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Entry

Science Festivals: Evolution, Structures, Impacts and Challenges

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Definition

Science Festivals are public events focused on showcasing science, technology, engineering, and mathematics in a celebratory and engaging setting similar in atmosphere to an arts or music event. Aimed at the general public, science festivals vary widely in form and duration, lasting from anywhere between a day and several weeks, and featuring interactive activities such as hands-on workshops, live demonstrations, lectures, and performances. Many include dedicated programming for schools, but they differ from school-based science fairs, which are aimed primarily at students and parents and are typically held on school premises. Their aims include sparking curiosity, promoting scientific literacy, enabling visitors to interact with working scientists, and making science fun and accessible. Festivals are distinct from other informal science engagement formats due to their temporary, joyful nature and diversity of offerings. The modern science festival concept originated in Edinburgh in 1989 and has since experienced rapid global spread. Hundreds of events now take place annually throughout Europe and North America, and to a lesser extent other parts of the world, supported by associations such as the UK Science Festivals Network, the European Science Engagement Association, and, in the USA and Canada, the Science Festival Alliance. Some of the largest festivals see attendance figures in the hundreds of thousands, and across the world, millions of people participate every year. An emerging body of research literature, situated within a variety of social science disciplines and lenses, suggests that festivals are greatly enjoyed by their attendees, and succeed in boosting science interest, increasing knowledge, and improving perceptions of science among visitors, making them a potential asset for societies that place a high value on scientific activity among the population. However, the events have also attracted criticism for their limited audience diversity, with visitors being disproportionately drawn from highly educated and affluent groups, prompting suggestions that they are 'preaching to the converted'. In response, some festivals have introduced targeted initiatives such as community outreach and partnerships to attract audiences from underrepresented communities. Despite these ongoing challenges, science festivals continue to evolve and grow as platforms for inspiring curiosity and fostering meaningful public dialogue around key scientific topics.

Keywords: science festivals; STEM; STEAM; public engagement with science; informal science education; science communication

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1. Introduction

Science festivals—accessible events that celebrate science and allow the general public to meet and engage with scientists and researchers—have become an established feature of the science communication landscape in developed economies. Distinct from other

provisions such as museums or school science fairs, science festivals are characterised by their temporary and festive nature, with many using 'wow factor' events such as explosive chemical reactions and hands-on activities to educate and inspire visitors by harnessing the benefits of experiential learning [1]. Science festivals are also able to provide a different learning experience to in-school provision, and there is a large body of research showing that school trips such as those to festivals boost both cognitive and affective learning [2].

Although attempts to engage the public in science emerged during the early 19th Century, the modern science festival movement began with the founding of the Edinburgh International Science Festival in 1989. The concept has spread rapidly, with hundreds of such festivals now held every year across Europe and North America, while their presence in other areas such as Asia, Africa, and South America continues to develop.

While science festivals are functionally separate from museums, science centres, and similar institutions, they can be seen as part of the same broad movement in science communication away from a deficit model and towards formats based on dialogue and participation. Rather than a scientist transmitting information one-way to a public that is essentially passive, these experiences promote conversation and even, in some cases, co-creation.

The science festival sector is characterised by its diversity, ranging in size from government-backed powerhouses attracting hundreds of thousands of visitors to small volunteer-led events, and aimed at a variety of audiences, such as adults or families. Theme and emphasis are also heterogeneous; recent iterations in the UK and North America have focused on cutting-edge topics such as biotechnology and AI, while festivals in developing countries may be more concerned with building the STEM (science, technology, engineering, and mathematics) workforce, local challenges, and national development.

As the sector reaches maturity, research interest in the impacts of festivals has developed as a distinct area of enquiry at the intersection of science communication, sociology, and cultural anthropology. Studies, typically drawing on both qualitative and quantitative methods, show that festival attendance boosts science interest and knowledge among visitors. There has also been some critical scrutiny; analysis has shown that festivals tend to attract visitors who are more affluent and highly educated than the general population, prompting suggestions that they are 'preaching to the converted'. Some festivals have begun to take action to address this issue.

This entry outlines the development of the modern science festival, gives an overview of the different forms it can take, engages with the evidence of the movement's impacts, and considers potential future developments. It is based on a thorough survey of the literature of the last 15 years, supported by a SCOPUS search of the term 'science festival[s]' over the full date range (1970–2025) as well as a similar Google Scholar search to access relevant grey literature.

2. Historical Development

2.1. Public Engagement with Science: The Roots of the Science Festival Movement

Early efforts to interest the populace in science were via public lectures, with the Royal Institution hosting talks by luminaries such as Humphry Davy and Michael Faraday from 1801 [3]. The British Association for the Advancement of Science (BAAS, founded 1831) had a focus on public education and held annual meetings in venues around the UK [4].

Although science dissemination in the 1800s continued to be mainly through lectures and journals, the groundbreaking Great Exhibition of 1851, held at the purpose-built Crystal Palace in London, contained some scientific elements, such as new telescopes [5] and a precursor to the fax machine [6], and the celebratory atmosphere perhaps foreshadowed the modern-day cultural festival. This was followed by a series of World's Fairs, which

showcased innovations and technological innovations, such as the telephone [7]. The early-to-mid 20th century saw sporadic efforts to promote public scientific knowledge, including exhibitions such as the Festival of Britain and the US National Science Fair.

2.2. Birth of the Modern Science Festival

It was in the 1980s that the modern concept of the science festival was arguably born, when the BAAS annual meeting was rebranded as a 'Festival of Science' [8], with a shift in focus towards public accessibility and multi-day programming; it would later evolve into the British Science Festival.

But the crucial development was the launch of the Edinburgh International Science Festival in 1989 [9]. Widely regarded as the first science festival in the modern sense, the event was modelled on existing arts festivals and aimed to create a broad appeal. The endeavour proved a success, and it was around this time that the term 'science festival' entered the public lexicon, as can be seen in the Google ngram (a diagram showing the frequency of words or phrases across time in the Google Books corpus) in Figure 1.

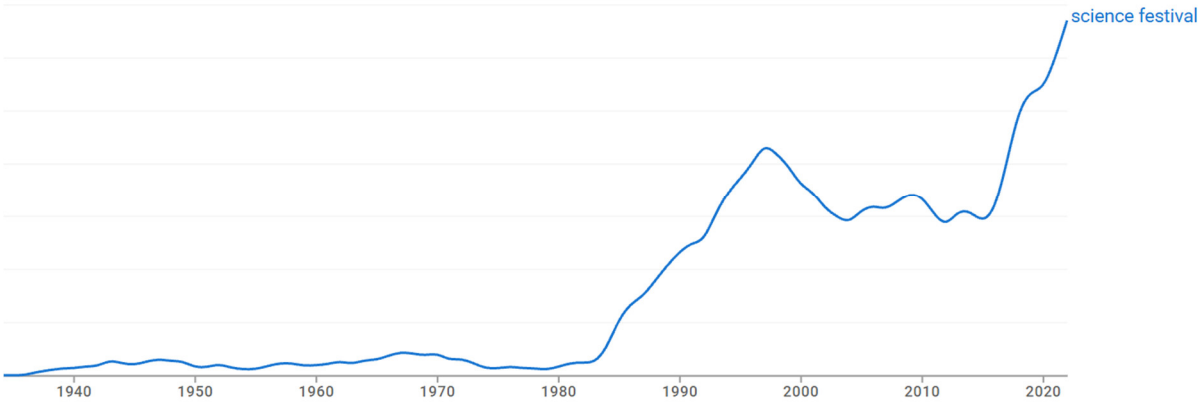

Figure 1. The growth of use of the term 'science festival' in published works. Produced via Google Books Ngram Viewer, https://books.google.com/ngrams/ accessed 28 January 2026.

2.3. Growth and Consolidation

The following decade saw several emulators appear in Europe, including, notably, the Gothenburg International Science Festival in 1997 [10], and the first such event in the US, Wonderfest in San Francisco, was held in 1998 [11]. But it was in the 2000s that a rapid global expansion began. New events began to emerge, including the Cheltenham Science Festival in 2002 [12], the World Science Festival in New York in 2008 [13], and the European Researchers' Night, initiated by the European Commission in 2005 [14]. The following decade saw a worldwide explosion in numbers, with up to 50 festivals active in the UK, 75+ in the USA and Canada, and dozens across continental Europe. During this period, the science festival movement began to spread around the globe; the World Science Festival launched an offshoot in Brisbane, Asian examples such as Singapore and Petrosains in Kuala Lumpur were founded or expanded, and both Africa and South America also saw events.

Some areas of the world have seen the development of networks for science festival organisers. The Science Festival Alliance, an umbrella organisation for covering events in the USA and Canada, was founded in 2009 [15] and had grown to around 75 members by 2020, while the UK Science Festivals Network (UKSFN) is managed by the British Science Association [16] and has around 40 members.

2.4. Diversification of Models and Emphasis

As the sector grew, so the model of what a science festival 'looked like' began to diversify. The format pioneered by Edinburgh—focused in one city, with an emphasis on families, taking place over two weeks—was used by some other festivals, but others took a radically different form. European Researchers' Night, for example, is held over just one night but in more than 25 countries, and is aimed at the general public rather than families specifically [17]. Another initiative, Pint of Science, has a grassroots model based in pubs and cafes that has spread over much of the world and is aimed primarily at adults [18]. These are just two examples of the variety of forms that a science festival can take.

The growth that has recently been seen in developing countries and the Global South has also given rise to events that have a somewhat different emphasis, often focusing on national development, the need to build STEM human capital, and addressing local challenges. In Kenya, for example, the 2025 National Research Festival had a theme of 'Sustainable Agriculture and Food Security', addressing a national core priority [19]. Governments or their agencies may be directly involved in running events; for example, the India International Science Festival (IISF) is organised by multiple government ministries.

2.5. Impacts of the COVID-19 Pandemic

As with many areas of life, 2020 saw a sharp dislocation in science festival activity, with the pandemic leading to events being either called off or held fully online in that year. Edinburgh cancelled its in-person activities and instead produced online events, videos, and exhibitions, while IISF saw more than 100,000 people take part in its fully digital offering in December 2020 [20]. Events in 2021 were often held in hybrid format; Cheltenham Science Festival held in-person, socially distanced events such as talks from prominent scientists which were also live-streamed, while the Lancashire Science Festival moved its schools content entirely online but held an in-person family day as in previous years.

The aftermath of the pandemic saw some changes in delivery in the festival sector. Whilst events have returned in person, some elements of hybrid programming remain; for example, Cheltenham now incorporates some live-streamed content, while Edinburgh has an 'Edinburgh Science On Demand' online platform. However, such digital offerings are seen as supplementary to, rather than replacing, in-person content.

In some cases, the post-pandemic scene has seen organisations take stock and decide to evolve in different ways that make a different use of finite resources; organisers of the Lancashire and Manchester festivals, for example, shifted to a biennial model, while the Cambridge Science Festival (US), previously a multi-day event, has now become the single-day Cambridge Science Carnival.

2.6. Current Status

It is difficult to give a precise figure for the number of science festivals operating worldwide at the time of writing, but a conservative estimate is over 500, with over 1000 if individual events associated with decentralised models such as Pint of Science are included. There are some signs that growth in mature markets such as the UK is levelling off, but in the developing world, expansion is still rapid, both in terms of new festivals and the size of existing events.

3. Format, Structure, and Programming

Science festivals are highly heterogeneous in nature. They can vary in length, scale, venue type, and audience. In this section, we give a brief overview of some of the key models and look at some current innovations.

3.1. Organisers and Funding

There are a variety of common organising structures for science festivals. Many, such as the Edinburgh Science Festival, are run by charities or other non-profit organisations with dedicated staff. Some festivals are also led by universities, as part of their core function of public engagement. Small local festivals may be run by grassroots or community groups, often led by volunteers; these may be hyper-local and low-budget, focusing on families in the immediate locality. At the other end of the scale are festivals organised through local or national government channels; perhaps the most prominent example is IISF, which is organised by government ministries. In less-developed countries, festivals may be organised or facilitated by non-governmental organisations such as MILSET (the International Movement for Leisure Activities in Science and Technology) or the OECD (Organisation for Economic Co-operation and Development).

Organisational models with a collaborative, partnership or consortium-based approach are very common, bringing together a lead organisation such as a university or charity with other interested bodies such as local authorities and community groups. Festivals are commonly also funded via a hybrid model, with contributions from government grants, philanthropic organisations, corporate sponsorship and sometimes ticket sales or entry fees, although events are almost exclusively run on a non-profit basis. Some models also rely on the efforts of volunteers, or time and venues being provided free of charge by universities or other institutions and their staff.

3.2. Venue

Science festivals are held in a wide variety of venues. Some are held in a single centralised site such as a university campus, while others are dispersed across a town, city, or even an entire state (for example, the Wisconsin Science Festival). There are advantages to both models; a centralised venue allows visitors to attend numerous events during the course of one day, while a more dispersed model may allow more people to attend individual events.

Venues used typically include university buildings, museums, exhibition centres, and performance arts facilities. However, unconventional spaces are also used to attract a wider audience and make events more accessible; these can range from cafes and bars to cathedrals. Outdoor events also feature, with stands and shows in town centres and public squares, aiming to take the festival to target groups, and encourage incidental/unplanned attendances.

A less common model is that of a festival with a moving venue. The most prominent example of this is the British Science Festival, which is hosted by a different UK city and one or more local universities every year; for example, in 2025 the festival was in Liverpool in the North of England, while in 2026 the venue will be Southampton, around 180 miles south.

3.3. Duration

A science festival can last from anywhere between one day and several weeks. Shorter events are often hosted by universities; examples include the South Side Science Festival (University of Chicago, one day) in the USA and the Lancashire Science Festival (University of Lancashire, three days) in the UK. The limited duration of these events minimises campus disruption while allowing the host institution to showcase its research.

Science festivals which are held in dispersed venues may be easier to sustain over longer periods. Edinburgh Science Festival, for example, uses some 30 venues across the city to stage events over a fortnight; similarly, in the USA, the Atlanta Science Festival stages over 100 events across the metro area, over a two-week period.

3.4. Scale

The number of events and visitors at science festivals can also vary widely. For example, Sidmouth Science Festival [21], an annual event held in a small town in the southern UK, registered just under 4000 attendances in 2024; by contrast, the International Science Festival Gothenburg attracts around 70,000 visitors per year [22]. IISF is even larger, with reports that the 2025 edition attracted over 200,000 visitors [23].

3.5. Frequency

The most common model is the annual festival; prominent events such as Edinburgh and Gothenburg take place every year. However, some are biennial events, such as the Lancashire Science Festival and Manchester Science Festival in the UK. There are also one-off events, often to celebrate milestones such as centennials of scientific institutions; for example, the Stanford School of Engineering celebrated its centennial in 2025 with 'A once-in-a-century birthday celebration' featuring more than 50 hands-on research exhibits [24].

3.6. Core Elements

While science festivals are diverse in their structure and scale, they tend to feature the same range of activity formats. The participative nature of these events is emphasised, with interactive workshops and opportunities to meet scientists, while the 'wow factor' is provided by demonstrations and experiments that may feature fire, explosions, or other dramatic effects. Other common elements are lectures or talks, panel discussions, exhibitions, and performances. One of the most popular features shared by many festivals is an interactive 'discovery zone' where members of the public can wander among stalls offering different hands-on activities.

3.7. Audience and Programming Strategies

Festivals may have a variety of target audiences, and will programme their content accordingly. For example, the Lancashire Science Festival is aimed at primary-age children, and the organisers programme a mix of school provision and family days. Others, such as Pint of Science, are mainly aimed at adults and may feature debates on controversial issues held in adult venues such as pubs.

Some festivals embrace a loose theme for each iteration, and programming will broadly reflect this; for example, Edinburgh Science Festival used the theme 'Shaping the Future' in 2024 and 'Spaceship Earth' in 2025.

4. Prominent Festival Archetypes with Examples

As discussed, the term 'science festival' is a broad umbrella, with individual events taking on a multitude of forms. However, it is possible to pick out a few common models; here we focus on five popular formats, giving a prominent example of each.

4.1. Culture and Family: Edinburgh Science Festival

Billed as the 'world's first science festival', the Edinburgh Science Festival was founded in 1989 and was inaugurated by Alan Shepard, the first American in space. The event was introduced to complement the world-famous Edinburgh International Festival, a celebration of the arts founded in 1947. Held annually during the two weeks of the Easter school holidays, the science festival features more than 250 events spread over a range of venues in the city, and has hosted luminaries such as Dame Jocelyn Bell Burnell, Brian Cox, and Richard Dawkins. It is run by Edinburgh Science, an educational charity that has also formed collaborations in other countries, such as being a programming partner for the Abu Dhabi Science Festival [25]. In terms of content and audience, it represents a popular civic

and cultural model that has been widely imitated elsewhere, integrated into the life of the city through venues such as theatres, museums, schools, and key outdoor spaces, with a strong focus on family engagement and interactivity.

4.2. Ideas and Thought Leadership: World Science Festival

Held in New York City, this festival represents the science festival in a curated intellectual form, with a focus on high-profile events, cutting-edge ideas, and star power. The festival was established in 2008 by string theorist and public intellectual Brian Greene and Emmy-award-winning journalist Tracy Day. Past participants include many high-profile names, including Hollywood stars Alan Alda and Glenn Close, classical musicians Philip Glass and Yo-Yo Ma, and world-famous scientists including Stephen Hawking and James Watson; the inaugural event included 11 Nobel laureates among the speakers. With a focus on high production values, live discussions, and events that explore the interface between arts and science, the festival aims to make complex science accessible to the public and is largely aimed at an adult audience. There is also significant digital programming, with over 250 million views of digital content worldwide.

4.3. Distributed Grassroots: Pint of Science

Pint of Science is the most prominent example of a grassroots, decentralised micro-festival, whereby local scientists speak to public gatherings in venues such as pubs and cafes. The movement stemmed from a 'meet the researchers' event hosted by Imperial College London scientists Michael Motskin and Praveen Paul, who were inspired by its success to 'bring scientists to people' [26]. The event was first held in 2013 in three UK cities and grew rapidly, expanding to six countries in 2014, and now sees annual events in more than 400 cities in 28 countries worldwide. The initiative reaches beyond the science festival strongholds of Europe and North America; events are also held in countries as varied as Laos, Ecuador, Thailand, Kenya and Brazil, the biggest national player with events in 169 cities in 2025.

Pint of Science works on a devolved model with a sense of community ownership; the stated aim is 'to provide a space for researchers and members of the public alike to come together. . . everyone has a place at the table'. Events are volunteer-led and programmed locally by the scientific community across three days in May annually.

4.4. University-Led: Lancashire Science Festival

The Lancashire Science Festival, founded in 2011, is organised by the University of Lancashire (previously the University of Central Lancashire) and hosted on its campus in Preston, UK. Held annually until 2021, with a break in 2020 due to the COVID pandemic, it now continues as a biennial event.

The event showcases the work of the university's own researchers in fields such as space science, exoskeleton engineering and biomedical research, as well as inviting guest performers and local STEM organisations to participate. The format includes two school days, when visiting primary-age classes take part in workshops and see demonstrations, and a public day where families are invited to explore a range of hands-on activities across the campus. In 2025, the event attracted around 10,000 visitors over the three days, mainly from the surrounding area.

The university's public service ethos means that it prioritises attracting a wide range of visitors to the event, with a focus on underrepresented groups. Selected primary schools in low-SES areas are given precedence in booking places at the festival, and organisers have pioneered testing of measures such as offering free meals to attract target families [27] and travel bursaries to youth groups.

4.5. National Development and Innovation: India International Science Festival (IISF)

This large festival is an example of how science festivals operate and grow in developing countries with state support. Founded in 2015, it is an initiative of the Indian government that aims to showcase the nation's developing presence in the science and technology sectors, as well as providing opportunities for public involvement. By centring Indian breakthroughs in fields such as space, biotech, renewable energy, and quantum technology, it positions science as the cornerstone of India's economic development, as well as strengthening connections between cutting-edge research and traditional knowledge systems.

A key aim of the festival is to inspire young talent, as well as to build the national STEM sector through providing opportunities for entrepreneurship and partnership-building. It is attended by huge numbers of visitors and aims for a broad appeal, with outreach programmes hoping to inspire remote and rural audiences, as well as welcoming international delegates.

5. Research on Impacts and Benefits

The growth of the science festival movement has seen a commensurate rise in interest in the potential benefits of such events. While little research into this subject was seen pre-2010, subsequent years have seen an explosion, with researchers such as Eric Jensen [8,28–30], Karen Peterman [31–34] and Cherry Canovan [1,2,35,36] active in the field. Individual studies have examined the science festival using a variety of theoretical lenses, including experiential learning theory [1,37]; social identity formation [38]; science capital [32]; and critical event studies [39].

Investigations have considered different aspects of the science festival experience, including demographic analysis of audiences, motivations for attendance, and the short- and long-term impacts on audience perceptions of science. The growth in the number of papers can be seen in the SCOPUS record, as in Figure 2.

Most work that has been done in the area has been on the short-term impacts of science festival attendance. Festivals are widely enjoyed and improve perceptions of science; key benefits are increased scientific interest [8], science learning and knowledge [1,40,41], and awareness of science careers [2,42]. A small number of studies have shown longer-term impacts [1,37], with Canovan [1] notably finding measurable impacts on aspects of science capital—a gauge of the science-related knowledge, attitudes, and experiences a person accumulates—a year or more after visiting.

The benefits of interacting with a scientist during the visit have been demonstrated by several studies. In the largest of these, Boyette & Ramsey [42] surveyed 5498 attendees at 14 science expos around the United States, finding that those who had interacted with a scientist rated their experience more positively in terms of learning, career awareness, and other measures. This supports the work of Manning et al. [43], who, using data from four US festivals, found that attendees who met STEM practitioners at a festival 'had more fun, were more interested, and learned more'. In a smaller study, Fallon et al. [36] found that half of the respondents said that meeting a scientist had made them more likely to think that their child could follow a science career, with attitudinal shifts particularly prevalent amongst parents from low-participation backgrounds.

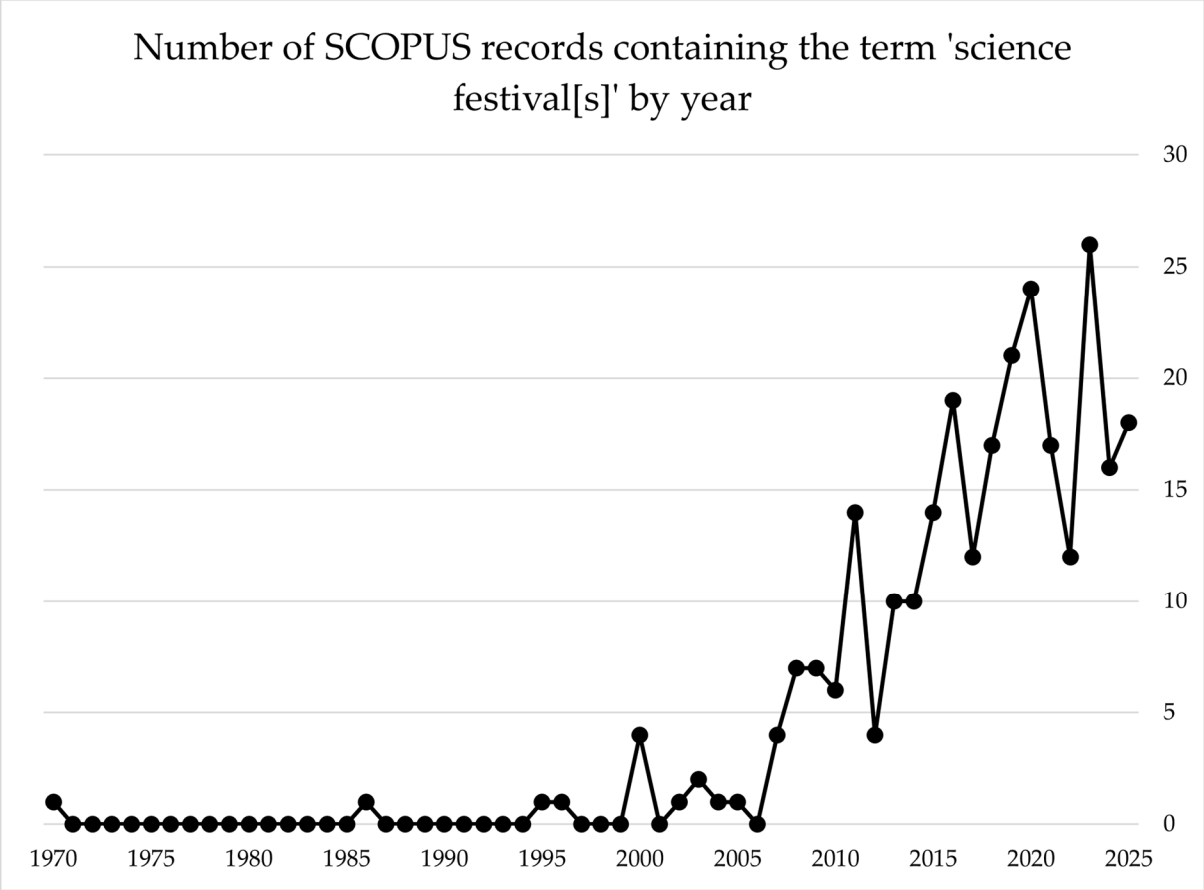

Figure 2. Growth in the number of research papers containing the term 'science festival[s]'. Created using data retrieved from Scopus (Elsevier B.V.) on 23 March 2026.

A few studies have also looked at the impacts of participation on scientists and other professional contributors. Exhibitors at a large US-based festival told King et al. [44] that participating had provided CPD opportunities, boosted their communication skills, and built a sense of community within local networks. Meanwhile, STEM professionals participating in Scifest Africa told researchers that they were motivated to take part by informing and inspiring the public, feeling an obligation to 'give back' to society, and a wish to be a role model for others, particularly among black African and female scientists [28].

6. Criticisms, Challenges and Responses

One of the major challenges to the perceived success of science festivals is the charge that they are 'preaching to the converted'—addressing themselves to audiences who are highly educated, affluent, and already engaged in science. Researchers such as Nielsen et al. [33], Manning et al. [43], Kennedy et al. [30], Evia & Peterman [31], and Canovan [27] have demonstrated that in the UK and North America at least, visitors to science festivals are more affluent and highly educated than the general populace.

A range of inclusivity barriers have been identified; these are similar to the barriers often seen in cultural engagement more broadly, with those with low levels of formal education, the unemployed and individuals with low incomes significantly underrepresented among the typical science festival audience. While the ethnicity of visitors is understudied in the UK, there is evidence that in the US, visitors are more likely to be White than the local population [43].

There has been some activity in the sector aimed at widening participation to underrepresented groups, with more festivals considering how to target underrepresented

audiences and reach out to their communities to engage with them on a deeper level. Festivals frequently work with community organisations to make their events more widely accessible [45,46], while some target programming at groups such as the LGBTQ+ community [47,48]. Some umbrella bodies are also active in this area; the UKSFN is collaborating with researchers at the University of Lancashire to develop a best-practice framework for widening participation [49].

Issues have also been raised with the methodology of the evaluations that support claims of the benefits of festivals. In the early years, much research was based on on-the-day intercept surveys, and many published studies rely on these to evidence their impacts, despite the risk that opt-in surveys pose of self-selection bias. Rigorous evaluation and longitudinal data can be sparse, although the situation seems to be improving. In 2012, Jensen and Buckley [8] noted that few festival evaluations had reached the threshold for peer-reviewed journal publication at the time, and described evaluation as 'often very limited methodologically'. More recently, Peterman et al. [34] noted that science festival papers had doubled in the previous three years, and although studies were still heavily focused on short-term outcomes, methods used were evolving. Examples of varied methodologies include the work of Canovan [1], who used online surveys to gather the views of festival participants one year after their visit, allowing an analysis of the longer-term impacts of attending. This was built on the work of Idema & Patrick [37], who explored family members' experiences of festival visitation by administering on-the-day questionnaires followed up by drawing activities and interviews three months later. Meanwhile, a before-and-after model surveying attendees at two festivals, paired with a grounded theory analysis, has been used by Jensen et al. [29] to develop a festival evaluation framework.

Peterman et al. [34] reviewed the research landscape in this area and made a number of suggestions for potential developments in evaluation, including the use of mixed methodologies, unobtrusive methods such as mystery shoppers, timing and tracking to understand festival navigation, and the use of shared measurement scales to build a community of evaluation. Other commentators have advocated an increased focus on equity and inclusion [1,27], and recent studies have used a science capital framework to this end [32,50].

7. Current Trends and Future Directions

Science festivals are constantly evolving, and certain themes are emerging as trends at the time of writing. Among these are deeply immersive experiences such as the use of gamification and virtual/augmented reality; co-creation, involving local groups in programming rather than adopting a top-down model; hybrid programming, including an online element; and a focus on inclusivity, via diverse audiences and citizen science, where members of the public are involved in scientific research and data collection.

As the sector reaches maturity across developed economies, a clear direction is emerging of a move from being purely celebratory events towards a repositioning as purpose-driven platforms. One noticeable trend is a strong focus on sustainability, climate, and planetary challenges among festivals. Themes including future food, marine conservation, and sustainable energy are popular, with many festivals aligning elements of their content, explicitly or otherwise, with the United Nations Sustainable Development Goals [51,52].

Another direction of travel is towards a greater emphasis on emerging technologies, particularly AI and biotechnology, and the ethical questions that go hand-in-hand with these. As well as talking about AI, some festivals have embraced the technology to assist in the organisation and delivery of their content; notably, Cheltenham Science Festival's guest

curator, the AI-powered AIDA, was introduced in 2019, presaging the more recent boom in the use of the technology [53].

A move towards STEAM (STEM + Arts) and interdisciplinary approaches is also noticeable, with many festivals utilising theatre, music, and storytelling to communicate the underlying scientific message [54,55], mirroring similar initiatives taking place in formal educational settings such as schools [56], where experimental studies have shown that girls in particular benefit from such approaches [57]. Research suggests that such approaches can lower barriers to entry for those who do not perceive themselves as 'science audiences'; Keith & Griffiths [58] suggest that the interdisciplinary nature of a STEAM event can lead to 'compelling, meaningful experiences', while others note that STEAM integration may assist with 'engaging non-traditional audiences and those who might not self-select into science activities' [55]. In addition, some studies suggest that engagement quality may benefit from STEAM approaches; Grimberg et al. [59] point out that art can 'act as a catalyst for scientific advocacy and community action'. A typical STEAM event might explore the interface between technology and fashion, with participants learning how to engineer 'structural garments' [60].

Another trend is a focus on career pathways; for example, the USA Science Festival's website speaks of its "expanded focus to connect students with STEM career pathways and future-ready skills that align with our nation's growing workforce needs" [61].

For developing countries, the picture has a different emphasis. An even greater focus on sustainability is seen, with themes frequently tied to local vulnerabilities such as water security and extreme weather [62,63]. There tends to be a particular focus on inspiring young people to follow STEM careers, in order to build expertise in the field to bolster national development efforts.

8. Conclusions

Science festivals are a distinct feature of informal science provision, offering a celebratory, transient, and diverse range of opportunities for the public to engage with STEM and scientists. The events that fall under the banner are popular, with some drawing massive audiences, and provide an enjoyable opportunity for public engagement. While fun and entertainment are still major drivers of the science festival experience, the sector is evolving to provide a platform for the public to engage with cutting-edge developments and ethical issues such as AI and biotechnology. Festivals in the Global South may have a slightly different emphasis, being particularly focused on national development, building STEM human capital, and sustainability.

Although some commentators have criticised festivals as 'preaching to the converted', and attracting audiences made up largely of affluent, highly educated individuals and families with high existing science capital, there are signs that organisers are beginning to recognise the problem and are taking steps to tackle it. Likewise, a previous lack of meaningful evaluation beyond on-the-day intercept surveys has begun to be addressed, and research into the impacts of festival attendance is itself a growing field, although much remains to be done.

Despite these limitations, festivals continue to develop and adapt, embracing new delivery modes, hybrid models, accessibility initiatives, and the latest technological advances. The sector exhibits a diversity of models, from huge government-organised events to small local gatherings, pop-ups and grassroots-led models. Emphasis on careers information and expansion into the STEAM sphere are likely to be continuing trends, as is engaging with areas where cutting-edge science meets society.

The longer-term outlook for science festivals is a maturing of the sector in the Global North, with events positioning themselves as conduits between STEM entrepreneurs,

governments and the public. Whether a greater focus on inclusivity will be sustained remains to be seen. The launching of large new festivals in the developed world will slow, and economic factors may cause funding issues for some; it is possible that the sector will see some consolidation, with collaborations likely. The picture in the developing world, by contrast, is likely one of continued rapid growth and evolution, with the potential for government-backed mega events to expand and new festivals to emerge.

As research begins to show the impacts that science festivals can have, we can expect to see their continued success, including increased global reach, and that they will have an active role to play in fostering informed, curious societies for many years to come.

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