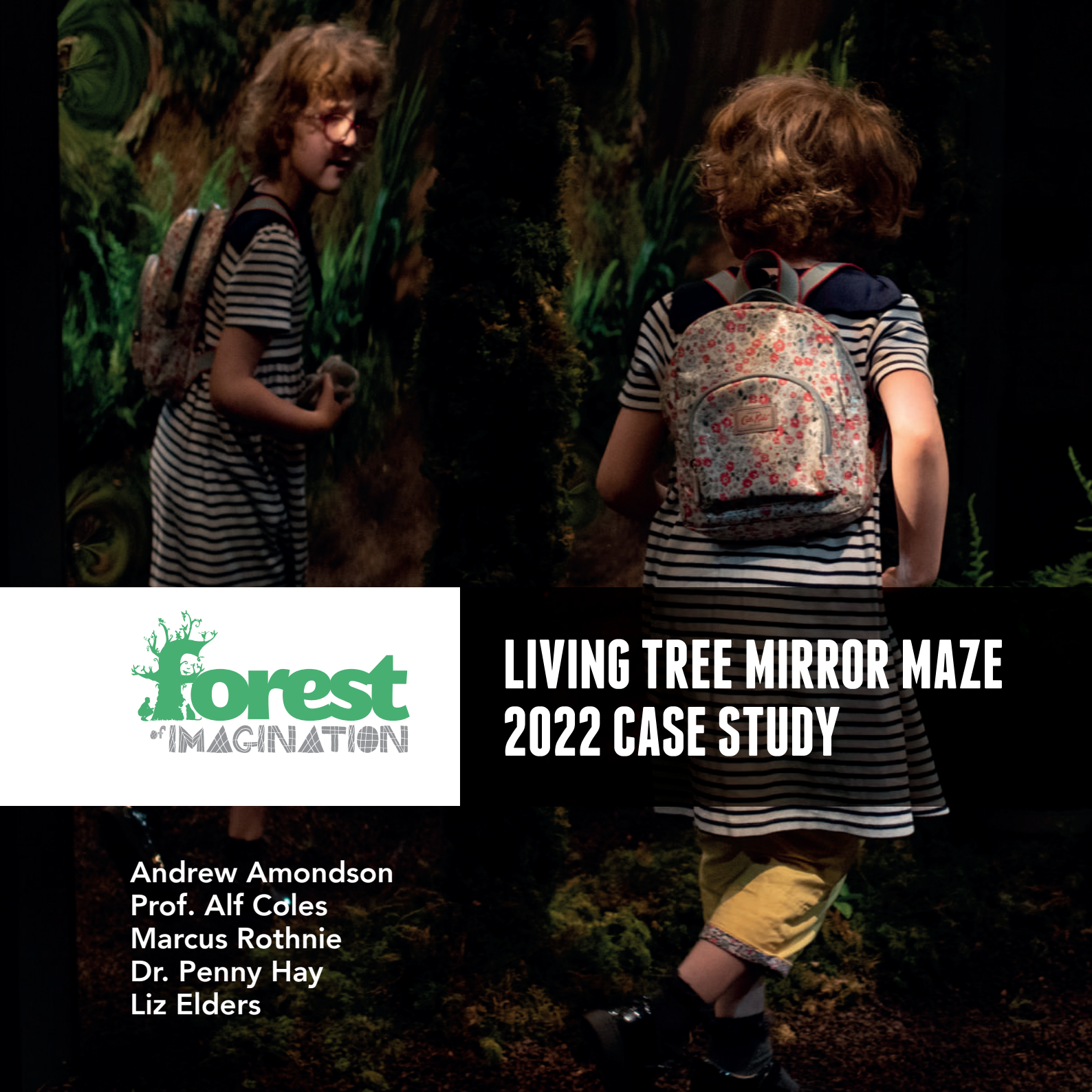
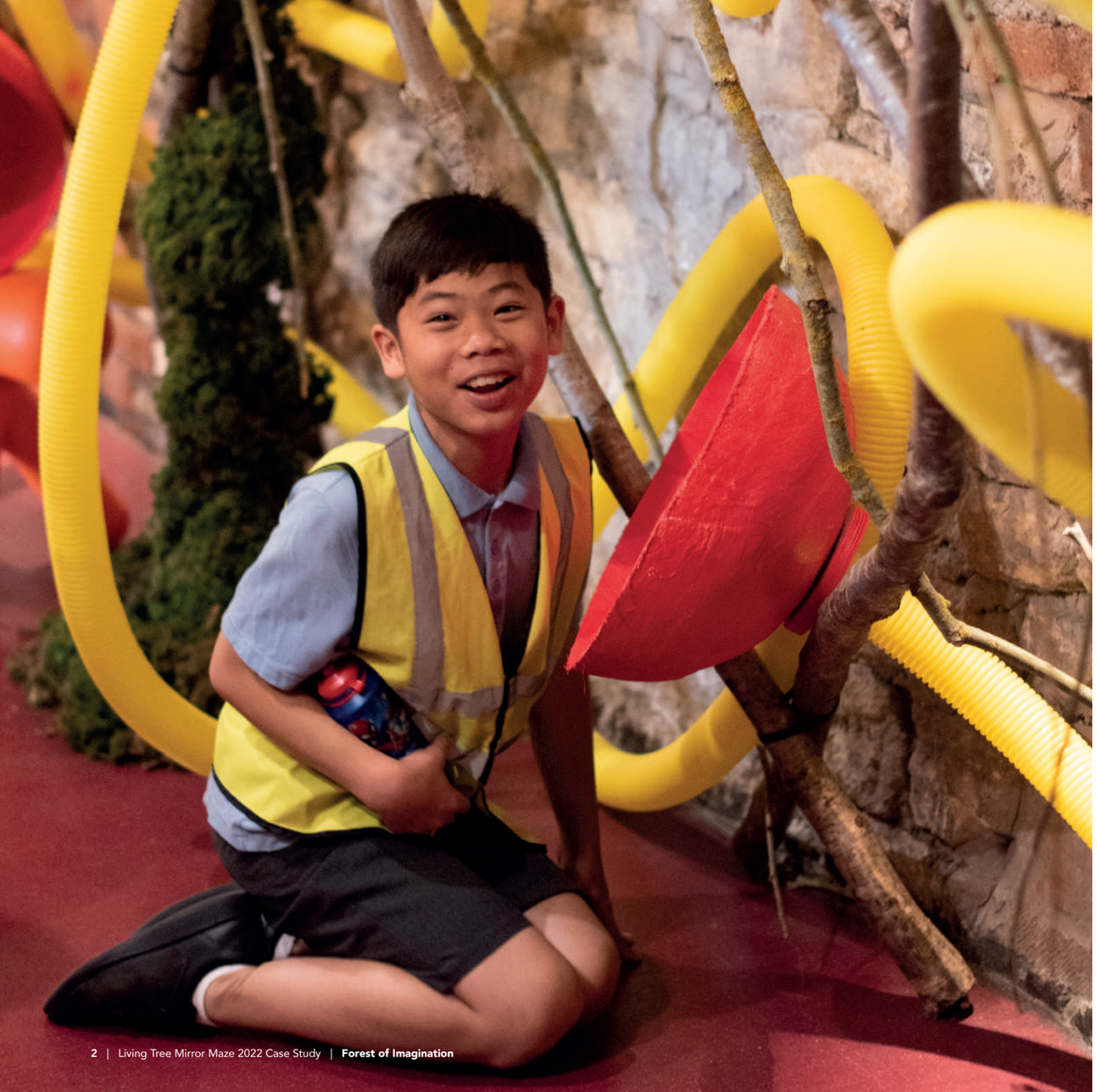


forest of IMAGINATION

LIVING TREE MIRROR MAZE 2022 CASE STUDY

Andrew Amondson
Prof. Alf Coles
Marcus Rothnie
Dr. Penny Hay
Liz Elders



Introduction

Forest of Imagination is a contemporary art and architecture event co-founded by Dr Penny Hay, House of Imagination and Bath Spa University and Andrew Grant, Grant Associates. Forest of Imagination is funded by Grant Associates, Feilden Clegg Bradley Studios, Bath Spa University and this year with additional funding from the Ragdoll Foundation. For 2022, Forest of Imagination partnered with the Egg Theatre (Theatre Royal Bath) and the American Museum to run events at both venues.

Living Tree Mirror Maze was an installation at the Egg Theatre (17 June – 3 July) designed by Berlin-based artist Andrew Amondson building on The Living Tree Forest (2021). It was co-created with artists and collaborators in Bath. The Mirror Maze was co-created by Professor Alf Coles, University of Bristol, and architects Feilden Clegg Bradley Studios. Living Tree Mirror Maze invited visitors and participants to walk through a geometric maze of mirrors into a living forest of sound, light and sensory experiences. The sound installation was created by Cosmo Sheldrake. On the ground floor of the Egg was an installation by designer Matt Leece, a FUNgal network of connecting and communicating tubes to represent the concept of a mycelium network.

House of Imagination liaised with artists to provide a series of creative workshops based on and in Living Tree Mirror Maze, inviting local schools to participate. The visits were coordinated and supported by the Egg team. The installation provided a ‘living classroom’, an experimental site of learning. Children were invited to ‘find and follow their fascinations’; to immerse themselves in self-directed enquiry. It was intended that the installation and the artists’ interventions would encourage the children to ask powerful mathematical and ecological questions and elicit their ideas on how they would like to respond to the installation. The artist’s workshops provided a variety of creative media through which children could respond, make their ideas visible, and have their voices heard. 16 classes of children visited and over 800 families visited at the weekend.

House of Imagination worked closely with one local primary school before and during Living Tree Mirror Maze; supporting the collaboration of artists, teachers and school, and documenting their experiences. The documentation and analysis forms the basis of the case study and contributes to the narrative of the learning from Living Tree Mirror Maze.

The case study aims:

- To elicit the children's ideas in the process of designing the Mirror Maze
- To explore the collaboration between artists, teachers and children
- To document the children's responses and ways of enquiring in the Mirror Maze
- To document what the children noticed in response to the questions used to frame their enquiries
- To elicit the children's hypotheses and questions in relation to mathematical questions
- To find the connections between the children's enquiries and the mathematical questions that Mirror Maze poses

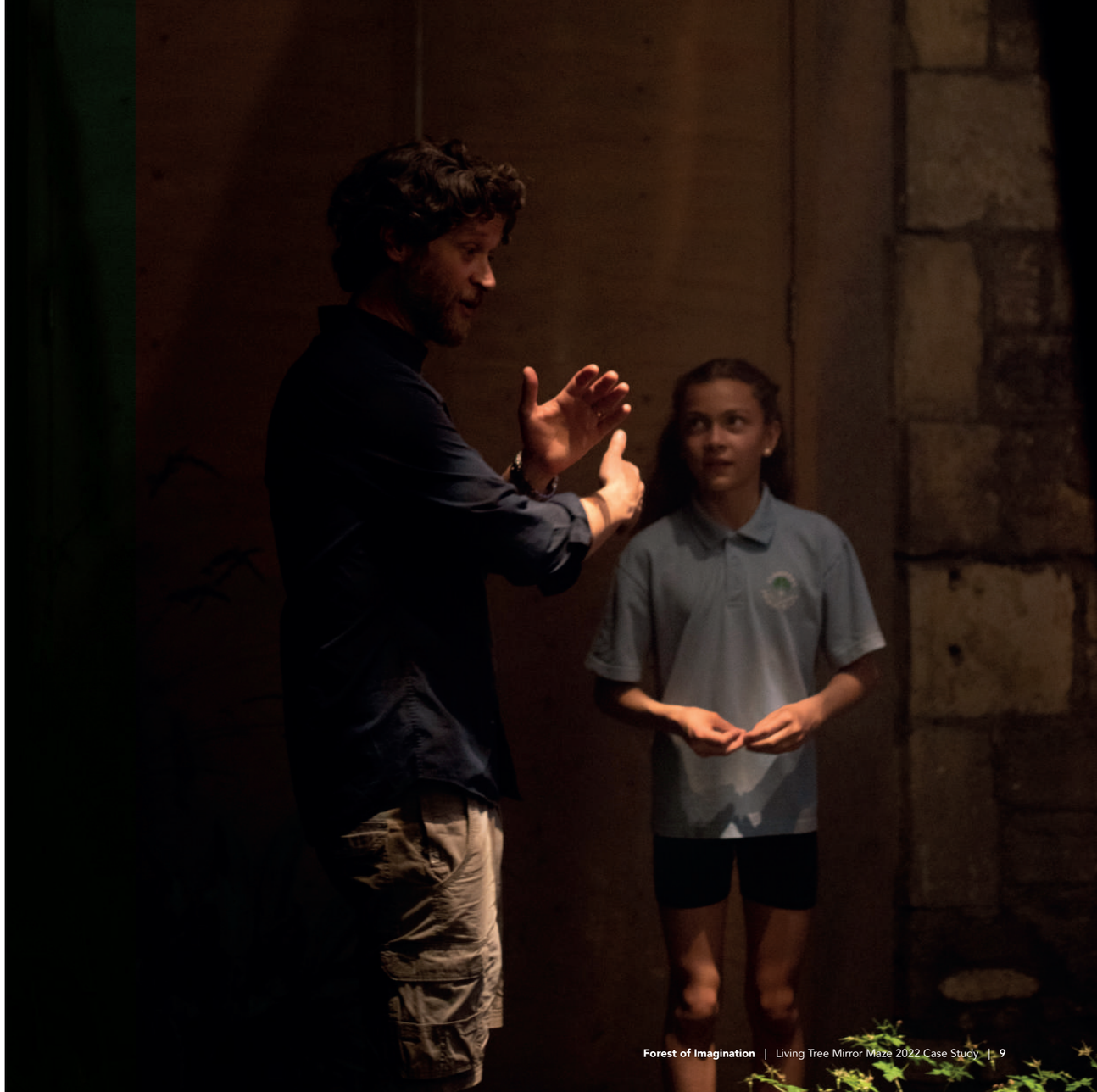
Methodology

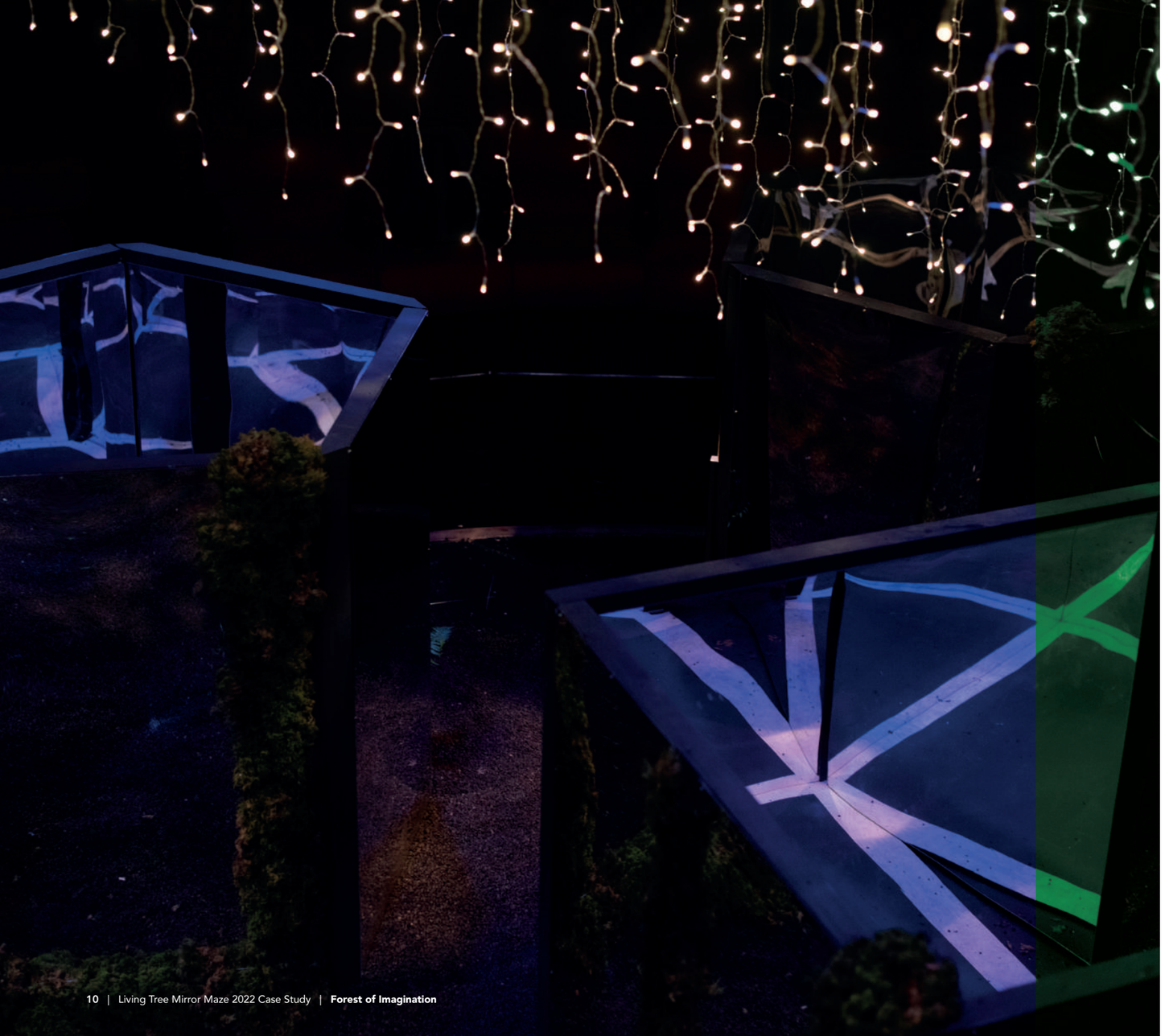
House of Imagination collaborated with St Andrews Primary School, Bath and liaised with the teachers and Headteacher. All of the classes participated in sessions with different artists during Living Tree Mirror Maze. Sessions with the Reception class, Year 2, Year 5 and Year 6 were observed and documented as part of this case study to give a representative sample across different ages and children. Three artist workshops were documented in addition to one with the Living Tree Mirror Maze co-designers.

The Year 5 children also had a session in school, prior to their experience of Living Tree Mirror Maze, led by the class teacher, which was also observed, with the documenter working alongside the children.

The children's responses, comments, enquiries, dialogue, and processes of making were observed and noted. The researcher and documenter explained to the children in all the sessions that they were interested in what the children noticed, felt or thought about Living Tree Mirror Maze and was writing these down as they felt these were important. Additional observations and reflections were contributed by some of the artists and these are attributed to them.

The observations were written up from each of the sessions and shared with the artists and class teachers. No children's names were recorded or used. Children's remarks, or as close as possible to them, are in quotation marks, to share their experiences, thoughts and feelings in their own words. The documentation of each of the sessions were combed and analysed in order to interpret them and find meaning in them in relation to the key questions and aims.





Contents

The case study covers in the sections below:

Design and intent for Mirror Maze

Three Mirror constructions, whose walls were mirrored inside and out, were placed in the space in relation to each other. These were square; regular pentagon and hexagon and each had a white line along the inner edge.

Alf explained his intent: ‘the idea is to provoke questions. There are some deep mathematical questions.’

Explaining the design and intent of the Mirror Maze to the Year 5 children, Alf said: ‘I’ve been responsible for some of the mirrors up in the space you’re going to go into. You’ll notice that there are three kinds of construction, and I’d like you all to go inside each one of them.’ He gave the children key questions to frame their enquiries: ‘I’m really interested in what you might notice? What do you notice is the same or different? Maybe look in particular at the patterns, the floor patterns and how they extend?’

A site for experimental learning

Mirror Maze provided an immersive learning environment for the children where they could be free to find and follow their fascinations and become engaged in self-directed enquiry. The pre-session in school introduced the children to some of the concepts behind Mirror Maze and gave them opportunities and additional time to explore them. It provided for more sustained enquiry. In the Mirror Maze and in school, the teachers and artists created a learning environment where the children could explore mathematical concepts without fear of failure and where there were no wrong answers; only infinite possibilities.

The children's initial responses within Mirror Maze show how motivational the space was as a site for experimental learning:
'I really liked the mirrors and I really liked the overall effect.'
'I love all the mirrors. It's really calming.'
Other children found the mirror spaces really energising. They used words like 'fun', 'wow', and 'cool' to describe them. Alf overheard children [families day] saying:
'Mummy look, it's a world of mirrors' and 'You can't move anywhere, it's mirrors.'
The following observations indicate the depth of their engagement and the nature of their self-directed enquiries.

Analysis of children's ways of enquiring

Analysis of the documentation of children's responses from the different groups revealed the ways in which the children enquired and their ways of learning in and through Mirror Maze. These included: whole body and kinaesthetic engagement; finding and following fascinations; and through drawing.

Whole body and Kinaesthetic engagement

Many of the children responded to the mirror maze with full-body kinaesthetic engagement: jumping, spinning, dancing, and marching inside them as in the following examples.

Children were observed spinning around in the mirrored spaces. In the pentagon mirror one child was spinning round and round: 'Spinning. Busy'. The visual images created by the reflections inside the mirrors and the child's actions could be described as 'busy'. Inside the hexagon mirror another child said: 'Where's the door?'; perhaps also indicating feelings of disorientation. Is there perhaps a link between their spinning and the idea of disorientation provoked by the visual disorientation inside the mirror spaces? Are they accentuating the disorientation or playing with the idea kinaesthetically?

Michael noticed one child walk around the inside of the pentagon mirror with her eyes closed; then make a bundle of themselves on the floor.

Inside the square mirror two children marched side by side. They could see two lines of figures marching behind them in the reflections. They then jumped and danced in front of the mirrors as if they were making the reflections of themselves jump and dance. Were they playing with the idea of making their reflections carry out their actions, as if their reflections were other than themselves like puppets that they had control over? Inside the square Mirror, one child stood in a corner, close up to the mirror. He pointed at his reflection, his finger slowly getting closer until he touched the reflection of his finger, fingertip to fingertip. His actions were slow and considered. He made faces at his reflection. He noticed his reflections to right and left and turned his head slowly from side to side. 'So many mirrors everywhere.'

These examples show how children enquired in Mirror Maze kinaesthetically; enquiring into it through their conscious movements; being in it with their whole body and being playful with the reflections created. There was a sense of freedom and excitement expressed through their whole body engagement.

Finding and following fascinations

In the pre-session in school and in Living Tree Mirror Maze the children were able to find and follow their own fascinations; to focus on their self-directed enquiries.
In school, after looking at images of Alf's concept for mirror mazes, the children tried out different numbers and configurations of mirrors and observed what they could see inside them and the visual images they created.

Two children experimented with placing 3 mirrors, vertically in a triangle with a square mirror (with a convex central round section) at the base. They placed a pencil vertically inside it to see its image or multiple images. They repeated it with 4 mirrors in a square with a convex mirror on the base, and moving 2 pencils around inside. They then slotted a concave mirror down one side watching the visual effects: 'How can some mirrors and 2 pencils look so weird and creepy'.

The children shared what they had discovered with their peers: 'endless passageways'; 'how many pencils can you see?'; 'a passageway, it goes on forever and ever.'
One child noticed that with 2 mirrors at an angle (90/90+); the closer you got inside it the more faces he could see. His question at the start was: 'what happens if you cut your face in half [visually] and put another mirror?'

In school, one of the children had drawn a colourful striped pumpkin which she held a mirror up to, observing how it changed. She explained and demonstrated that if she bent the mirror one way it lengthened and narrowed the pumpkin turning it into a car racetrack. Bending it the other way made it shorter and wider.

In the Mirror Maze constructions at the Egg, many of the children were observed being playful with their reflections; both trying to catch a reflection of themselves as they spun round or trying to surprise the reflection as is if it were other to themselves. For example: one child stood inside the square mirror construction facing one of the sides. He stood still looking at the image of himself in front. He put up a hand to touch his reflection. He then looked from left to right at his other reflections. He turned slowly to see it and then turned rapidly from centre to left, then centre to right as if to catch the reflection out.

Two of the children held a geometric drawing they had made up to the mirror: 'Let me try something.' They made the paper convex in shape and looked at the image in the mirror again. They experimented with bending the paper in and out from curved to flat. They then noticed and were astonished to see an image of the back of the drawing paper, in the reflection in front of them which was reflecting from the mirror behind them.

In school, the children were introduced to the concept of possible mirror mazes, and many of them chose to experiment with creating their own on a small scale, noticing and playing with the visual images they could create. They began to enquire into the mathematical possibilities with different shaped mirror constructions. They were excited to see the large-scale Mirror Maze, to get inside them and feel what it was like. Many became immersed in playing with multiple reflections of themselves.

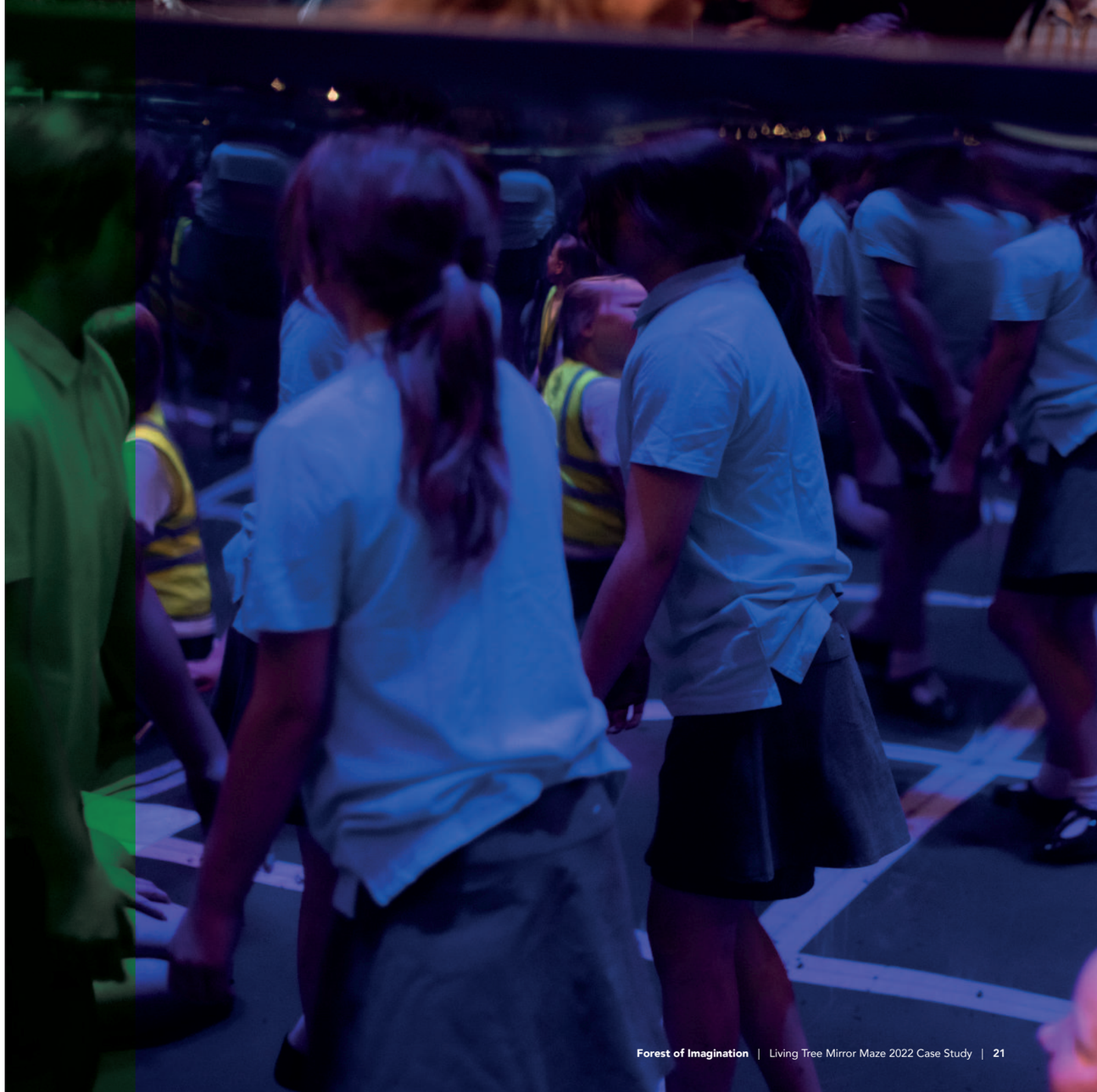
Through drawing

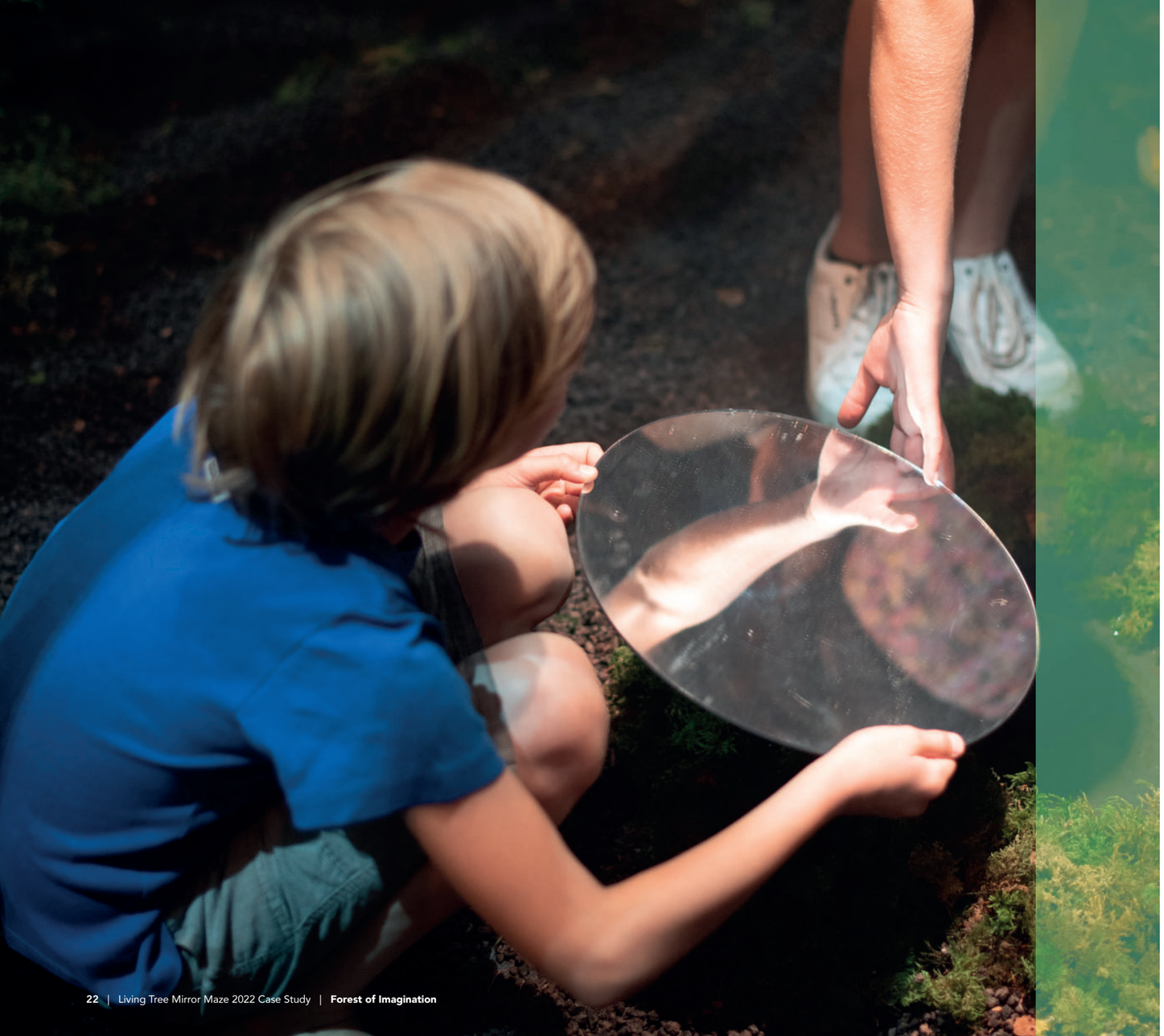
In school and in the Mirror Maze the children enquired through drawing, often combining it with reflections of their drawings in the mirrors. In the mirror maze, two children from the Year 5 class initiated drawing in the square mirror construction:
‘We’re making optical illusions here’ [to the adult]
‘You can make a parallelogram’ [to each other]
‘We’re doing an experiment’ [to another child who wants to come into the space]
They drew concentric triangles in the centre of a square piece of paper; held it up to the mirror; then folded it so that just the triangular shape was visible. The drawing followed on from experimenting with mirrors and drawing in school. The idea of drawing was quickly taken up by other children who also wanted to draw inside the mirrors.

Another two children began drawing small concentric squares in the centre, then a larger one around it. They took it in turns to add curved, petal-like shapes to each side, then added triangles inside these. The symmetrical drawing developed with straight and curved lines, kaleidoscope-like, resembling opening flowers, petals or leaf buds like some of the drawings earlier in the week in school and perhaps influenced by the nature around them.

Co-enquiries with the mirrors and reflections seemed to spark children exploring shape, geometry, pattern and symmetry through drawing. What influence did the patterns created by the lines inside the mirrors and the reflected patterns have on their drawings?

The children’s ways of enquiring indicate how their enquiries cross curricular boundaries; between maths, science, art, and design. The experimental site of learning provided by Mirror Maze and the co-enquiry approach didn’t place divisions between subject areas. It allowed for learning in one realm to connect with, flow into and inform others.





Children's observations, debate, thoughts and hypotheses on key questions

Perception of space and infinity

When looking at images of possible mirror mazes and the Mirror Maze website in school, one of the children said, 'Looks like you're falling into a black hole, into infinity.'

There were several comments when children were experimenting with their own small-scale mirror constructions and from being inside the mirror maze itself where children express the feeling of a sense of space and it stretching out into infinity:
'It feels really big' [inside the square mirror]
'Endless passage ways'; 'a passage way, it goes on for ever and ever' [Mirror Maze created by the children with small mirrors].

Inside the square mirror two children commented on how it 'Looks like you can keep walking forever but you can't.' Inside the hexagon and pentagon-shaped constructions they remarked: 'It looks like a big long corridor'; 'It's neverending.'

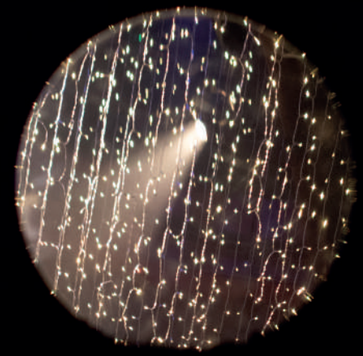
Number, multiplication, and an infinite number

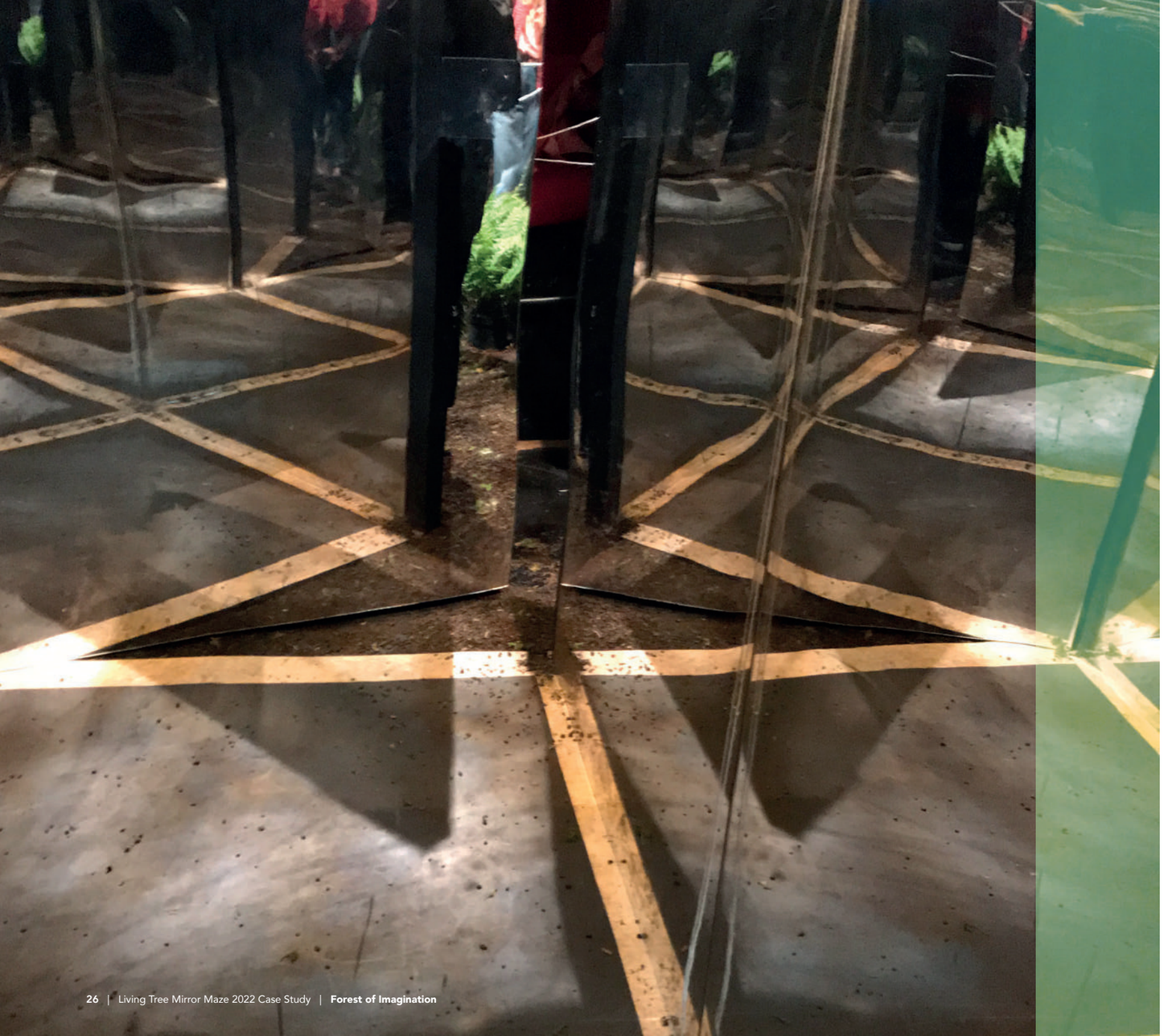
Many of the children made reference to number, how the images of themselves were multiplied and to an ‘infinite’ number.
‘50 more mes.’ [Inside the square mirror]
‘There are 6 mirrors but it looks like it’s a hundred’.
‘It looks like there are thousands of me’; ‘Too many.’ [Alf’s observations]
‘There’s lots of people in there. A hundred million thousand.’ [coming out of the pentagon mirror]

Michael noted one of the Year 5 children reflecting after their experience in the Mirror Maze: ‘I like the mirror maze because even though there [are] six mirrors inside, it looks like a much bigger number.’
Liz asked one of the children what they noticed inside the mirrors: ‘There’s only 1 of us but it’s like there are a 100 of us. It’s like an army in there.’ He made reference to his multiple reflections as an ‘us’: ‘1 of us’ and a ‘100 of us’.
Morgane (artist) had a conversation with some of the children about what they noticed in the hexagon mirror. ‘How many of you can you see?’ They counted initially and then realised there was more and more; concluding: ‘it’s an infinite dimension’.

The children’s commentary to the adults alongside them indicates how they perceived the number of reflections (particularly of themselves) to be multiplied to infinity by the mirror configurations.

When looking at Alf’s concept of possible mirror mazes in school beforehand, one child hypothesised: ‘You only really need one mirror to project off, that bounces off another and another and another.’
What are the connections between the children’s ideas of infinite reflections created by the mirrors and the deeper mathematical questions the mirror maze poses?





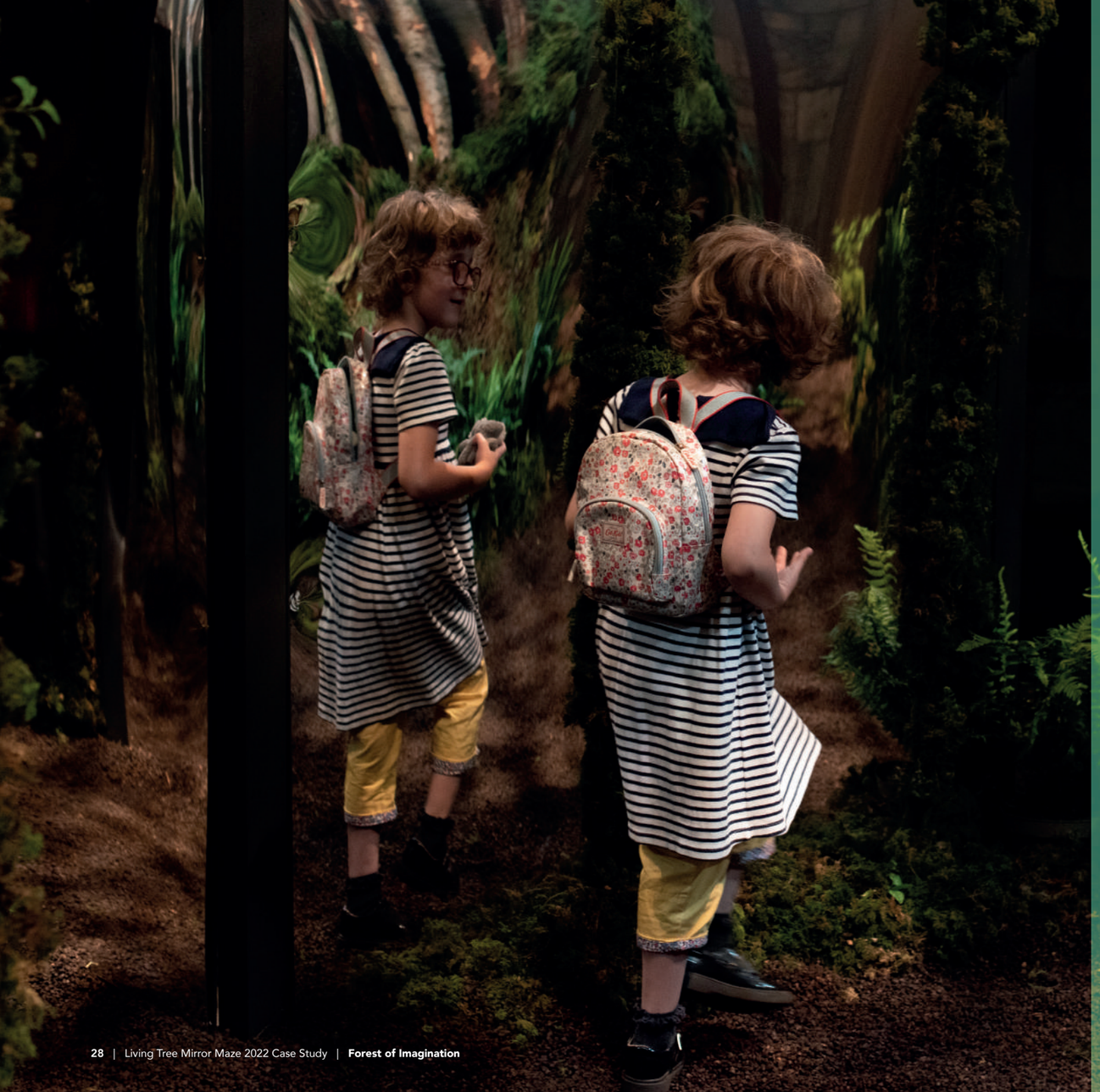
Differences and similarities between different shaped mirror constructions

Alf had suggested that the children should go inside each of the mirrored spaces and consider: 'What do you notice that is the same? What do you notice that is different?' He suggested that they pay particular attention to the patterns.

After going in each of the mirrors, two of the children were asked what they noticed. They commented on the sense of space 'going on forever' in each one, but didn't remark on any differences. Many children across the groups were drawn to reflections of themselves rather than the patterns on the floor. Often there were groups of children in the mirrors at the same time. This raises several questions:

Were the children naturally drawn to reflections of themselves rather than the patterns? Were the patterns created by the mirrors less noticeable if several children were in the mirror construction at the same time?

Other children did notice differences. Clare (artist) observed one child trying out the different shaped mirrors, working out if there were any differences between them:
'I think the square one is the biggest'.
'I can't see the front of me except once'
'I've found a different shaped one!'
'Let's try another one of those shapes'
'It's different in here'
'Look what shape it makes'



Which is the real me?

In observing and documenting the children's enquiries with mirrors there is a sense of perceiving their reflections as being 'other' to them. After two children played with their reflections, marching side by side, one of them commented: 'It was like an army. They copied whatever you did.' It gives a sense of detachment from their reflections with the use of 'they'. Morgane (artist) noted one child pointing at herself in the mirror: 'It's me.' The child then noticed the reflection of her back in another mirror and she said she looked like 'someone else' from her class.

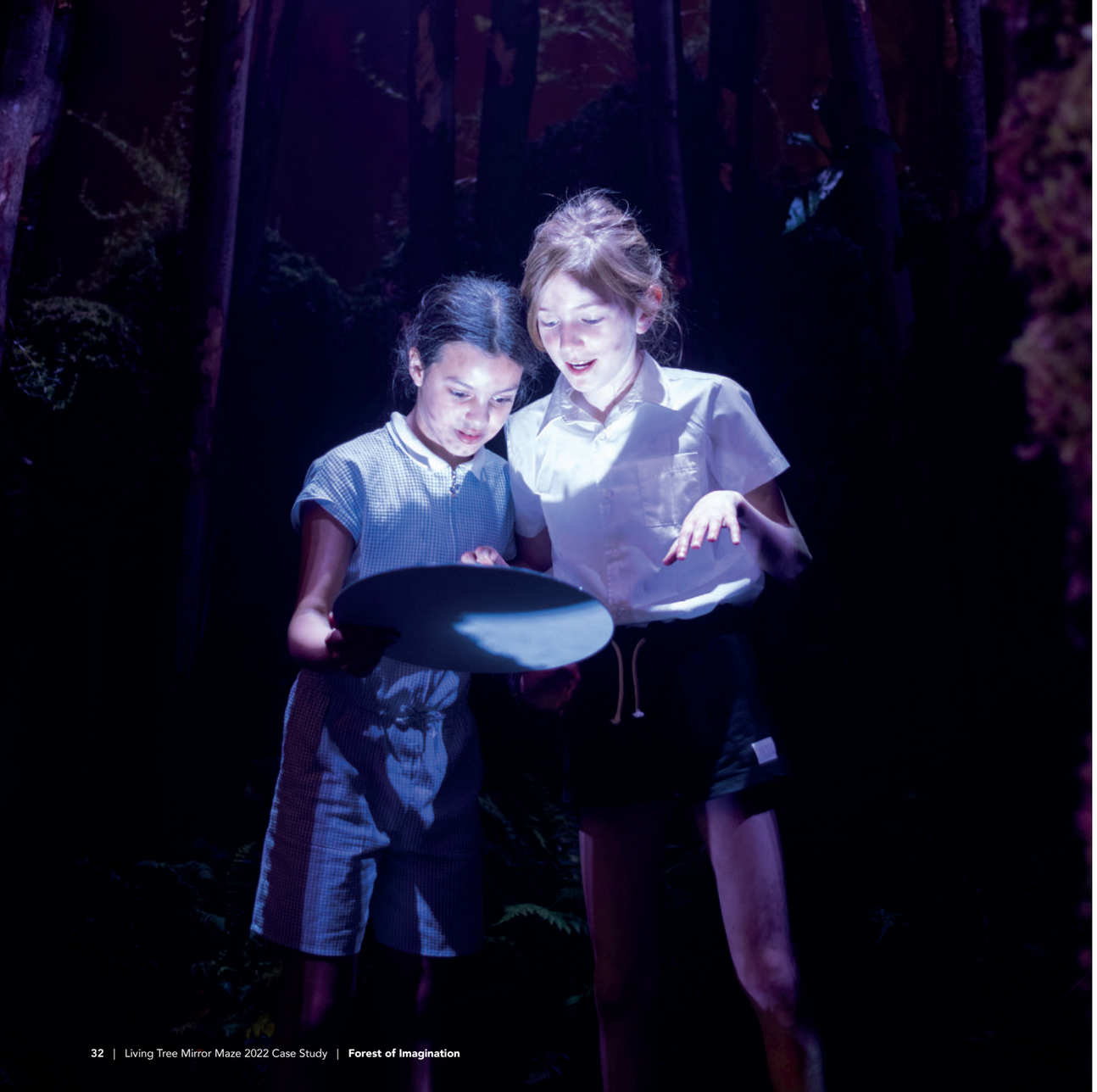
There is a sense of another reality or parallel reality in what they express. On leaving the square mirror one child shared that he loved how you couldn't tell which [reflection] was looking at you?

Tristan (teacher) asked the children, at the end of the session, if there was anything they were particularly curious about, that surprised them or made them think of a question? One child described putting a mirror under a wall light: 'You could see it, but not really see it.' This implies that he thought the object (the light) was real, but the reflection of the object was not real. They also made reference to optical illusions while drawing. Alf overheard one child say: 'Guess which is the real-life me?' It recalled conversations with children in a previous House of Imagination project with a nursery where the artist (Andy Kemp) had used a video camera on a tripod, which could be set to split the image In half and mirror it. He linked this to a live monitor so the children could interact with and manipulate the images through their body movements and see themselves on the monitor. When reviewing the video film, the children debated with each other over which was 'the real Zac'?

The children seem to be touching on questions related to space, time, parallel universes and realities. What are the connections between the children's question 'which is the real me' and the mathematical and scientific questions?

The children's question: 'which is the real me' could be considered from many perspectives: as mathematician, artist, scientist or philosopher.

"There is a hugely significant mathematical concept which is the "identity transformation" – a transformation that keeps you in the same place … the identity comes in, for example, in "group structure" which is one of the deeply abstract and profound ideas met at university. You can make a "group" whenever you have a set of things that combine to give something that is still within the set. So, if I have a shape like a square, I can make a group from different rotations of that square, e.g., I can rotate 90, 180 or 270 degrees … and then I can start combining rotations and need a way of describing (as a transformation) what happens when eg I rotate 180 twice. Hence, to complete the group structure, I need the "identity" transformation – rotating zero degrees – and now any combination of my transformations gives me a result which is one of those transformations (0, 90, 180, 270). And it turns out that loads of things in mathematics have this kind of group structure – and if you can establish that a set of things can be combined to make a group, then there are all sort of other things that must be true about them and which are proved – in the abstract.
So, yes … the children could be seen as saying – where is the identity transformation?"
[Alf, from email]



Collaboration of mathematicians, children and teachers

The Year 5 class were invited to consider the ideas of Living Tree Mirror Maze a few days before their visit to the Egg, the idea being to document the session and share their thoughts and ideas with the co-designers, to allow for an exchange and collaboration of ideas. The teacher worked with the concept of ideas for the design of the mirror maze, and collaborated with Alf and Andrew to co-lead the session at the Egg.

Whilst exploring and enquiring into mirror mazes, the children made connections with the geometry they were learning in school. When Tristan (teacher) asked them why the examples of possible mirror mazes were different shapes; they said 'because of different angles'. In conversation with Andrew about the design and engineering of the Living Tree he made reference to geometry and that triangle or cone shapes were very strong, to which one of the children asked: 'Is it like an isosceles?' There was a network of connecting ideas and enquiries which coalesced for the children from different aspects of their curriculum and learning experiences.

Summary and concluding comments

The children immersed themselves in the ‘world of mirrors’ and explored kinaesthetically the interrelationship between themselves and their reflections; interacting with them, observing their actions as if other to themselves, and whose actions they could control. They found their own ways of exploring and expressing mathematical, artistic and design ideas through drawing. They followed their curiosity and fascination to enquire into multiple reflections, the sense of space, and the concepts of an infinite number and infinity. They asked their own powerful questions such as, ‘which is the real me’?

forestofimagination.org.uk