

# *Pathways in informal science learning*

**A practice-research brief**



## About the project

This briefing paper reports findings from the Youth Access & Equity in Informal Science Learning (ISL) project, a UK-US researcher-practitioner partnership funded by the Science Learning+ Phase 1 scheme. Our project focuses on young people aged 11-14 primarily from under-served and non-dominant communities and includes researchers and practitioners from a range of ISL settings, including designed spaces (eg museums, zoos), community-based (eg afterschool clubs) and everyday science spaces (eg science media).



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### Research partners

The project involves research partners from King's College London, University College London, Michigan State University and Oregon State University.



### Practice partners

Our practice partners include informal science learning organisations across the UK and US such as At-Bristol science centre, STEMNET, Zoological Society of London, Open University media, American Museum of Natural History, Community Science Workshop Network, and KQED Public media for Northern CA.

### Science Learning+

Science Learning+ is an international initiative established in partnership between the Wellcome Trust, the US-based National Science Foundation and the UK-based Economic and Social Research Council, and in collaboration with the Gordon and Betty Moore Foundation, the MacArthur Foundation and the Noyce Foundation.

## A practice-research brief for pathways in informal science learning (ISL)

*“ When I think of science pathways I think of science fairs and stuff. I don't think I was ever that kind of a person... It makes me feel like an imposter to call my pathway a science pathway.”*

CHANDLER, PRE-MED STUDENT WHO PARTICIPATED IN ISL PROGRAMMES IN MICHIGAN



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Across the informal sector, there is broad consensus that informal science learning experiences can powerfully support youth learning and development in science (Family Education Project, 2010). However, access to, and opportunities within, the informal science education sector remains deeply mediated by socioeconomic, cultural, ethnic and systemic factors. As pointed out by Elle, a participant in the US-based community ISL workshop:

*“ Not all youth have the same access. One youth might be able to go to museums with their family and do science fairs and festivals and the like. Other youth might only have what they might be lucky to get at their community club.*

*What we have seen is that it is the kids from lower-income families, the refugee kids, who have the least access to informal science experiences. And yet, these experiences provide opportunities to really engage science that schools sometimes simply cannot.”*

As this participant points out, access to ISL is important for youth development, yet remains, in the US and UK, unequal across class and racial lines.

Elle speaks from the perspective of community-based programmes – after school, weekend and summer programmes that serve young people in their communities. Often these are located in community organisations, such as boys and girls clubs, after school clubs in school settings or in homeless shelters and Girl Scouts (US)/ Girl Guides (UK), but they can also occur in collaboration with designed spaces, such as community-programmes that grow out of museums. Indeed, the diversity of ISL, which includes community-based programmes and designed spaces (eg museums) and everyday science (eg media and festivals) is its very strength.

Such a diversity of experience allows for a wide-reaching range of opportunities and settings for young people to encounter and participate in, across the time and space of their daily lives. However, we also know that youth have varied access to these opportunities, and when they do access ISL spaces they engage in them, and learn from them differently. They also move through ISL spaces differently.

Some youth move in more planned or sequential ways that open up in-depth experiences in a particular domain.

Some youth bob around a wide range of experiences by luck or happenstance, or because it is simply all they can access. One of our participants in the UK put it this way: *“It [pathways] is useful not just for seeing, but for doing things that we want to do. The nice thing about pathways is that it shows people are going somewhere and that we [our programmes] are not a final destination.”*

However, as noted by another participant in the US, pathways are not always evident to the youth themselves: *“The ecosystem is not self-evident - youth cannot see the connecting factors. Where are the connecting factors that make that pathway?”* Regardless of how or why or where youth move through ISL experiences across spaces and over time, participants in our workshops agreed that *“Pathways are always about opening doors, not closing them”* (US participant). In a sense, we can think of the wide range of possible opportunities as an ISL ecology.

A pathways approach foregrounds youth agency, valuing the resources they bring to the table and the diversity of routes they navigate as they pursue science across the spaces of their lives. As one participant from the UK put it, *“No one-off event is going to cut it in terms of making real impact on social inequalities and wide science engagement. The appeal of the pathways model is that it means no one person or organisation has to try to do it all.”*

Pathways also foreground how such learning plays a role in how youth perceive themselves, how they position themselves in relationship to others (adults and peers), and in how they develop the agency to cross-leverage ideas/practices/resources as they move across settings and contexts.

We are interested in how institutions, organisations and other providers, as well as researchers and practitioners, are also transformed as youth navigate them. Lastly, this view foregrounds the need for novel approaches to studying learning and its wide-ranging outcomes, including deepening scientific knowledge and practice, interest, motivation, identity development and engagement.

## What does a pathways approach mean for the field of ISL?

We draw from a learning ecologies perspective to interrogate pathways as one way to understand how youth move within/across/through learning spaces toward possible futures (Bell, et al., 2012). The pipeline metaphor is simply not adequate. Some possible pathways are created or facilitated by power-mediated opportunity structures that some youth can traverse. Always, however, pathways are being designed, built, negotiated, and shifted or morphed by the interest-driven actions of youth (Lyon, et al, 2012). Often times, these youth-centred actions are not recognised by traditional structures and gatekeeping authorities (Tan et al, 2013).

A pathways lens highlights the forward trajectory of young learners' decisions and opportunities toward promising possible futures in/with science (Cannady et al, 2014). Seeing such movement allows for nuanced examinations of the twists/turns pathways take throughout individual learning landscapes. How youth choose to engage science, for what purposes, where and when all shape, and are shaped by, the people, places, events, and power structures that constrain or expand activity. A pathways lens foregrounds the multiple directions one may take with science, the various lane switches and on/off ramps into/through science, and the agency youth have to author their lives within/across the multiple layers and contexts of learning experiences in science.

## Practice–research visions of equity in ISL

We recorded and analysed the discussions that took place across the seven practice-research workshops that we convened, relating these discussions to different views of pathways. Pathway ideas, initiatives, and concerns (eg issues of recognition, empowerment, valuing difference, starting from a youth-centred approach) were foregrounded in both US and UK workshops. However, more explicit discussions of equity and success dominated US-based ISL workshops, whereas UK workshops yielded a focused conversation on the nature of pathways and the conditions that made pathways equitable or not. Because our workshops purposefully focused within each ISL domain there was not as much conversation on pathway formation across ISL type, although this idea still emerged in all workshop conversations.

Some participants saw pathways as a way of describing the journeys from informal to formal learning. Others saw it as a way of identifying the other activities people might go on to participate in after 'doing our thing' (eg watching a programme then visiting a science centre). In the end, however, pathways seemed to be a useful idea to participants in the context that it portrayed a sense of shared responsibility for promoting equity across different ISL sectors.

There were common ideas across the workshops in both the US and UK, which framed talk and programmatic work around pathways. The pathways discussions and mapping activities yielded important insights in four categories of ideas regarding pathways: pathway elements, movement, successes and challenges. On the right we outline the key ideas, which emerged.

### 1. Elements of pathways

Across the pathways drawn by workshop participants, key ISL spaces included hobbies, schools, designed environments and community spaces. Maps also prominently included family and friends. Many of the individual elements of pathways were specific spaces or places. Many participants drew their own organisation in the centre of their diagrams, however those drawing pathways based on an individual were more likely to locate their organisation as more peripheral. Elements of pathways were fairly common between both the US and the UK.

### 2. Movement through pathways:

#### relationships, resources, and broader ecology

Pathways are always in-the-making, and are unique for each individual, with different beginnings, different choices along the way, and different goals. However, there is diversity within this movement that is important to recognise, understand and design for. Pathways can have both obstacles and stepping stones, making pathway formation more or less difficult for any individual youth. Pathways are also marked by important moments that lead to new ways of being, new forms of participation, new interests in science, new partnerships in one's science journey, etc, all of which can have positive or negative effects. Examples of critical moments can include: fieldtrips, interactions with staff at afterschool programmes and meaningful, supportive relationships. There are many critical moments along the way, and the challenge is in recognising them (for oneself, or for others).

### 3. Successful outcomes

Successful pathways for youth attend to where they are at in-the-moment and over time. We need to think about how to create pathways that support youth on their own journeys, rather than providing regimented or predetermine pathways. Some workshop members used the term 'health' of the pathway and of the learning ecology, which we think is an important way to push on the construct of success. While successful outcomes seemed to be more challenged by participants in US workshops (eg an explicit desire for an accepted expanded set of outcomes for ISL), both participants in the US and UK felt it was important to frame outcomes in fairly broad ways (eg traditional outcomes such as developing youth learning and interest in science, and less traditional outcomes, in terms of using ISL experiences to enable young people to engage more broadly in everyday life and improve their life chances). Across the ISL sectors in the US and the UK, three core concerns related to success emerged:

- *Access and opportunity.* Pathways are successful when youth have the chance to do science in ways that are relevant in their lives. Youth should not be not turned away from ISL experiences. These opportunities should reflect their cultures, experiences, interests, and needs, and furthermore these opportunities should come to them (rather than youth always coming to the opportunity).
- *Agency and choice.* Pathways are successful when youth are able to define the direction of the pathways and individualise them to their interests and needs. Part of this idea is that youth develop the ability to articulate their own goals in science/science learning (rather than have someone else always establishing goals for them). Pathways are successful when youth are able to connect or link experiences in science over time (vertical) and across the spaces of their lives (horizontal).

- *Legitimising/valuing the experiences youth bring.* Pathways are healthier when youth's STEM experiences – whether traditional or non-traditional – are recognised by those in authority. One consideration here is how youth's cultural knowledge and experiences can be central to what they value in the potential programmes and experiences that make up their pathways, or in how they name the important outcomes of their pathways. At the same time, such pathways should link youths' cultural knowledge and experiences with science so that they have access to these worlds in ways that are culturally sustaining. As one of the participants in the US put it, "If all youth see are people not like them and programmes that do not take their experiences into account, then why would they want to participate? We need to spend more time learning about the cultural experiences of the youth we serve."

### 4. Challenges

The obstacles or challenges to pathways in ISL focused, in all locations, around cost, staffing, and norms/expectations.

- *Cost.* The concerns were complicated, but nonetheless strong in terms of ensuring pathway opportunities. In the US, cost was discussed primarily related to funding to support initiatives. Questions were raised around programme sustainability and development. As one participant suggested, "How can the programme then be sustained financially once started as the groups being addressed cannot absorb some of the cost. This then creates the issue of trying to establish scaffolding and on-going community relationships." However, in the UK, the role of cost stretched across funding and access, noting that programme costs shaped the diversity of their participant audiences. As one participant in the UK noted, "[the] pay barrier is not necessarily the whole thing, we focus too much on discounts and membership."
- *Staffing.* There was common concern that the quality of staffing can be uneven, and that professional development for leading ISL experiences is lacking. These particular obstacles around staffing, in some workshops (eg designed spaces in the US) were discussed as systemic issues, where the lack of educator training, information and personnel were major concerns. As stated by a UK-based participant, "In terms of the zoo educator workforce, I think we need to work on our own abilities in doing that kind of work and capacity building, we need to build our knowledge in this area and share that knowledge with one another".
- *Norms/expectations.* Across all US spaces was the concern that society can over-emphasise one particular pathway, while marginalising others. This was not unlike the UK concern that framed the issue similarly but in terms of core offerings. That is, expanding societal views of powerful pathways may involve expanding or even shifting the core of ISL practice.



## What about EQUITY pathways?

While the concept of pathways seemed to be useful and understood by participants, *equity* pathways was a more difficult idea for participants, in particular in the UK. Participants tended to draw all of the possible options and links that might be associated with an ISL organisation, rather than identifying which of the paths were open to all audiences and which were not.

It took some prompting for the participants to consider what ‘switches the connections on or off’ for the pathways. Three major themes emerged in terms of *equity* pathways: **power dynamics, critical moments and design concerns**. While these themes dominated US-based conversations explicitly, they did emerge implicitly, and across the ISL spaces in the UK as well.

ISL pathways are marked with power dynamics, and how youth are supported in navigating these power dynamics will shape their experiences there. Examples of these power dynamics include: messages about who is allowed to participate, what legitimate participation looks like.

Relationships were a key equity concern with respect to pathway formation and sustainability – youth relationships with ISL providers, relationships among ISL providers, and between informal and formal science education, and family relationships with ISLs all mattered in metering access and opportunity for youth in ISL.

Pathways can be marked by critical moments that lead to new ways of being, new forms of participation, new interests in science, new partnerships in one’s science journey, etc, all of which can have positive or negative effects. For example, these critical moments can shift the direction of pathways, by opening them up or shutting them down.

Pathways, themselves, may not necessarily be proscriptively designed, but the **social spaces which make up pathway moments** can be designed for in ways that make access to and movement of ideas, tools, people and resources possible. These spaces should foster agency and ownership in science (for becoming and moving in particular ways).

Perhaps most importantly, across the US and the UK the point that emerged most strongly in terms of explicit discussion regarding equity pathways was the point about **transitions** (which included entry points, movement between spaces, and outcomes), and how doing so might shape how the field, broadly, thinks about impact. This point was echoed across the workshops:

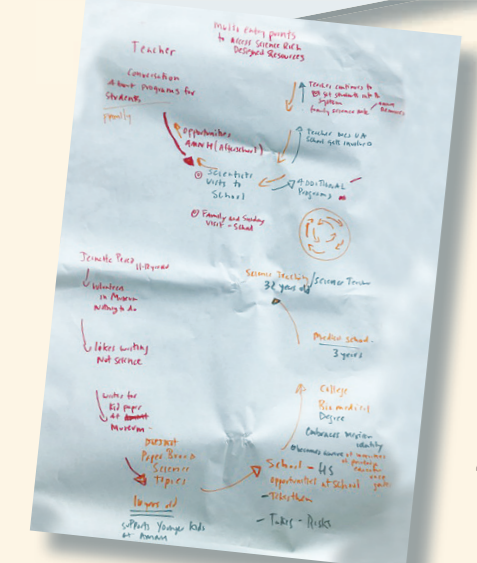
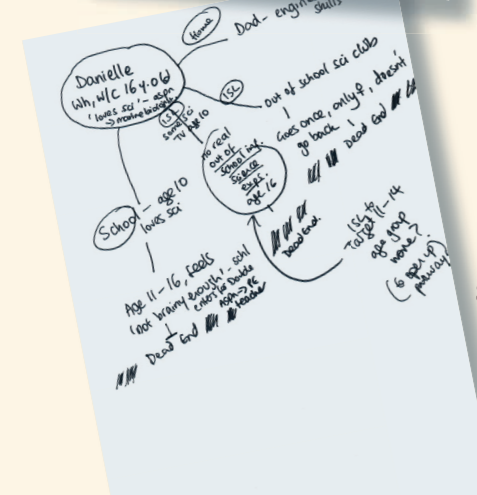
- *It is all about transition from informal learning environment into a structured learning environment. We need to get smarter about how to support these transitions. It is a reality check we need.* (US).
- *We need to find ways to connect institutional science with community agendas. We need to think about equitable airspace, collective impact, challenging assumptions* (US).
- *The interesting thing about the maps is the notes I was attaching to each line, ‘this is viable when X...’. It is the connections between the routes, which one switches on or off, or where there are diversions, that’s what is interesting* (UK).

On the left we share four maps (two US, two UK) which we feel highlight this critical point of transition alongside the broader issues on pathway elements, movement, successes and challenges.

- [US] This map illustrates the importance of transportation early in the pathway (without the bus for programmes in 6th and 7th, the youth’s pathway would not be possible).
- [UK] Pathway of young girl who engages with science in a range of ways, including non ISE format.
- [UK] It was harder for participants to imagine how pathways might not be equitable, however, some participants helped us to see what ‘dead-end’ pathways might look like.
- [US] A map illustrates the importance of multiple entry points, including those that are, on the outside, non-science related (eg writing).

## Example of a real life pathway

Alex is a fan of science. He’s also a child of lower-income migrant workers, a linguistic/ethnic minority and a gang member. This is Alex’s pathway with STEM.



## References

Bell, P, Tzou, C, Bricker, L, & Baines, AD (2012). *Learning in Diversities of Structures of Social Practice: Accounting for How, Why and Where People Learn Science*. *Human Development*, 55(5-6), 269–284. <http://doi.org/10.1159/000345315>

Cannady, MA, Greenwald, E, & Harris, KN (2014). *Problematizing the STEM Pipeline Metaphor: Is the STEM Pipeline Metaphor Serving Our Students and the STEM Workforce?* *Science Education*, 98(3), 443–460. <http://doi.org/10.1002/sce.21108>

Harvard Family Research Project. (2012). *Afterschool Programmes in the 21st Century*. Harvard Family Research Project. Available at: <http://www.hfrp.org>.

Lyon, GH, Jafri, J, & St. Louis, K (2012). *Beyond the Pipeline: STEM Pathways for Youth Development*. *Afterschool Matters*. Retrieved from <http://eric.ed.gov.proxy1.cl.msu.edu/Pid=EJ992152>

Tan, E, Kang, H, O'Neill, T, & Calabrese Barton, A (2013). *Desiring a career in STEM-related fields: How middle school girls articulate and negotiate between their narrated and embodied identities in considering a STEM trajectory*. *Journal of Research in Science Teaching*, 50(10), p.1143-1179. DOI: 10.1002/tea.21123

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### Further information

For more information about our project and to find our other project publications and outputs, please see [www.kcl.ac.uk/sspp/departments/education/research/crestem/Research/Current-Projects/YAERPA/Home.aspx](http://www.kcl.ac.uk/sspp/departments/education/research/crestem/Research/Current-Projects/YAERPA/Home.aspx)

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