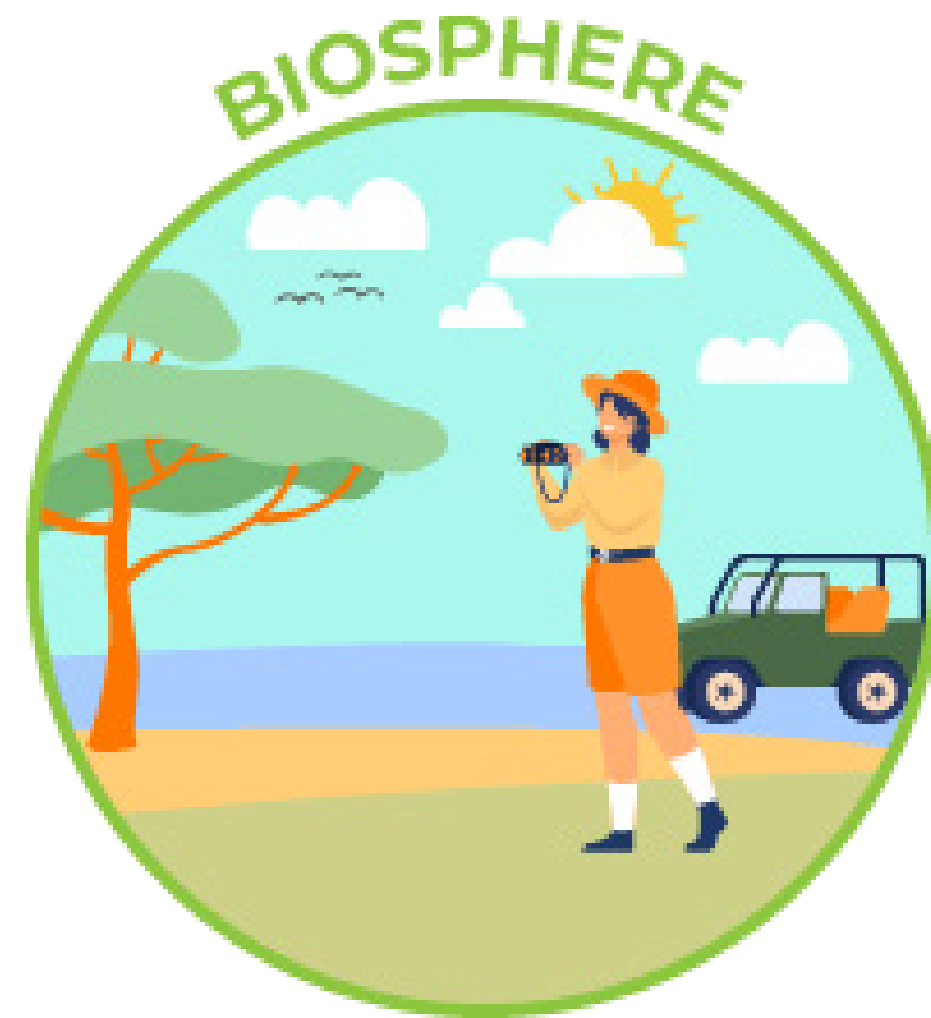
Feedback & Ideas

How understanding how life behaves and moves in reacting to their environment changes how I do things in the lab.

Put science on rocks around Dolphin House to give a message back to earth (and thanking the worms?)

Note how the mesh in the story might prevent water worms and how seawater absorbs more CO2 than fresh water.

JULY 15th



Proposed Story

summarised

Queen Biosphere and the South Tower

Queen Biosphere loved gardening and as the Lady of the castle she chose the South Tower for it was sheltered from wind and rain, and received the most sunlight.

The Queen Biosphere liked to grow flowers, which she tried to do in the castle courtyard, but crows or goats devoured everything!

Her roof garden started with a few wooden barrels to grow lavender and herbs, then made wooden planters by the windows to fill with jasmine, passion flower, magnolia and roses.

She noticed some plants weren't looking as healthy, so castle gardener advised, 'nice big earth worms and manure!'

Serving boys and girls were given the job of 'Worm Charming', placing each worm in a pot or planter, and the plants thrived.

She built a balcony and a greenhouse, where she could grow heat-loving plants like, grape vines, pineapple, orange and lemon.

Feedback & Ideas

With the day being spent at Dumfries, can they link the story to outdoor activities.

Can young learners take away a sunflower or another plant to learn how to care for live plants, perhaps from the first week?

Links to the sun, water, recycling, energy and how we include or exclude life.

JULY 29th



Proposed Activities

Sending a Message to the Future

Painted rocks, collages, sand drawings and more creative 'big pictures' to photograph and add to the story book.

Modify the King's Castle

On a large illustrated print out, add sustainable changes to the castle so that it becomes more environmentally friendly.

Kites to Display Messages

Small or real kites to display or fly.

Add Characters

What characters could they see themselves as in future?

Stories as Fold-outs

Can each story be a fold-out booklet with a poster or activity on the back?

The Final Book

Along with the stories, including the young learners responses, additions and messages for a sustainable future.

WHAT'S NEXT?

Delivering these workshops and this report has allowed us to bring together a series of STEM learning activities for young learners with disabilities in a playful and engaging way. The co-developed structure of different spheres for each day, proposed science activities and commissioned stories and characters have provided a rich package of ways for young learners to engage with what sustainability might mean to them.

This report therefore aims to support the preparation and production of materials to support and deliver these five STEM learning days. The following four points are recommendations on how the scientists, engineers, educators, storyteller and illustrator delivering the activities can use the insights and ideas developed through these workshops.

SPARK IMAGINATION BY CONNECTING THE SCIENCE TO THE PLACE AND STORIES

For the scientists and engineers delivering their STEM activities, we encourage you to read the stories and explore what you can do at Dolphin House and the surrounding environment.

In the moment, activities and learning could become more tangible for the young learners and will help them show what they have learnt on the final day.

WE ARE ALL STORYTELLERS

The stories are not there to replace the science, and the science is not there to replace imagination. From delivering these two workshops it has been clear to us as designers that knowledge and imagination come together by telling rich and engaging stories.

This Summer School is a great opportunity for everyone to show and develop your storytelling skills: on explaining the science, on understanding the planet, on your own journey doing what you do, as well as on how human society can impact and change how it lives with our wonderful planet.

MATERIALS TO SUPPORT AND EVIDENCE THEIR LEARNING

A watchword throughout these workshops has been 'flexibility'. Working with the STEM Equals team has shown the value of providing a space for different perspectives, questions and ideas to emerge. This will also be true for the young learners at the Summer School.

The spheres, stories and how they are provided through booklets and creative activities aim to inspire curiosity and ways to express questions and new understanding. This should allow the young learners to show their progress and enable us to capture and evaluate how they support the event.

REFLECTING ON AN INTERDISCIPLINARY APPROACH

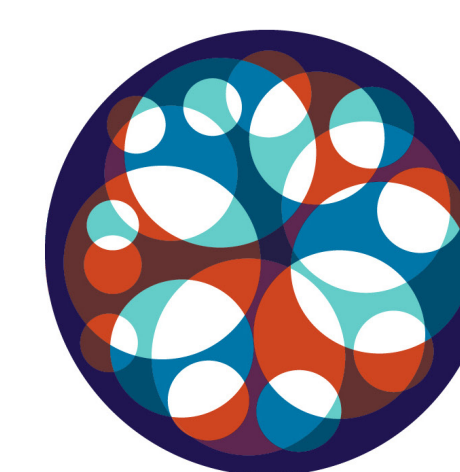
At the end of the whole journey, we are keen to gather and share collective learning on how you found engaging with different disciplines to approach this Summer School. In particular, how design-led workshops and collaborating with storytelling may have adapted the way you approach STEM education.

We will do this by sharing reflective questions both before and after the Summer School. You will be welcome to provide written responses or we can do a short Zoom interview. Once we have collected each of your thoughts on the progress, adaptations and any wider learning on STEM education you care to provide, we will share this between us all as a resource each of our further development.



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