Public Dialogue on Space

Using Space safely and sustainably for the long-term benefit of humanity

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THE ROYAL SOCIETY
Ipsos
The Liminal Space

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Executive Summary

Background and method

The Royal Society commissioned Ipsos UK to conduct a series of independent public dialogues about accessing Space safely and sustainably for the long-term benefit of humanity. A total of 96 members of the public took part, across four locations in Great Britain (Wrexham, Glasgow, Leicester, and Cornwall). The participants attended two full day workshops, aided by informative stimulus and access to Space specialists.

The Royal Society identified four policy themes to engage the public on: **Discovery of Life, Governance in Space, Industry in Space, and Sustainability.** These key themes formed the basis of four future scenarios and framed the workshop discussions. Conclusions and recommendations made throughout this report have been informed by the participant discussions and expressed by Ipsos UK.

Governance

Participants thought effective global collaboration will be vital to avoid conflict and widespread damage in Space, but worried it may not be achievable. However, the International Space Station provides hope that global collaboration is possible, and scientific collaboration is seen as a possible pathway to achieve this.

There was strong support for a single International Space governance authority, which should be globally inclusive, so all countries have a say in significant decisions. Participants felt strongly that efforts to achieve global collaboration must begin now, so that we are prepared ahead of significant advances in Space activity.

Division and ownership of territories in Space was seen as an inevitable source of conflict. Some felt that human ownership of territories in Space is always unacceptable, as these are not ours to claim. Others felt that the ownership of Space territories is key to incentivising innovation for countries and private companies.

Participants frequently suggested a licensing model as an alternative to ownership of territories. They felt that this would enable access for research or industry, without fully giving over control, providing a way to protect areas for conservation or research. They also suggested that a licensing model could be a mechanism to share benefits from Space industry and would be a way to enforce Space laws, as licenses can be rescinded.

Industry in Space

Participants learned about different potential industries that may emerge in Space in the future, including mining of planets or asteroids, Space-based solar power, and Space tourism. Participants were sceptical about the cost barriers to progress in such industries, though hopeful about the potential benefits, particularly for Space-based solar power.

Participants often considered long-term solutions (such as Space-based solar power) to be more justifiable than those they saw as quick – but temporary – fixes (such as mining finite resources in Space).

Space workers' rights are important to participants, especially considering the isolation from Earth. Participants wanted Space workers' rights to protect mental and physical health, and to ensure equal safety, quality of life and human and legal rights for all Space workers.

Private activity in Space is seen as necessary to provide the innovation and investment needed to achieve progress and realise the benefits from Space exploration. However, governance is needed to maintain control over private industry, and to prioritise human and environmental benefit over profit.

Discovery of life

Participants predicted that there are most likely to be lifeforms in Space, however, they were uncertain if these would be discovered. They expected any life discovered in Space to be simple lifeforms rather than advanced, intelligent life.

The discovery of life may present the opportunity for learning and improving the sustainability, and long-term survival of humanity, through studying the lifeform itself, its environment, and how it survived or became extinct.

Participants emphasised the need for us to protect our own and other ecosystems upon the discovery of life. Any intervention with a lifeform in Space must be clearly justified, and only after careful observational study.

Participants appeared more concerned about the impact humans might have on a lifeform if we discover it, rather than the impact a lifeform might have on humans, hence there would be a need to pre-empt this to avoid unreversible damage.

There were calls for a global collaborative approach towards agreeing on how to respond to a discovery of life. Participants wanted an international discussion to start soon, so we are prepared to make quick decisions responsibly in the event of a discovery.

Sustainability and safety

Participants saw the potential for Space industry to help energy and environmental issues on earth but wanted this to be done responsibly, safely and sustainably.

They were concerned about environmental damage that might be caused to celestial bodies through activities, particularly mining. However, there was a lot of division on whether causing harm in Space is acceptable if it reduces harm on Earth.

Participants wanted licensing of activities to protect sustainability and prevent environmental damage, as well as protecting scientific discoveries.

Participants called for thorough measures in place for the safe use of Space, including: an Earth customs system to regulate shipping to and from Earth, rules for safe transportation of hazardous materials around Earth.

Participant principles

- Future Space exploration and activity should be governed by an International Space governance body, with people from different backgrounds, and representation from all countries to create the

rules, enforce the rules and hold countries and commercial actors to account. There should be negative repercussions for those who break the rules.

- Consider a licensing model for the management of Space territories – managed by the International Space governance authority for land/resources.
- Laws, rules, and activities should not disproportionately benefit countries who have greater financial resources or power.
- Future Space exploration and Space activity should be responsible and underpinned by principles of safety, sustainability, and minimal impact to planets and celestial bodies, life if found, ecosystems and habitats.
- Ethical and fair return for public benefit: Future activities in Space should be safe, sustainable and ideally benefit humanity.
- Preservation for research: If anything of interest/significance is found (i.e., life), initially the site should be preserved for research and nothing should be brought back to Earth until deemed safe to do so.
- If any life is found, there should be global collaboration and majority agreement about what action to take, if any.
- Communication about new discoveries or scientific breakthroughs should come from trusted representatives from within the scientific community and be removed from politics.
- Ensure diversity and equity of those working and living in Space, minimum standards for quality of life, that human rights are upheld and that there are legal protections for all.

Introduction

Background

Space activity within the UK has been of increasing interest, given the potential for economic growth alongside environmental and technological advancements critical to society. Space-based technologies already help facilitate much of modern-day life and the impacts of Space activities are likely to rapidly increase in the coming decades.

'Space' is the third instalment in a series of works by the Royal Society called Perspectives, which aims to consider emerging scientific and technological developments and how they may impact the future. However, there are very few opportunities for the public to engage with these issues and contribute to conversations around policy. Therefore, to gain an understanding of public perceptions and priorities around future Space activity, and to inform the development of their broader Space policy programme, the Royal Society commissioned Ipsos to conduct a series of public dialogues about using Space safely and sustainably for the long-term benefit of humanity.

Research aims

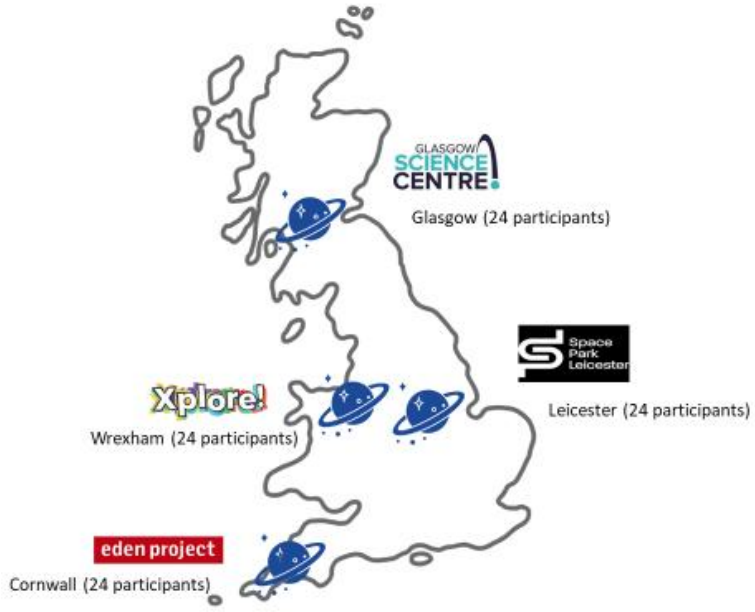
With a look forward to 2075, the aim of the dialogues was to understand how a public audience considers the major issues, aims and implications of these three areas:

- How lunar activities should be governed.
- How evidence of life (if found) should be treated.
- How human life in Space should be safely sustained (managing health, risk, and Space workers' rights).

Methodology

We recruited a total of 96 participants across 4 locations in Great Britain (Wrexham, Glasgow, Leicester, and Cornwall), to take part in day long, in person workshops. The same 24 participants in each location attended the first workshop and then returned for the second several weeks later. Participants were recruited from central and surrounding areas of these locations to ensure that we included people who live in both urban and rural settings.

Figure 1: Workshop locations



The workshops were hosted in science and Space discovery centres in all four locations to create an environment that would stimulate engaged and topical conversations.

Participants were recruited by a trusted agency, Fieldmouse, to be broadly reflective of Great Britain demographically, while capturing a range of interest levels and attitudes towards outer

space. These attitudinal quotas included the belief in life on other planets, interest in outer space, and engagement with recent space-related events.

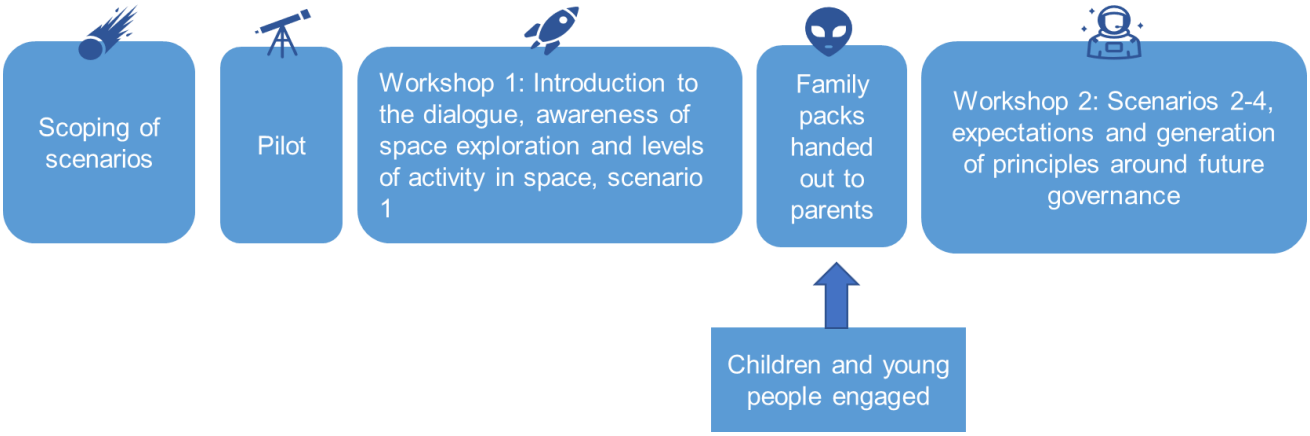
Considering the long-term outlook of the project, and the Royal Society's desire to engage young people in the conversation, 33 of the 96 participants were recruited as parents of young children (aged 7 - 15) and were given activity sheets for their children to complete between the two workshops.

For further details, please see the achieved sample in Appendix 1.1.

Participants engaged in two full day face-to-face workshops over two months. At each location, participants were separated into smaller discussion groups, each with their own moderator to facilitate four scenario-based discussions. Preliminary work with the Royal Society identified four policy themes that we could engage the public on, these were **the Discovery of Life, Governance in Space, Industry in Space, and Sustainability.** These key themes formed the basis of the four scenarios and framed the workshop discussions.

These discussions were aided by a range of stimulus material that are discussed more in depth later in this chapter, and can be found in the appendices. Experts from the Royal Society's Space working group and other subject specialists were also present at the workshops, to allow participants to ask questions and discuss themes openly with them. This is a key element of the public dialogue, as facilitating interaction between members of the public and subject specialists builds trust and empowers the participants to fully engage in an unfamiliar topic.

Figure 2: Overview of approach



Development of scenarios

Given the abstract topic for discussion, four future scenarios were developed describing the state of play in the year 2075. During the initial scoping stage, the content of the scenarios was informed by discussions between Ipsos, the Royal Society, and their network of specialists. Members of the Ipsos and Royal Society teams participated in a two-hour workshop with working group specialists to shape these scenarios, to ensure that they each represented viable descriptions of the future and were credible and valuable enough to inform the development of the wider policy programme. Following the workshop, the Ipsos team led on the initial development of the four scenarios, and these were further developed with the help of the Royal Society and members of the working group. The full scenarios can be found in the appendices.

Pilot study

Prior to the mainstage workshops, we ran a small pilot focus group with 10 participants in London. The purpose of this focus group was to assess basic comprehension of the four scenarios, and whether they worked as intended for the main workshops. This was necessary given both the vastness of the topic, and that prior to this study, there has been limited public engagement in Space and Space governance.

Workshop 1

The first set of workshops took place on the 11th (Wrexham), 18th (Glasgow), and 25th (Leicester) of February and the 4th (Cornwall) of March 2023. The focus of this workshop was to assess participant's initial levels of awareness of Space exploration, and to provide them with information on national, international, and private activity in space. This involved exploring current forms of governance in space, research into the discovery of life, and the potential benefits of Space exploration. There was also an open question and answer session with the specialists who attended the workshops. As the issues we set to explore were complex, the aim was to equip all participants with knowledge and confidence that would allow them to fully participate in the later deliberation phase of the workshops.

After giving time to absorb this information, participants were introduced to the deliberation phase at the end of the workshop, where they were introduced to the first of the four scenarios which they discussed for the remainder of the workshop.

Family packs

In between the two workshops, those recruited with children were asked to engage their children in the discussion. Collaborating with The Liminal Space, we created activity sheets for the younger children to complete, that would allow them to engage with the same key themes (discovery of life, governance in space, sustainability, and industry in space), as the participants in the main workshops. They were asked to consider the implications of living in a Moon settlement in 2075, with prompts such as:

- "Would there be a separate currency on the Moon?"
- "Which kinds of jobs will exist on the Moon?"
- "Who makes the decisions in your household and about your future? Who's in charge of your town or village?"
- "How will we build homes on the Moon?"

To engage with the discovery of life theme, the activity sheets also asked children to draw what they think any extra-terrestrial life or plants may look like, and whether they should be protected like endangered species are here on Earth.

Workshop 2

The second set of workshops took place on the 11th (Glasgow), and the 18th (Wrexham and Leicester) of March, and the 1st (Cornwall) of April 2023. These workshops were more deliberative than workshop one, focusing on discussing the three remaining scenarios. Towards the end of the workshop, participants engaged with principle formation, whereby the facilitators reflected back to participants what they had heard throughout the first workshop in the way of principles and priorities for action, and participants were given the opportunity to edit, discount or ratify these, accounting for changes to the way that they felt about the issues as a result of the discussions throughout workshop 2.

The Liminal Space props

The workshop activities were supported by immersive stimulus materials created by The Liminal Space, a people-centred creative consultancy, in discussion with Ipsos and the Royal Society. Each of the four scenarios had at least one prop relating to a key policy theme. These props were designed and used to help the participants engage with the vast and complex topics that this dialogue focuses on by synthesising and translating them in creative ways. Images of the props can be found in the appendices.

Other stimulus

Acknowledging that the public may not have given much thought to this topic before, and to further build knowledge and aid engagement, participants were given fact sheets created by The Royal Society and Ipsos focusing on five of the following research areas; microgravity, space-based solar power, Space mining, Space technologies to combat climate chance and lunar activity and exploration. These fact sheets were on hand for participants throughout both workshops.

Reading this report

Qualitative research approaches (including public dialogues) are used to shed light on the range of views held, and the strength of feeling amongst participants, rather than how many people hold these views. The results are intended to be illustrative and show nuance and reasoning, rather than provide statistical findings. This report aims to provide detailed and exploratory findings that give insight into the perceptions, thoughts, and feelings of people. We have used participant quotes from both workshop sessions to illustrate these points.

It is important to note that the respondents' perceptions may not always be based on the existing scientific evidence, or may not account for regulations or governance systems already in place. However, as this report represents participants' views, it is important to include these in the way that participants expressed them, as they demonstrate the concerns, expectations and areas of confusion for the public.

As the scenarios were used as a tool to explore the key research themes, (discovery of life, governance, industry in Space and sustainability), this report will be structured by these themes, rather than the scenario-based structure of the workshops.

In both workshops we used extensive stimuli, including the scenarios, their corresponding physical props, and the fact sheets. These are referenced throughout this report and can be found in the appendices.

Participant journey

Chapter summary

- Participants displayed mixed levels of awareness of national, international, and private activity in Space.
- Participants showed high levels of interest in the discovery of life and governance in Space presentations and felt that although they had not considered how to govern Space before, they now felt it was important and very complicated.
- There were several underpinning perspectives that influenced workshop discussions, these included a general pessimism about human nature, particularly in relation to colonial history, and global environmental damage.
- All groups engaged well with the scenarios. The physical props, particularly the Globes, the Moon Jobs Board, and the Nebucillin drug, aided the complex discussions participants were having.
- There was general agreement (with a few dissenting views) with the draft principles provided, and participants took on board the opportunity to edit, ratify or withdraw any they saw fit.
- Regardless of prior knowledge or interest, all participants showed enthusiasm for the topic, and considered the topics discussed throughout to be of great importance.

Initial awareness and associations with Space

To gauge a baseline of participants' views and knowledge levels, at the beginning of the first workshop, as a warm-up exercise, participants were asked to give their spontaneous associations to the words 'space' and 'solar system'. From this, there were three clear emergent themes:

- **Vastness:** There was a strong sense coming from participants of the infinite and incomprehensible scale of space, especially in relation to black holes. This made some participants reflect on how small and insignificant they felt as humans on Earth in comparison.

- **Mystery:** Due to vastness, there was a sense that there are many unexplored areas of space, and that we, as humans, may never be able to fully understand space. Participants felt that there was a sense of mystery around the unknown, often in relation to the potential discovery of life. Some participants found this exciting, whereas others were more apprehensive and found this overwhelming.

- **Technology:** Participants associated Space with both its historical and recent technological advancements. Some discussed watching the first Moon landing, and how much technology has advanced since then. Participants made specific reference to how we use satellites to track weather patterns, and imagery for GPS. There was a sense that participants felt recent private activity in Space has pushed technological developments further.

Participants shared that they hear about Space from multiple sources, particularly from their verified social media accounts, alongside science podcasts, documentaries, and YouTube videos and – some - from the NASA website. Participants also hear about Space on the news, via online, Instagram and TikTok and TV platforms. Brian Cox was also cited as a trusted source on Space developments.

Whilst there were mixed levels of knowledge among participants, there were specific developments or events that the groups were generally aware of, particularly the James Webb telescope, and the quality of images that it produces. Other technologies, such as the Mars Rover, were familiar to some participants, with a few recalling paying to have their names on a microchip so that their names reached Mars. There were also participants who were also familiar with recent rocket launches, such as those by SpaceX and the Spaceport launch from Cornwall. Generally, participants were less familiar with the U.S Artemis Programme, and even less so with Blue Origin's New Shepard. However, there were some participants who had heard of these.

Responses to information

Governance in Space presentation

This presentation interested participants, but also made many feel uncomfortable and wary of future conflicts in space. Participants commented that they hadn't thought about how to govern Space before, but now they had it felt important and very complicated.

There was a strong feeling amongst participants that Space governance needs to be both collaborative and global. Participants felt that achieving this in Space will be challenging, especially when taking conflicts happening on Earth into account and if certain countries attempt to divide territory up, but that ultimately global collaboration should be strived for.

> **"We don't really need another area where countries are battling for, you know, Space and being the number one at something. So I think you just really need to push for the idea of an international collaboration rather than staking a claim around it."**
> Workshop1, Leicester

Participants in general felt that some form of commercial activity or private ownership in Space would be necessary to provide funds that would drive innovation.

Discovery of life presentation

Participants were very intrigued by this presentation and speculated about the possibility of life in space. They generally thought lifeforms must exist somewhere other than Earth but had significant doubts that we would ever discover it. Generally, participants seemed more accepting that we would discover bacterial or micro-organism forms of life, rather than intelligent beings. Participants often commented on the vastness of time as well as distance, noting that humans have not existed for long in comparison to the age of our planet, and other lifeforms in Space may be just as fleeting.

At the beginning of the fieldwork, participants were often excited or slightly scared about the prospect of discovering life, especially intelligent life, due to the unknown impacts and capabilities the lifeform might have. However, during the course of their discussions, these heightened feelings softened, as participants began to navigate what they thought was likely and became more familiar with the subject. Towards the end of the fieldwork, they were generally more concerned about the impact humans might have on the lifeform if we discover it, rather than the impact it might have on humans. Participants often made references to the devastation caused to uncontacted tribes, once western explorers transferred new illnesses to them, worrying that we might repeat such a mistake to vulnerable lifeforms in Space.

Participants began to contemplate how we should treat any life that is discovered, and differing opinions began to emerge, with some participants believing that we should respect any lifeforms found and leave them alone, whilst those that disagreed thought we should be considering if they could have any potential benefits for Earth.

> **"Why do we have the right to disrupt another planet's living life or anything, just for our own curiosity?"**
> Workshop 1, Wrexham

> **"I feel like it depends. It should depend on what they're made of. If they're made of something toxic to us, it wouldn't really make sense for us [to engage with it]. But then, if certain components that they're made of, they're beneficial, let's say for example…beneficial to make medicine."**
> Workshop 1, Leicester

Fact sheets

Participants read the fact sheets to themselves and raised questions and comments freely during the sessions. This allowed participant-led and unstructured discussion, highlighting which topics really stood out to them.

Generally, participants showed concern over the cost of the different types of Space activity and felt that they were too expensive to be paid for via public spending and taxpayer money. Some participants thought that, as we are at the very beginning of these developments, it will require a lot of time and money to make these realistic endeavours and suggested that this money should be reserved for issues facing the public sector and people struggling with the cost-of-living.

> **"If people who've got millions and billions and then people who are going to food banks, I'm like, 'Sorry, but I just feel like it's just such a waste of money'. There are people who can't afford their bills."**
> Workshop 1, Leicester.

Those that disagreed thought that the long-term benefits would be worth the costs, and that we would see a return on investment in the form of jobs, industry, and reducing climate change. However, some participants were concerned about the environmental damage of Space mining, and of transporting resources from Space to Earth and vice versa.

The information given to participants prompted some commonly asked questions across the four locations, such as:

- What is dark matter, and is it dangerous?
- Why is the International Space Station being decommissioned, and what will be done with it after?
- Will building on the Moon affect our tides? What impact could this have on Earth in general?
- How much private vs. government money is currently being invested in Space activity?

Underpinning perspectives

There were several contextual perspectives that shaped how participants viewed the future and future Space activity:

- **Pessimism about human nature** – participants seemed to feel that, as humans, we are intrinsically reckless, competitive, and individualistic. This was often discussed in relationship to the environmental damage that we have inflicted on Earth, and the historic and current legacies of colonialism. Some participants referred to the industrial revolution as an example of humans seeking rapid progress without the seeing the environmental damage that would be caused in the

long-term, especially where the impacts may disproportionately affect countries that were not as responsible for the damage.

- **Corruption** – there was widespread feeling across the workshops that governments and private companies are often corrupt and will act in the interest of personal, not societal benefit. For some participants, there was a feeling that scientists can also behave corruptly if incentivised or influenced by private companies or governments.

Both underlying perspectives affected discussions across all four locations and were often cited when participants discussed wanting cautious approaches to Space exploration, with clear and robust regulations to curb human or corporate greed.

There was also a strong desire for transparency and independent oversight when discussing the four key policy themes, which was often related to worries over misinformation or a lack of information altogether. Overall, there were general feelings of resignation about future human behaviour, and anxiety that we would repeat the mistakes we have made on Earth in space. There was a belief that we would take a colonial approach to claiming and controlling Space territories, or re-enact the environmental damage done to Earth to other planets.

Although participants placed strong emphasis on the need for global collaboration, there was a general agreement that conflict between countries in Space would inevitably happen, as it does on Earth. It should be noted that these perspectives and concerns are present in other studies, and are not exclusive to this project.

Location differences

There were some points of distinction in terms of participant knowledge between the four locations. These differences did not have significant consequences in terms of the conclusions that participants in different locations made about future Space activity, but they are helpful in illustrating how local references and knowledge were sometimes used to frame their discussions.

- **Wrexham** – Across both workshops, participants in Wrexham generally appeared to have more positive opinion on commercialism and private activity in Space in comparison to the other three locations. Some of the participants were also aware of Welsh Government proposals to expand and invest in Wales' Space activity.

- **Glasgow** – Out of all the locations, Glasgow participants generally had strong anti-colonialism views in comparison to the other locations and showed slightly more discomfort over repeating these behaviours in Space. Some participants were also aware of a launch station being built in Shetland and discussed how this would be a positive contribution to the local economy.

- **Leicester** – Generally participants in Leicester seemed to be slightly more informed about the UK's Space activity compared to other locations such as Glasgow. This may have been partly because their city has an active Space research centre and Space Park, where the Leicester workshops took place. Some participants searched online to find out how much the centre cost to build, and this was occasionally used as a reference point when discussing the potential costs of investing in Space development.

- **Cornwall** – Similar to Leicester, participants in Cornwall were aware of the Space activity in their local areas, and often made references to the Spaceport hub located there. This prompted

discussions about having local representatives for communicating recent and local Space activity. In relation to mining in Space, participants discussed Cornwall's local relationship to the industry, as lithium is mined in Cornwall, and the workshop venue was in a disused clay quarry.

Responses to Scenarios

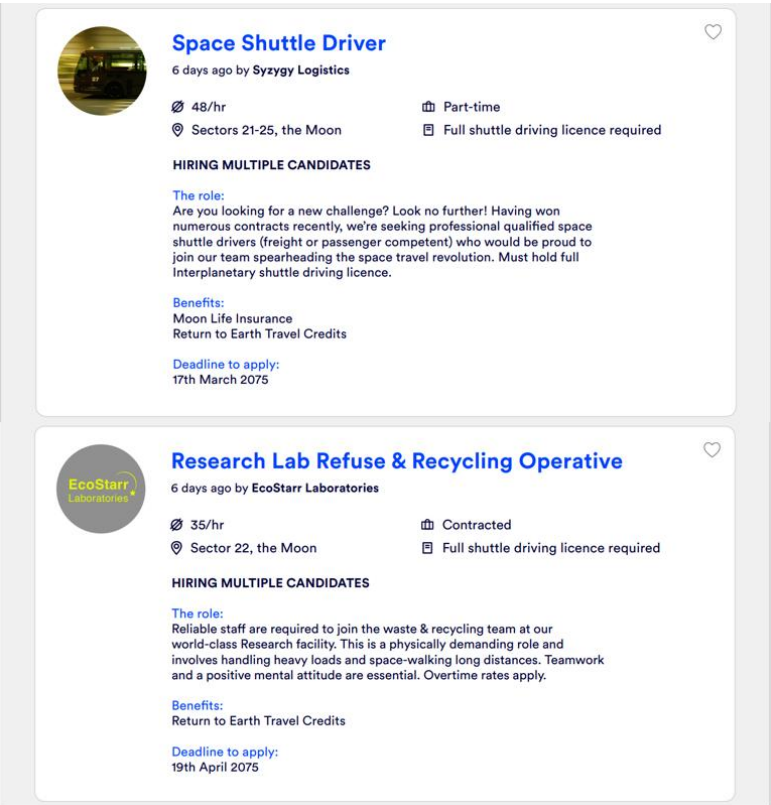
Scenario 1

This first scenario featured a Moon settlement where workers were allowed to move with their families, and as a result the Moon's surface has been developed, and waste has piled up into landfills. Countries who previously invested in Space activity have collaborated to form a government, however countries who were not initially involved in this collaboration are beginning to form alternative systems of government. Scientists have also presented evidence that suggests it is unlikely that there is other life in our solar system.

Props for this scenario were:

- ***Moon Job Board:** A job listing website which participants could scroll through on a tablet, advertising a range of roles on the Moon.*
- ***Newspaper headline**: An A-board showing a newspaper headline reading "Scientists Claim We Are Alone: A green light for new industries?"*

Figure 3: Extract from the 'Moon Job Board' prop (full image in appendix 4.2.)



There were mixed views towards this scenario. Some participants found the ideas presented, particularly of the Moon settlement, very futuristic, whilst others were disappointed that we had not developed further by this point. Across the locations, participants were particularly struck by the prop newspaper headline that no other life exists in our solar system. Participants were also curious about the prospect that we could be working in Space in the future and the impacts this could have, specifically about worker's rights in space. The jobs listed on the Moon job board prompted participants to consider how people's freedoms and quality of life may be impacted if they are employed in Space rather than on Earth.

"If you're the only GP there [on the Moon settlement], they're not going to let you go [home], are they? You'd have to wait for your replacement 5 days later. Then you can go."
Workshop 1, Cornwall

Scenario 2

In this scenario there has been some global collaboration on space-based energy production, and significant developments are imminent. However, outside of this, countries are operating in a competitive way, and are laying claim to land masses in Space in order to discover resources first. This conflict has led to a decision to divide the land on Mars and the Moon by all Earth countries, but there is a debate about how this should be allocated. During this global debate, a spacecraft has received sequential radio signals from a nearby solar system, suggesting signs of intelligent life.

Props for this scenario were:

- ***Mars globes:** Two cardboard polyhedric 'globes' of Mars presented two ways of dividing territory between Earth nations: either equally or divided by country land mass. They also indicated areas of scientific value.*

Figure 4: Extract from the 'Globes' prop (appendix 5.2.)

Participants generally felt quite negative about this scenario, specifically due to the lack of global collaboration and focused the discussion on the division of territory, and the possible conflicts this could cause. The globe props were particularly helpful in aiding this conversation, as they allowed to compare between two different approaches to dividing territory in space.

> **"That [globe], you get something comparable to your Earth size, does that mean that if there's a problem, for example, India accidentally stumbles upon something really toxic, is it their problem? Do they have to clean it up? Whereas if there was a more equitable approach, could that mean we all own an equal proportion…so we're all going to clear it up, or fix it together?"**
> Workshop 2, Leicester

Scenario 3

In the third scenario, Space has become dominated by private countries, and governments are unable to regain control. Space tourism is a big business, however there are reports of poor working conditions in Space resorts. Microbial life has been discovered which may be able to make medicine, and private organisations are planning to harvest these organisms to begin trials. There is also concern that specimens may be brought back to Earth and not properly contained.

Props for this scenario were:

- ***Tourism leaflet:** A tourism brochure advertising luxury cruises to Mars.*

- ***'Nebucillin' trial drug:*** *Medication boxes for a trial drug containing a microbe discovered on Europa.*

- ***Confiscated box seized at customs:*** *A metal box containing a mystery item that has been seized at Earth customs. Forms attached to the box indicate it is suspected of having false declarations about its contents.*

Figure 5: The 'Nebucillin' trial drug, and confiscated box props

Participants generally felt disappointed about this scenario due to the loss of control to private organisations. However, those that disagreed felt that it was more positive than scenario two, as there was some form of collaboration between governments. They also felt that the solutions to Scenario 3 were more straightforward than in Scenario 2, with a need for improved regulation and control over private organisations rather than complex geopolitical issues.

> **"We are, at least, knowing who our enemy is [in Scenario 3]…It's the commercial world, yes."**
> Workshop 2, Wrexham

There was a general agreement that this scenario seemed quite realistic given the current dominance of private companies in space. The tourism leaflet aided this conversation, as some participants thought that Space tourism exists currently as a leisure activity for the ultra-rich. Participants also focused on the risks of bringing materials from Space to Earth, and the "Earth Customs and Border Agency" label on the confiscated box prop helped participants express what types of regulation they wanted to see in place for regulation. The Nebucillin trial drug prop generated a conversation around whether using space-based resources would just allow us to ignore the issues we have created on Earth, rather than solving them. It also promoted discussion about how the extraction of resources in Space (even when the resources were living beings) felt far more justified when there were direct benefits to the health of humankind.

> **"My worry with this is that if this does what it says on the tin and it treats drug-resistant stuff…that's something we've created, that's a problem that we've made. And so now we're going elsewhere to find a solution, and at some point we're going to have to go elsewhere to find a solution to that, and it just becomes a self-fulfilling prophecy."**
> Workshop 2, Cornwall

Scenario four:

In scenario four, climate change has led to strong collaboration on Earth, which led to governments working together on beneficial and safe Space exploration. With Space industries tightly regulated by governments, advanced space-based technology has been developed that is helping combat climate change on Earth, and some countries have set up recycling plants and nuclear waste storage on the Moon. Scientists have discovered a multicellular form of life similar to algae, but are unsure how intelligent it may be.

Props for this scenario were:

- ***Article about endangered Space algae:*** *An online article from a fictional charity 'Friends of the Solar System', which is raising awareness of the need to protect the new lifeform discovered on Enceladus, by introducing a new emoji representing it.*
- ***'Have your Say' Space solar power leaflet:*** *A leaflet inviting local residents to a community consultation to discuss plans for a new space solar power capture and conversion plant in the area.*

Figure 6: Extract from the 'Have your Say' leaflet prop (full image in appendix 7.3.)

Across all locations, participants were optimistic about this scenario, and generally spoke about how this was the most positive out of all the scenarios discussed. This was mainly because it was less dominated by private companies and had more of a focus on addressing environmental issues.

Participants found the comments section on the algae emoji article particularly engaging, and this aided a conversation on how any algae or similar forms that are discovered may later develop into intelligent life. The 'Have Your Say' leaflet also helped participants visualise how space-based energy sources could be implemented on Earth.

> **"I like the point on that unlike other green sources of energy like wind farms or solar panels this solar-based power supply wouldn't be dependent on weather conditions or Earth-based conflicts or disasters. So, it just seems quite a safe option."**
> Workshop 2, Wrexham (Referring to Scenario 4 prop 'Energy leaflet')

Forming principles

Principles were formed throughout the fieldwork process. In all discussions, moderators reflected participants own thoughts back to them when they raised any values, concerns, or hopes for future Space activity, probing further to see what boundaries or principles participants would like to see.

At the end of Workshop 2, a set of draft principles were presented to participants, based on Workshop 1 discussions across all four locations. The aim of this final principles session was to refine or ratify the emergent principles and to add any that were felt to be missing.

Participants largely felt that the draft principles reflected the values and regulations they had discussed throughout the workshops. There were some participants who disagreed with certain principles, and some wished to add new principles that had not been thought of yet, however most of the changes were to add nuance or specificity to the already existing principles. All of these responses and participants suggestions are discussed more in depth in the principles chapter of this report.

General participant engagement

Regardless of prior knowledge or interest, all participants showed enthusiasm for the topic. In between workshops, we had very little participant drop out (full attendance figures can be found in appendix 1.2), and found that those who attended both stayed engaged throughout the two sessions. There was a spectrum of feelings about our future Space activity, some participants found it exciting, others were more cautious and found it unnerving, whilst some displayed a mixture of both. Whichever stance participants took, they all considered the matters discussed across the two days to be of great importance.

Across the locations, all participants actively contributed to group discussions. Throughout the sessions, we were pleased to see that participants who were initially less confident eased into the conversations and contributed more to the discussions. Moving participants to different discussion groups for each workshop was beneficial to the dialogue, as it reset group dynamics and participants were then able to engage with a variety of perspectives and attitudes.

Governance

Chapter summary

- Participants thought effective global collaboration will be vital to avoid conflict and widespread damage in Space, but worried it may not be achievable.
- The International Space Station is a beacon of hope that global collaboration is possible, if led by scientists.
  - Scientific collaboration is seen as a possible pathway to global trust and political collaboration.
- There was strong support for an international Space governance body.
  - This should be globally inclusive so all countries have a say in significant decisions.
  - There were mixed views on whether all countries should have an equal say, or if some countries should have more authority than others.
- There must be efforts to begin collaboration now, so that we are prepared ahead of significant advances in Space activity.
- Division and ownership of territories in Space was seen as an inevitable source of conflict.
  - One view was that human ownership of territories in Space is always unacceptable, as it is not ours to claim.
  - Another view is that ownership is key to incentivising innovation, and that agreeing boundaries in advance will help to avoid conflict.
- Participants suggested a licensing model as an alternative to ownership of territories.
  - This would enable access for research or industry, without fully giving over control.
  - This would provide a way to protect areas for conservation or research.
  - This would be a mechanism to share benefits form Space industry with humanity as a whole, or with environmental causes.
  - Most importantly, this would be a way to enforce Space laws, as licenses can be rescinded.

This theme covered how human activity in Space should be governed, as well as how territory in Space should be divided and owned, if at all.

This topic was initially introduced in Workshop 1, with a short presentation (see appendix 2.2). Each of the Scenarios included a section on governance, named ‘division and power’.

The key sub-themes of this topic included:

- Global collaboration and conflict
- Balance of power between countries, between private and public sector, and between scientists and politicians
- Setting rules and laws for Space

- Managing territories in Space (ownership, prioritisation of use)

Participants thought effective global collaboration will be vital to avoid conflict and widespread damage in Space, but worried it may not be achievable.

Throughout discussions participants consistently reiterated how important effective global collaboration is for the future in Space. Without this, participants felt progress in Space would be uncontrolled, with each country acting on separate and contradictory plans, which would lead to conflict, and make sustainable and responsible use of Space far less likely.

Successful collaboration was considered as having agreed rules and boundaries, a system for debating and agreeing these collaboratively, and commitment from all countries to abide by them.

Participants felt that any collaborative system is only meaningful and effective if all countries who are active in Space are committed to it. If a singular country decides to operate outside of this collaborative system, they could cause harm or cross boundaries that most of humanity disagree with, without many options to prevent them. Essentially, any rules we set are only as effective as the number of countries who agree to them.

For this reason, participants thought it is important for efforts to be made to encourage all countries to join global collaboration, which may mean compromises are needed. For example, they felt that the UK may have ideal principles for how humans act in Space, but some of these principles may be at odds with the priorities of other countries, creating a barrier for collaboration, and therefore undermining collaboration entirely.

> **“That's quite a scary thought…some countries could just decide to do it on their own anyway and they're almost lawless.”**
> Workshop 1, Leicester

> **"If one country wanted to mine, and everyone else says 'We don’t want to do that we are focusing on the solar power', if that’s the only way to get them involved, then do we compromise?"**
> Workshop 1, Wrexham

Participants thought that the UK could also contribute to achieving global collaboration by demonstrating good-faith between countries in the early stages of global Space collaboration, to support poorer countries in their progress and in turn building trust and alliances. This may be in the form of sharing data and knowledge openly and transparently or leading the way in global space-skills development through our world-leading universities. Some participants also thought that the UK should be willing to financially contribute more than it receives from global collaboration, particularly where we can support developing nations in their own Space advancements. Participants referred to this as being ‘net-givers’ rather than ‘net-takers’.

If there is an initial boost to partnerships and collaboration, with plans for how benefits can be achieved and shared together, participants suggested that this would provide incentive for other countries to join the collaboration.

> **“I think the more people that are in the group, the more people want to join the group. They realise they're going to be on the outside and they want to be on the inside, a bit like the UN.”**
> Workshop 2, Cornwall

The International Space Station is a beacon of hope that global collaboration is possible, if led by scientists.

Participants often referred to the International Space Station (The ISS) as a sign that collaboration is possible, even when there are tensions or conflicts on Earth between collaborating countries. Aside from the ISS, participants reference Antarctica and deep-sea treaties as an example of scientific efforts from different countries working alongside each other successfully.

> **"Well, here we've got Antarctic where there are science bases there that everyone accesses. It could be the same, even though it's not in your territory you have [access]"**
> Workshop 2, Leicester

Some participants felt that scientific collaboration is easier to achieve than political collaboration, but that this could lead to effective partnerships between countries.

> **"There's a lot of international collaboration between scientists, but then the power structure in certain countries in influencing who their scientists are allowed to collaborate with. And it's how do you get that correct balance between politics and science?"**
> Workshop 1, Wrexham

Participants explained that scientists from different countries working together are likely to be focused on the shared goal of research and knowledge, and may benefit from different perspectives and skill sets together. Some believed that international collaboration between scientists could, over time, build trust between the countries that they are from.

> **"When scientists collaborate it's more about the research and the outcome rather than the money and the funding. So scientists, I believe, tend to be going towards the same goal from different angles…A variety of scientists from different countries will be able to get you so much further than just countries individually."**
> Workshop 2, Cornwall

There was strong support for an international Space governance authority.

When discussing what the model for global collaboration and governance could look like, participants frequently referred to a 'UN-like' organisation. Some suggested it should be the UN itself, arguing that the while the UN can be bureaucratic and slow, it is the most established existing system for global collaboration, and therefore the best system to pursue collaboration in Space.

It is worth noting here that participants were not generally familiar with existing UN organisations such as the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS) or the United Nations Office for Outer Space Affairs (UN OOSA). Some of the participants' suggestions discussed in this report are in line with the role that these organisations hold already, while others outline expectations and hopes that organisations like this play a bigger role in governance, land and resource allocation, and global decision making.

Some participants suggested that the UK work through the UN to initiate global collaboration on space, championing the importance of working together early to get ahead of future dilemmas and conflicts.

Other participants suggested a new organisation working adjacent to the UN, which would solely be focused on Space governance, rather than Earth governance. Some groups created names for this organisation to aid their discussion, such as the 'International Space Council', the 'UN Science Agency', 'OfSpace' in reference to Ofgem, and SUN which stands for 'Space UN'.

Whether it is the UN itself, or an adjacent organisation, participants stressed the importance of the governing body being globally inclusive, with all countries able to have a say in significant Space decisions.

> **“I would want there to be some kind of collaboration, possibly under the UN, that says, 'This is the organisation which governs these issues,' and almost takes it out of the hands of governments who can only operate on, at most, a 4- or 5-year cycle. We have trouble enough planning for new nuclear power, or any infrastructure project because our [national] political cycles are so short.”**
> Workshop 1, Glasgow

There were different views on how equal each country’s voice should be on major decisions. Many felt that all countries should have equal say, and that there should be a democratic process to ensure fairness and a global majority agreement. Participants who felt this way argued that this is the only way that all of humanity can benefit from Space exploration, rather than only the wealthiest or most advanced countries.

> **“Poorer countries in the world that don't have a Space programme and don't have a capacity to have a Space programme [may be left out]. And if we're saying that Space belongs to everybody then it should be the richer nations combining together to do these projects for the benefit of everybody on Earth, not just their own country.”**
> Workshop 1, Leicester

However, there were also participants who felt that countries who have invested a lot in Space, or who are more active in Space, should have a bigger say than countries who are less active in Space. These participants argued that countries who lead the way have more at stake in decisions, and have earned the right to lead decision making due to their investment in human progress.

> **"Maybe basing it on possibly a percentage of what countries put into it...If you want to monetise it, what percentage you put of your GDP into Space companies, then that's the percentage you get to help you. "**
> Workshop 1, Cornwall

Participants who wanted equal say for all countries felt strongly that we should avoid a colonialist approach to Space, and that poorer countries and countries slower to become active in Space must have equal say from the beginning to ensure a fair and collaborative approach for the long term. They also felt that this was needed to create principles and rules that work for everyone, rather than just for the countries who get there first and set rules that favour themselves.

> **"But then it's just colonialism but in space…We, as rich western countries, have imposed our governance and everybody that follows shall go along with us."**
> Workshop 1, Leicester

Aside from the balance of power between countries, participants wanted balance between scientific and political leadership in the governing body. Some felt strongly that international Space governance should be led by scientists, who they thought would prioritise sound science, rather than political motivations or bureaucracy. Participants acknowledged that it may be unrealistic to completely remove politics from any system of governance, but they wanted to see some independence from national government politics.

> **"I think it'll have its own set of politics, as any industry will do but I think keeping it out of, like, parliament as we know it would be better because it's going to be set up in a slightly different way. It's not going to be the guys [sic]at the top deciding what questions are going to be asked. It's going to be the collective common people via, hopefully, an independent way of communicating directly with our scientific head of board person who represents our country."**
> Workshop 2, Wrexham

Aside from politicians and scientists, participants suggested that the governing body should include ethics and human rights specialists, to ensure that these aspects are always considered in decisions, rather than an afterthought. They also felt that it was important to have diversity represented within the governing body.

Participants suggested that anyone serving on the Space governing body should have fixed terms and have some way of being accountable to the public.

According to participants, this global governing body would be responsible for:

- Debating and agreeing international Space laws
- Permitting or denying activities in Space
- Monitoring activities in Space for compliance and sustainability, as well as safety
- Managing territories and licensing (see section below on proposed licensing scheme)
- Enforcement of laws and punitive powers.

The body must have methods of enforcement available to it, or it will be meaningless. Participants spoke about Space police, trade sanctions on Earth, fines, and retracting licenses. They were clear that consequences for breaking Space laws or causing environmental damage must be severe enough to be genuinely prohibitive, rather than an acceptable cost of business to actors who are making high profits via Space activity.

There must be efforts to begin collaboration now, so that we are prepared ahead of significant advances in Space activity.

Participants were worried that rules and major decisions may be left to the last minute, or only after problems have occurred. They did not want governance decisions to be made in a reactive way and were keen to see proactive organisation between countries to get ahead of Space development.

They felt that the groundwork to establish trust and allyship between nations should begin straight away as this will be a slow process to achieve the foundations for effective international collaboration.

Participants noted that private activity in Space is already rising, and they were nervous about the lack of rules in place. For this reason, many said that Scenario 3 seemed quite realistic, as they could imagine governments responding too slowly, giving private actors a head start to establish their operations in Space without appropriate restrictions or accountability.

> **"[Scenario 3] showed the need for early collaboration between countries before it gets out of hand with the commercial organisations. There's no point trying to change things once it's completely out of control. It needs to be thought about now really."**
> Workshop 2, Cornwall

Division and ownership of territories in Space was seen as an inevitable source of conflict.

In this section we refer to both countries and companies, as participants thought that ownership and territory management was relevant to both, especially given a shift from government Space activity to private Space activity.

Participants expected disagreement between countries and companies operating in Space no matter what approach is taken to manage this. A key point of discussion was whether it is even acceptable for humans to claim ownership of territories in Space.

There were several leading views that emerged:

- **Ownership models are unacceptable:** Participants who felt this way said that territories outside of Earth are not ours to claim and referred to a human 'arrogance' to assume we have a right to do so. They felt deeply uncomfortable with the idea of countries or companies owning areas of Space and argued that this would lead to conflict as different actors feel entitled to more than they have. They referenced historical and current wars on Earth to point out that dividing our planet into territories has not been a way to avoid conflicts.

  "We should be building bridges rather than walls…It feels like laying claim to area, territory, land, whatever it is, it's just building walls around it, and inviting conflict. Whereas we should be working on principles that allow us to collaborate much more freely with other countries"
  Workshop 2, Glasgow

  Ownership models are positive and important to progress: Participants who felt this way argued that clear ownership is needed to drive progress, with owning a site of operation being a key incentive for private and government investment into Space research. Participants said that companies or countries wouldn't be willing to risk investment in exploration or resource extraction if there was a risk that their operational site could be removed from their control.

  "Money equals commercialisation, and commercialisation requires ownership…If that asteroid is worth a quadrillion dollars, well someone can make a business case…but by definition that requires ownership."
  Workshop 1, Wrexham

- **Ownership models are a necessary evil:** There were participants who sat in the middle, and felt that human ownership in Space is not right, but inevitable and therefore needs to be planned ahead to minimise conflict and seek fairness. They argued that it is human nature to claim territories and resources, and a Space land grab is already underway.

  Again, participants stressed the importance of preparing early in anticipation of major developments in Space activity, as once countries or companies have laid claim to a territory in space, it will be hard to dispute this if ownership had not been planned in advance. Getting ahead of ad-hoc territory claims, they argued, is the only way to ensure that ownership is fair for all countries, and to avoid a colonial approach that gives first-movers a huge advantage over poorer countries.

No matter the approach taken, participants wanted to see a way of protecting valuable sites such as areas of the Moon or Mars that are particularly suitable for scientific research. When looking at the Scenario 2 globes props, they noted that certain areas of territory may contain resources or conditions that are valuable, and these areas should not be solely owned by one country or company. This is

important not only to protect such sites, but to avoid an imbalance of power if access to such sites is not equal.

Some participants thought that ownership should be based on ability to make use of a territory, so that valuable resources and land are not wasted by being allocated to a country that does not have the means to resource or extract them. They thought that this may seem unfair to countries who are less advanced in space, but it would ensure the biggest benefits for humanity as a whole.

Participants suggested a licensing model as an alternative to ownership of territories.

Across all workshop locations participants suggested a licensing model as an alternative to division and ownership of territories in Space. This was not something presented in the scenarios, rather an idea that participants suggested themselves. While not all agreed, it was a leading popular solution amongst participants.

Participants thought that the licensing system would be managed by a international Space governance body (possibly as part of the UN) described earlier in this chapter. They suggested that the governing body would grant licenses to countries or companies to use territories in Space for specified periods of time, and under specific conditions. This would be in place of any permanent ownership of territories.

> **“If you had to divide it up, I'd want it more like a lease basis. Then it's yours to use, but you don't own it. So, whatever this governing body looks like, the UN equivalent or whatever, they would grant you the right to use it.”**
> Workshop 2, Leicester

The key benefits of a licensing model that participants articulated were:

- **Enabling progress without giving up control:** A licensing model would create a way to permit industries that may be beneficial to humanity, without handing over full control to the companies or countries involved. Enabling activity in Space without ownership could also avoid a land grab, reducing the incentive to claim territories even if it causes conflict on Earth.

- **Ability to protect certain areas:** No licenses would be granted for areas in Space that have special scientific value or may contain life. If a license is granted for activity in an area that later turns out to have more significance than initially thought, the license conditions would allow for the governing body to cancel the license, ending operations there.

- **Mechanism to share benefits:** While participants did think that private companies who invest in Space industries should benefit from the outcomes, they wanted to ensure that they are not the only beneficiaries. A licensing system could include conditions that ensure a proportion of the benefits have a positive impact on humanity as a whole, or on environmental causes on Earth or in Space. This is especially the case if public money was used to support the launch of such industry.

> **“These exterior bodies should be managed under some form of international control, possibly with licensing to extraction industries …It was government money that got them there, therefore the government recoups its money through licensing …[similar to] the deep water treaties, and the Antarctic Treaty, those sorts of collaborative things, where big organisations do the groundwork, but then it's licensed, and the benefits are distributed more widely.**
> Workshop 2, Glasgow

- **A method for regulation and enforcement of Space laws:** There would be strict conditions for licenses to make sure that safety, sustainability and fairness are prioritised. Licensee activity would be monitored, and if operations are not compliant, the companies or countries responsible would be at risk of losing their license. Participants felt that this would be the most effective way to ensure rules are adhered to, as they thought that fines could be seen as an acceptable cost of business when profits are high.

"If the companies are potentially damaging the planet, then they should have some way of being able to shut it down."
Workshop 2, Cornwall

Industry in Space

Chapter summary

- Across all potential Space industries, participants were sceptical about the cost barriers to progress.
- Participants often considered long-term solutions (such as Space-based solar power) to be more justifiable than 'temporary' ones (such as mining finite resources in Space).
- Space workers' rights are important to participants, especially considering the isolation from Earth.
  - Mental and physical health are seen to be bigger issues in Space than on Earth
  - Concerns about unequal health and safety or quality of life between job types
- Private activity in Space is seen as necessary to provide the innovation and investment needed to achieve progress and see benefits from Space exploration.
- Governance is needed to maintain control over private industry, and to prioritise human and environmental benefit over profit.
  - The licensing model suggested by participants was seen as key to effective industry regulation.
- The idea of global reparations was popular across participants to protect vulnerable Earth communities if major industries move to Space.

Participants learned about potential future Space industries through the fact sheets, scenarios, a presentation and through conversations with the specialists who attended the workshops.

The potential future Space industries discussed included: mining of planets or asteroids, space-based solar power, Space tourism, microgravity research and manufacturing. Participants discussed which future Space industries are justifiable, and how industry should be managed.

Across all potential Space industries, participants were sceptical about the cost barriers to progress.

Participants recognised that costs to launch Space activity are currently very high, which may prevent industries forming. Participants felt that due to the high costs and risks for Space industries, there would need to be clear justification for pursuing them, especially with public money.

Participants naturally compared different industries to each other, debating which were most worthy of investment. There were a wide range of often contradictory views on this, which we have included here.

Below are some responses to specific industries that were discussed frequently in groups:

Mining for resources in Space

- This was recognised to have potentially huge benefits, especially for green technology, which is currently reliant on minerals that are depleting or causing conflict on Earth. Some participants felt that as there is a tangible benefit to humanity and sustainably, mining is a better investment than searching for life, or Space tourism.

- However, there were participants who felt that mining finite resources in Space is just a temporary fix, as these resources will eventually run out and we will still be dependent on them. For some, a temporary fix is acceptable, as long as longer-term solutions are researched in the meantime.

- A big concern for mining in Space was environmental risk; mining was seen by many as inherently harmful to ecosystems and prone to pollution and accidents. Participants were particularly concerned about the unintended and unknown consequences of mining planets and other celestial bodies in terms of the potential to disrupt the position of planets in the solar system, by changing the shape of the Moon for example.

- While still seen as costly, participants felt that valuable resources would always mean that a sound business case can be made by private companies to justify the investment and risk.

- There was distrust in the organisations that might be involved in mining, especially if there are huge profits at stake. They felt that mining industries are prone to corruption, worker exploitation, and unequal distribution of benefits. Participants thought that mining companies or countries could accumulate power and money by controlling access to high-demand resources.

  "Space mining for me is a real concern I think…initially you can control it. But what happens when it becomes a much more prominent…[It] gives [corporations] access to colossal resources of very precious metals. I think it will artificially create wealth in places where it maybe shouldn't be, and it almost seems like a cheat to start getting resources from elsewhere."
  Workshop 1, Glasgow

Space-based Solar power

- Space-based solar power was seen as very promising to participants, who felt that long-term solutions were a more justifiable investment in Space. Participants were hopeful about a reliable renewable energy source, uninterrupted by weather conditions or Earth conflicts.

- The costs felt more of a barrier here, as the profit incentive for investment is less tangible than for mining. However, some participants felt that this cost would be justifiable in the long-term through environmental improvements and access to renewable energy.

Tourism

- Space tourism was seen to be for the ultra-wealthy only, as the costs would render it unaffordable for a typical person. However, participants were fairly ambivalent this exclusivity, considering it inevitable and familiar, not dissimilar to the existing luxury tourism on Earth that only serves the very wealthy.

- Space tourism was often described as 'harmless' and was only seen as an issue if it causes environmental damage, on Earth or to other celestial bodies. They felt that there would need to be regulations to ensure that tourism did not cause any harm.

- Due to the expected wealth of future Space tourists, participants saw an opportunity for a tourism tax. They felt that some profits should go back into projects for public-good or protecting environments in Space or on Earth.

> **"Some of the [tourism] profits should go to helping space… Protecting the Moon or Mars, like, research projects for the Moon and Mars."**
> Workshop 2, Cornwall

Space workers' rights are important to participants, especially considering the isolation from Earth.

When considering the types of industries in space, participants gave a lot of consideration to what it may be like for people to live and/or work in space. This was a particular focus in Scenario 1, and the 'Moon Job Board' prop stimulated a lot of discussion on the subject.

Participants were very clear that there needs to be high standards of care and safety for workers in space.

They perceived several ways in which working off-Earth could make workers vulnerable and in need of legal protection:

- **Naturally unhabitable environment:** Working in Space would mean a reliance on the employer to provide basic elements needed for survival, such as oxygen, water and protection from the vacuum and microgravity in space. This means that the availability and quality of safety equipment is vital to workers safety.

- **Isolation from Earth:** Workers in Space may not be able to easily report poor conditions to unions or officials outside of their company, as they would be able to Earth. They also may not be able to easily leave their working environment without the support of their employer. Participants thought this could enable exploitation of workers if there are not independent and easily accessible transport and communication systems available to Space workers.

- **Mental and physical health:** Due to the combination of the dangerous environment and isolation from Earth, participants thought that both mental and physical health issues may be likely for workers in space. They wanted to see proper provisions in place to care for those in Space if they face health issues. This meant healthcare facilities, free healthcare, and screening for mental and physical health issues before permitting individuals to work or live in Space and be available for people when they return to Earth.

Participants considered the range of job types and grades that there may be in Space, especially when interacting with the Scenario 1 prop, Moon Job Board. They wanted to see equal standards of health and safety for workers, even if they are in lower paid jobs. This was seen as especially important as workers would be reliant on equipment for survival.

> **"Not all the jobs are going to be [equal], some of them are going to be more menial, but it doesn't mean to say that my minimum quality of life should be any less."**
> Workshop 2, Cornwall

Participants felt that Space workers must have unions and access to representation, without any barriers to accessing this support. Some even suggested that this role should be based on the work site, to ensure it is accessible to all workers, regardless of communications or transport options.

Many felt that there must be an affordable and accessible way for workers in Space to get back to Earth within a reasonable time frame if they need to. This was in reference to the Scenario 1 Moon settlement, where they thought workers may be away from Earth long-term. They felt that people may need to leave if their mental or physical health is impacted by being in Space, or if they have a family emergency on

Earth. They suggested that workers should have the flexibility to return within a few weeks or months upon request.

Similarly, participants felt it was vital that workers in Space have access to reliable and affordable (possibly free) internet and communication links with Earth. They said that this was key to mitigating the mental health impacts of isolation from Earth.

Any settlement for workers in Space must also ensure that there are adequate leisure, entertainment, exercise, and comfort facilities, so that workers can have good quality non-working time. Access to nature was also seen as important given how bleak Space was assumed to be.

Finally, participants wanted to see some sort of minimum wage for work in Space. They were worried about vulnerable people being shipped to the Moon or other parts of Space and being exploited. They also felt that the pay for working in a risky environment, isolated from Earth should come with a higher minimum wage than on Earth. They recognised that minimum wages vary between nations on Earth (or don't exist at all in some places) but felt that it should be established early on in Space industry to ensure fairness between workers from different nations.

Governance is needed to maintain control over private industry, and to prioritise human and environmental benefit over profit.

Private activity in Space is seen as necessary to provide the innovation and investment needed to achieve progress and see benefits from Space exploration. Participants felt that Governments cannot (and possibly should not) commit large budgets to developing Space technologies and industries, especially as Earth issues such as poverty and climate change are so prevalent. Therefore, participants recognised an important role for private activity in Space, to fill the gap in investment left by state-funded Space research.

While participants recognised that private commercial activity is likely necessary to drive forward progress in Space, they felt that measures need to be in place to prevent these private actors from assuming total control over operations, infrastructure, and benefits. There was a widespread view that without boundaries and measures in place, Space industry leaders may be likely to prioritise profit over the wellbeing of humanity as a whole, and over sustainability in Space or on Earth.

> **"You basically get three billionaires that are leading the charge in terms of the commercialisation of Space …How do you govern against something so vast? …What is there going to be, like, a customs station in Space or whatever, to check what they're bringing back? How do you stop it and how do you stop the rich just getting richer?"**
> Workshop 1, Glasgow

While this was a commonly held view, the strength of feeling ranged quite a lot. There were many participants who saw the prioritisation of profit as an inevitability with commercial organisations, and potentially very dangerous for humanity. However, there were also some participants who didn't think that this would be inevitable, suggesting that there can be moral business leaders who seek human benefit alongside profits.

When discussing what kind of measures should be in place to reign in commercial activity, participants felt that the governing body should decide what activities are permitted and under what terms. They felt that there should always be a solid justification for why the activity should take place, with a defined purpose.

> **“The questions should always be asked, 'Should we be doing this?' Not, ‘Can we do it?’”**
> Workshop 1, Glasgow

Participants often said that any activity in Space should deliver some human or environmental benefit, even if the main objective is profit. They felt it was unacceptable to conduct activities in Space solely for commercial gain. However, this wasn’t unanimous, and other participants felt that solely commercial gain is fine, as long as it doesn’t cause harm in any way.

The idea of global reparations was popular across participants to protect vulnerable Earth communities if major industries move to Space.

Participants in some groups discussed the impact of moving significant industries to outer Space, and the impact this may have on communities of Earth who currently rely on them for employment, for example landfills, recycling, manufacturing or agriculture.

The concept of global reparations was mentioned in Scenario 4 and was met with general support from participants. Participants felt that any such reparations should be planned and agreed before the activity in question takes place, to ensure that the terms are acceptable to all involved. They wanted to see vulnerable communities protected from the impacts of major industry changes.

Participants suggested that reparation funds should be spent on re-training local workers for new careers, so there is a long-term solution to loss of jobs, rather than a cash pay-out which wouldn’t properly mitigate the impact on the community as a whole.

> **"So they're growing palm trees [in Space], so we're not deforesting areas which is bad for the environment…for that maybe small country it's a very huge source of income, maybe the only source of income. And now they don't have that. It would be morally right to give some kind of financial compensation for that. "**
> Workshop 2, Wrexham

Discovery of life

Chapter summary

- Participants predicted that there are most likely to be lifeforms in Space, however, they were uncertain if these would be discovered.
- Participants expected any life discovered in Space to be simple lifeforms rather than advanced, intelligent life.
- The discovery of new life would transform our core understanding of evolution, philosophy and the meaning of life, while also posing major questions to the fundamental beliefs which underpin religious groups.
- The discovery of life may present the opportunity for learning and improving the sustainability, and long-term survival of humanity.
  - Through studying lifeform itself, its environment, and how it survived or become extinct.
- Despite this optimism around benefits, participants felt there would be significant risks and fear raised by the discovery of life in Space.
- Any intervention with a lifeform in Space must be clearly justified, and only after careful observational study.
- Participants emphasised the need for us to protect our own and other ecosystems upon the discovery of life.
- There were calls for a global collaborative approach towards agreeing on how to respond to a discovery of life.
  - Participants wanted this to be done soon, so we are prepared to make quick decisions responsibly in the event of a discovery.
- Global trust, collaboration and communication is key to managing a discovery of life responsibly.

This chapter explores participants' initial thoughts and predictions towards the discovery of new life. It then discusses their views towards the implications of any evidence for new life, particularly covering their perceptions of what such a discovery could pose to humanity and other lifeforms. Finally, an overview is provided of the public's recommendations for the rules and regulations around the discovery of life.

During Workshop 1, before participants were introduced to discovery of life via a presentation, they were asked to stand in line with one end of the line representing the position of being 'very excited' about the discovery of life, and the other end being 'not at all excited' about the discovery of life.

In all four locations participants spread out along this virtual line, with the biggest clusters in the middle and at each end. When asked why they were stood in the middle, participants' responses suggested that they were either ambivalent or had other things in their lives that were more significant than the idea of finding life.

Those who stood at the end of the line to suggest that they were 'very excited' spoke of how amazing and life changing discovering life in Space would be, and how it would really change everything. While

those at the opposite end of the line (i.e. 'not at all excited) reported that the idea of finding life was concerning or scary or that they thought it was very unlikely that this would ever happen.

Participants predicted that there are most likely to be lifeforms in Space, however, they were uncertain if these would be discovered.

From the workshops discussions there was a sense that it was inevitable that other life exists when taking into account the vast number of other planets and solar systems which are yet to be explored. Participants described it as a matter of probability, and felt it is extremely unlikely that Earth is the only planet to contain life in the universe. However, it was more believable that there may be no other lifeforms in our own solar system, as there are limited hospitable celestial bodies to host life.

> **“It's a matter of probability for me. I'm pretty confident that (other life) exists.”**
> Workshop 1, Glasgow

However, many participants felt that humans are unlikely to discover intelligent life in Space. Additionally, they assumed the discovery of intelligent life to be more likely in other solar systems. They spoke of long distances in Space and time as a barrier to discovering life, citing that any lifeforms would need to exist at the same time as us for an encounter to be possible. Given that humanity has only been on Earth for a fraction of the planet’s existence, this small window of existence seemed unlikely to coincide with life on another planet.

Participants expected any life discovered in Space to be simple lifeforms rather than advanced intelligent life. While there was a broad consensus that other life exists, the public offered a range of suggestions over what such lifeforms would be. They were less inclined to believe that lifeforms would be at the same level of evolution or more advanced than humanity. Instead, participants often suggested that any life found in Space would tend to be less advanced, less intelligent than humanity. In turn, participants initially felt that microbial lifeforms such as bacteria were most likely to exist in Space.

> **“If I imagine you discovering life, I think it's going to be a microscopic cell or something that's had some chemical reaction, I don't think it's going to be little green men.”**
> Workshop 1, Cornwall

Plants, insects, gases and single-cell organisms were also put forward as types of lifeforms that might exist in Space.

> **“How many galaxies are there and in all of those galaxies there has to be one planet to have something similar to a caterpillar."**
> Workshop 1, Wrexham

Participants expressed sadness and disappointment at the possibility of not finding life when presented with the newspaper headline prop in Scenario 1. Participants told us that the prospect of no other life in our solar system made them feel lonely and prompted a sense of fear that humanity were isolated in their existence. Some also felt that if this was discovered to be the case, the time and resources dedicated to the discovery of life over the years may have been wasted. There were participants who disagreed with this, and thought that searching for life would have benefits even if no life is discovered, such as discovering resources or technological developments, and achieving a better understanding of the universe.

> **“As technology advances, you'd go out further and further, wouldn't you? And you start looking at what else is out there. And it's not always necessarily about life on other planets…it could be materials or anything, you just want to know what's around.”**
> Workshop 1, Leicester

The discovery of new life would transform our core understanding of evolution, philosophy and the meaning of life, while also posing major questions to the fundamental beliefs which underpin religious groups.

The prospective discovery of life in Space was portrayed to pose major ramifications which would challenge and transform humanity’s core understanding of philosophy and the meaning of life. For instance, participants felt that proof of life in Space would prompt society to question existing assumptions over the beginnings and the meaning of ‘life’ and of humanities role in the universe.

Such discovery was also viewed to have big implications for different religious groups given that it could challenge their existing beliefs about the creation of life. Participants thought that some religious groups may adapt and transform their core beliefs accordingly. However, there was also a view that such a discovery could risk conflict if other religious groups refuse to acknowledge the discovery of life.

The conflict in Scenario 2 prompted discussion around the possible risk that news coverage around the discovery of lifeforms could result in disputes among countries driven by fear, disagreement over the appropriate response, and given that many new questions around philosophy, evolution and life would be raised.

> **"I just think there's so many other questions it then leads to which I think will break down some societies."**
> Workshop 2, Glasgow

The discovery of life may present the opportunity for learning and improving humanities sustainability, and long-term survival.

Evidence that there once was a lifeform (such as fossils) may teach us how a lifeform died out, and how to protect ourselves form a similar fate.

> **"It's worth looking for it to potentially see if there ever was life, or if there still is life, how are they sustainable or what killed them off, and what might kill us off"**
> Workshop 1, Wrexham

Learning that life can be supported on another planet may provide opportunities for humanity to survive elsewhere, if needed.

While discussing the receipt of radio signals from other lifeforms in Scenario 2, participants expressed excitement as they were curious over the intentions of the sender of the signal and were happy to know that other life exists. A discovery of, or contact from, an advanced lifeform may expose us to new technologies, or demonstrate ways of existing sustainably.

Microbial life may have practical uses on Earth, particularly in medicine. With regard to the Nebucillin trial drug in Scenario 3, participants were partly enthusiastic that the discovery of microbial life posed an opportunity for the trialling of drugs that posed health benefits (i.e., curing cancer or Alzheimer’s). When discussing the discovery of multicellular life in Scenario 4, participants also expressed a degree of cautious optimism towards the prospect of the multicellular life evolving.

> **“(It) could be a cure for Alzheimer's. You don't know. We need to do these kinds of tests.”**
> Workshop 2, Leicester

Despite this optimism around benefits, participants felt there would be significant risks and fear raised by the discovery of life in Space.

One fear was that physical contact with new life posed the threat of transferring new illnesses and diseases to humans, particularly with the recent effects of the COVID-19 pandemic in mind.

While discovery of advanced intelligent life felt very unlikely, participants did have concerns that more intelligent forms of life could pose to humanity if they lay claim to humanity’s resources, or see humanity as a threat due to our environmental damage and expansion into Space.

> **“I thought we were just going to present ourselves to any new lifeforms just showing our bad human nature and just presenting like a virus that is just going to spread.”**
> Workshop 2, Cornwall

Participants also raised concerns over the tendency for humans to react aggressively to anything that we do not understand, including other lifeforms, treating them as a threat and potentially looking to exploit them. They thought this response would be particularly fuelled by the media’s long-standing depiction of aliens as being violent beings.

References were also made to humanity’s colonial past and what this may indicate for how we would treat lifeforms in Space and their habitats.

> **"We've become this kind of colonial-, making all the same mistakes, treating everything as carte blanche, like settlers going to America. Like, 'We've discovered a whole new land' and the people who live there are like, 'Um excuse you?'**
> Workshop 2, Glasgow

Any intervention with a lifeform in Space must be clearly justified, and only after careful observational study.

Participants deliberated on the extent to which we should intervene with a lifeform in Space upon its discovery. On one hand, there were arguments that new life should remain completely untouched and instead be observed. This stance was rooted in concerns that any physical interaction could result in the transference of disease, damage to ecosystems, or disruption to the lifeform’s evolutionary path.

> **"It's evolution, isn't it? Everything came from something. We interfere at an early stage, what's the knock-on effect over millions of years? At some point you might be hampering what it could [become]."**
> Workshop 2, Wrexham

There were also instances when participants reversed the hypothetical situation to ask how we would feel if aliens extracted humans for their own benefit or research, arguing that we should not intervene in any way upon discovering new life.

> **“The whole alien abduction thing, it's sort of similar, isn't it, in terms of what people theorise has happened of people being abducted and tested and probed. It's a similar thing to what you're saying about bacteria.”**
> Workshop 1, Leicester

On the other hand, other participants felt that intervention could be justifiable depending on whether a lifeform posed significant benefits to humanity. For example, the discovery of microbial life such as in

Scenario 3 was associated with presenting potential lifesaving medication, thereby providing justification for scientists to trial the Nebucillin drug.

However, participants called for any interventions to be undertaken with caution and pose minimal risk of damage to the new life discovered. They also stressed that any new life ought to be subject to an observational stage and potential quarantine to mitigate the risk of transferring disease. They also felt that any human use of a lifeform should involve cultivating it separately from its ecosystem, rather than endlessly harvesting more, to avoid depleting the source.

> **"I think it's important to research into these things, but personally I would say let's try to be as less invasive as possible. I just wouldn't want to disrupt it and cause any negative changes."**
> Workshop 2, Wrexham

There was some discussion about whether the protocol for responding to a discovery of life should vary depending on the type of life discovered. For example, participants felt that discovering a bacteria would be very different from discovering an intelligent lifeform, and therefore different boundaries and justifications would be needed for intervention. If a lifeform might be able to think and feel, then there would be more ethical considerations to consider in how we treat it. If they are intelligent enough to be a threat then communication would be key.

> **"I think it depends what kind of form of life you're talking about as well. If it's, like, plant life or heart-beating life…I think it has a big difference in moral implications of responsibility I guess, and other things. I think we all have different attitudes of the category of life [that] counts as life."**
> Workshop1 , Wrexham

However other participants challenged this, pointing out that we might not be able to categorise a newly discovered lifeform by our current understanding of biology and intelligence. They argued that we may discover a type of life that doesn't fit within the categories we have on earth, or we may not be able to tell if a being is intelligent if it does not reflect the type of intelligence we have seen before.

Scenarios 3 and 4 raised discussion around concerns over private companies or the government conducting research or trials on new life (i.e., the Nebucillin trial drug, and the Algae). These concerns stemmed from a general distrust in private companies which were perceived to be driven by profit. In turn, participants felt that independent scientific bodies ought to be responsible for the trialling and regulation of lifeforms from space given that they would not have a conflict of interest.

Participants emphasised the need for us to protect our own and other ecosystems upon the discovery of life.

There was a concern that an ecosystem or lifeform in Space would be so unknown to us, that we would not be able to predict the impact we could have on it, or how we could inadvertently impact Earth's ecosystem.

They discussed the obligations for humans to protect environments in Space, as well as being obligated to protect any life discovered within its natural environment. Some participants felt that if any new life is discovered it would become part of our shared ecosystem, hence placing emphasis on the need to avoid the contamination of ecosystems. Participants felt that removing a new lifeform from its initial location posed a risk to its environment, as well as our own.

Participants supported global regulations meaning that nations would be held legally accountable for any damaged habitats in Space (i.e., leaving toxic waste and debris) upon discovering new life.

There were calls for a global collaborative approach towards agreeing on how to respond to a discovery of life.

Participants suggested that the International Space governance body must agree on the course of action following the discovery of life.

While it was also recognised that it could be impossible to reach complete global agreement on what to do with new life, participants felt that there ought to be a majority agreement from nations in order to promote transparency.

> **"If any life is found, there should be global collaboration and majority agreement about what action to take, if any."**
> Workshop 2, Cornwall

In order for this collaboration and decision making to be efficient, participants stressed that we must make international efforts to be prepared. They suggested that each country should share their views on how humanity should respond to a discovery of different types of life, and seek as much consensus as possible. While these would be hypothetical stances, if there was a discovery it would be much quicker to achieve majority agreement if the fundamental principles have already been debated, rather than starting from scratch.

> **"There's no point in it happens and then going, 'Right, what do we do now?' They've obviously got a lot of time to think about, 'What are we going to do IF it happens? "**
> Workshop 1, Cornwall

Participants also called for collaboration across all countries to police any crime committed that harmed a lifeform or ecosystem in Space.

Global trust, collaboration and communication is key to managing a discovery of life responsibly.

Participant felt that a discovery of life by one country could lead to disagreement and distrust in the findings and data. They also thought that the public could be confused and worried by media coverage, and that there are many organisations that may seek to spread misinformation. They felt it would be important to have a well thought out communication approach, and to take active measures to ensure trust in the discovery between countries on Earth by encouraging knowledge sharing and transparency.

Lack of trust in general was seen as a big risk for communications about discovery of life. Governments, scientists and private companies were all seen to be potentially untrustworthy, depending on their agenda. However, scientists were significantly more trusted than the others.

Scientific bodies such as the UK Space Agency were preferred to lead updates and communications around new life rather than politicians due to their knowledge and expertise in the event of any discovery of life. There were subsequent concerns that politicians could have political biases to influence the way they commentated on new life and increase the likelihood of them withholding information from the public.

Participants were sceptical towards the newspaper headline in Scenario 1 as confirmation that no other life exists. They questioned the validity of the 'claim' that no other life exists, and felt that if they were to believe such a claim, they would need to see factual evidence provided from credible bodies such as

NASA. There was scepticism towards the truth of the newspaper headline as participants questioned the credibility of the publisher and questioned whether the claim that no life existed had been made for commercial interests.

> **“Claim, because there was no evidence to back that up. So, where did they get the claim from? I would like to see enough evidence to support that.”**
> Workshop 1, Glasgow

> **"It's quite common that headlines can portray stuff in a certain way. Like I do English Language and a lot of what we study is how easy it is to manipulate people to believing what you want by leaving out certain bits of information. So I'd assume that's probably what's happening here. "**
> Workshop 1, Cornwall (in reference to ‘Newspaper headline’ Scenario 1 prop)

Participants hoped that humanity would persist with exploring Space in search for new lifeforms. Despite this hope for persistence, participants suggested that the cost and resources dedicated to the search for new life or resources should be controlled and limited.

Sustainability and safety

Chapter summary

- Participants saw the potential for Space industry to help energy and environmental issues on earth but wanted this to be done responsibly, safely and sustainably.
- Participants were concerned about environmental damage that might be caused to celestial bodies through activities, particularly mining.
- There were concerns that impacts on the Moon would also impact Earth, through things like changing the tides.
- There was a lot of division on whether causing harm in Space is acceptable if it reduces harm on Earth.
- Participants wanted licensing of activities to protect sustainability and prevent environmental damage.
- Participants wanted humanity to learn from mistakes and not cause the same issues in Space as it had on Earth.
- Participants wanted scientific discoveries to be protected.
- Participants wanted thorough measures in place for the safe use of Space, including:
  - An Earth customs system to regulate shipping to and from Earth, enforcing quarantine for materials from Space, and policing for smuggled Space materials.
  - Rules for safe transportation of hazardous materials around Earth.
  - Strict rules on how dark matter can be used or researched for its potential as an energy source, to minimise risk.

This theme covered the potential issues and benefits of human activity in Space with regards to sustainability, and safety implications. Each of the scenarios presented in the workshops included a section named ‘Sustainability in Space’, and themes around safety came up through general discussions.

The key sub-themes of this topic included:

- Using Space to improve sustainability on Earth
- Sustainable use of outer space
- Safety issues with human activity in space

Participants saw the potential for Space industry to help energy and environment issues on Earth but wanted this to be done responsibly and sustainably.

Participants generally acknowledged the potential for advancements in Space to help address sustainability issues on Earth, such as through the use of space based solar power and factories in Space, and considered it likely that we would need to look for alternative energy sources outside of Earth.

However, they wanted to see Space resources used sustainably for future generations, and were against notions that Space resources could be used as temporary fixes or exploited in the same way that they had been on Earth. For some participants, there was a sense of sadness that we were having to resort to solutions in Space as sustainability on Earth had not been managed.

Participants were concerned about the environmental damage that mining, tourism or transporting resources might have in Space. They wanted clear principles and oversight to minimise, or completely avoid environmental damage to moons, planets and other celestial bodies.

> **“I think morally and ethically we have an obligation not to ruin everything as we have done on Earth.”**
> Workshop 2, Leicester

There was also discussion about the potential and risk of dark matter, as it was mentioned in Scenario 2 in the context of future energy generation. Participants spoke about how little they understood about dark matter, and specialists in the room clarified that there is still very little known about it in the scientific community. However, participants felt that there could be the potential for huge advancements in renewable energy and technology if dark matter can be successfully researched and harnessed. That said, the potential promise of dark matter was largely overshadowed by concern about the unknown risks of using it as an energy source, given its powerful influence on the physics of the universe. Participants were quite concerned that a reckless approach to researching this unknown force could put Earth in danger, and they wanted global collaboration to ensure a responsible approach.

> **"It raises all the questions that were raised about nuclear energy, though. You're dealing with something that you don't know about, actually. Mistakes are going to be made."**
> Workshop 2, Leicester

There was a lot of division on whether causing harm in Space is acceptable if it reduces harm on Earth.

While participants generally disagreed with the notion that it was acceptable to pollute Space, some participants saw things like using the Moon for landfill (Scenario 1), or mining Mars for resources (Scenario 3) as acceptable as it would be more damaging if this was on Earth, and may be necessary for Earth’s survival.

> **"If that planet is uninhabitable and is never going to have any form of life on it… no water, there's no plants, nothing's ever going to live there because it can't, but there's something very valuable there for us, then, should we not take it to help save Earth?"**
> Workshop 2, Leicester

Many other participants took issue with landfill or nuclear waste dumping on the Moon (as depicted in Scenarios 1 and 4), for a range of reasons. Some participants disliked the idea that humanity was shifting problems like waste elsewhere rather than finding solutions to it on Earth.

While some participants saw an absence of life (Scenario 1) as justification for landfill, others felt that even if there was no life on the Moon, it should still be protected in the way that other historical or heritage sites are, rather than ruined for future generations, with one person suggesting a ‘Moon heritage organisation’.

Others had concerns that impacts on the Moon would also impact Earth, through things like changing the tides which could have significant unknown effects on the environment. As previously mentioned, there was major concern raised about damaging planets and unintentionally displacing the position of planets

in the solar system which felt frightening and particularly careless. There were also concerns that exploiting the Moon set a precedent to damage other planets in the future, and that we were repeating the same mistakes from Earth by ruining another planet.

> **“When we were talking preserving the Moon, yes we should preserve the Moon, but we should probably also have preserved Australia, and we are now undoing some of the damage that has been done at places like Uluru and whatever else.”**
> Workshop 1, Glasgow

Participants had stronger opposition to resource exploitation in scenarios where there were habitats or lifeforms in Space (Scenarios 3 and 4), although some made a distinction between areas with sentient beings, where mining should be prohibited, and areas with microbes / bacteria, where it would be okay to mine. Participants felt that lifeforms such as fungi should be researched and not disturbed in their natural habitat through activities such as mining, and were in favour of restricted areas to protect new forms of life.

> **“They should leave everything undisturbed, they should not go to different planets to mine for our own benefit.”**
> Workshop 2, Cornwall

Participants wanted licensing of activities to protect sustainability and prevent environmental damage.

Due to concerns about the negative impacts of human activity on the Moon and in outer space, participants were supportive of different strategies to mitigate harm, and wanted to have places like the Moon regulated and managed via the proposed licensing.

When presented with scenarios about private companies operating and mining resources in Space (Scenario 3), there was a general consensus that there should be rules and systems in place to limit damage before any activities took place. Participants wanted to see companies’ licenses removed for breaches, as they felt that was the only way to make companies put environmental care over profit. Other suggestions to limit damage included having limits on the size of the area that could be mined, and provisions to return the area to its original state.

Participants wanted humanity to learn from mistakes and not cause the same issues in Space as it had on Earth.

Some expressed doubts about humanity’s ability to have sustainable practices in space, given our track record on Earth, pointing to things like COP climate agreements as examples of where humanity has failed to deliver on promises.

> **"The landfill on the Moon and some of the environmental problems... it's like we haven't advanced in certain areas as far as we should have. We're just pushing the problem a little bit further away."**
> Workshop 1, Wrexham

There were concerns that humanity would exploit resources they find in Space as they had done on Earth, destroying planets in the process. Instead, participants wanted to see humanity learn from past mistakes on Earth and act in a sustainable way on the Moon and elsewhere in space. Some felt that people needed to change our lifestyle of constant consumption to avoid ruining other planets.

> **"If we're going forward to other planets and this is a stepping stone, we really need to get the habit in of not trashing places. "**
> Workshop 1, Cornwall

Participants wanted scientific discoveries to be protected.

There were strong concerns that human activity may damage ecosystems or lifeforms in space, and that removing specimens may have knock-on effects to celestial environments that we cannot foresee. There was a consensus that damage to habitats in Space should be classed as an international crime, and participants wanted potential impacts to be catalogued, with restricted areas for newly discovered lifeforms.

> **“You've got to do no harm.” “Who are we to decide who's more intelligent and who gets to destroy other planets?... It could be way more intelligent than us, like, we could learn from it.”**
> Workshop 2, Cornwall

Participants wanted thorough measures in place for the safe use of Space.

Participants raised a range of safety concerns related to the different scenarios, and the processes they wanted to see to address these. These included:

- Dangers of transporting hazardous waste or other materials in Space. Participants felt that the companies mining or transporting resources should be responsible for any leaks or contamination, and made accountable through licensing processes, with fines or bans issued.
- Consequences for Earth, other planets and the solar system if we mined on the Moon, affecting things like tides. In general, participants wanted the risks of new activities to be evaluated and felt that new technologies should not be used until they are proven to do no harm.
- Collisions in Space caused by debris and congestion. Participants wanted to see consistent regulations and controls to limit congestion and hold companies or countries accountable for accidents.
- Participants felt that thorough oversight and regulation would be needed for the safe use and research of dark matter. This view was driven by participants’ concern over our current lack of understanding about how dark matter behaves, and the possibility that humans may be reckless in seeking its potential as an energy source. Some also suggested that any particularly risky research, that experiments with dark matter should be restricted so that it can only be conducted away from Earth, potentially on Mars.
- Risk of contamination or harm from materials shipped from Space. There was a consensus that there should be quarantine environments to check goods from Space to ensure they are safe, and participants thought that vessels coming from other planets needed to be contained and tested to ensure they wouldn’t do any damage on Earth.

Participants wanted the international governing body to manage borders and customs for Earth. They felt that private companies profiting from Space trade should be responsible for goods in transit until they have been accepted by customs, so that they can be held accountable for any accidents or dangerous imports.

Other participants felt that Earth customs should not actually be located on Earth, as this could be too late if hazardous materials have already reached our planet. They suggested Earth customs checks to happen on-site where materials are shipped from, or at a dedicated location nearby, such as the Moon or the International Space Station.

> **“I would like to think it was confiscated at source rather than on Earth because if it's on Earth it's too late, it should be stopped at the source, as in where it's taken out from or whatever planet it came from. So it would have been checked over there.”**
> Workshop 2, Leicester (in reference to the Scenario 3 prop ‘Confiscated box’)

Even if there were clear rules about imports from Space, participants were worried about the risk of smuggling materials past customs checks. They referred to smuggling issues on Earth, commenting that our systems here don’t fully prevent drug and human trafficking, and that the implications for smuggling from Space could be much higher. To mitigate this, participants wanted to see investment in policing imports, and global collaboration share information and align systems to prevent opportunities for smuggling.

Participant principles

Future Space exploration and activity should be governed by an International Space governance body, with people from different backgrounds, and representation from all countries to create the rules, enforce the rules and hold countries and commercial actors to account. There should be negative repercussions for those who break the rules.

Consider a licensing model for the management of Space territories – managed by the International Space governance authority for land/resources.

Laws, rules, and activities should not disproportionately benefit countries who have greater financial resources or power.

Future Space exploration and Space activity should be responsible and underpinned by principles of safety, sustainability, and minimal impact to planets and celestial bodies, life if found, ecosystems and habitats.

Ethical and fair return for public benefit: Future activities in Space should be safe, sustainable and ideally benefit humanity.

Preservation for research: If anything of interest/significance is found (i.e. life), initially the site should be preserved for research and nothing should be brought back to Earth until deemed safe to do so.

If any life is found, there should be global collaboration and majority agreement about what action to take, if any.

Communication about new discoveries or scientific breakthroughs should come from trusted representatives from within the scientific community and be removed from politics.

Ensure diversity and equity of those working and living in Space, minimum standards for quality of life, that human rights are upheld and that there are legal protections for all.

The key purpose of this public dialogue was to understand the public's priorities for using Space safely and sustainably for the benefit of humanity. Throughout the discussions across the two days a range of underlying principles and values expressed by participants started to emerge.

The Ipsos core team formulated a set of overarching draft principles, following an analysis of workshop 1 and involving all facilitators. These draft principles were sense checked with dialogue participants towards the end of the second workshop and worked up into a final set of principles, with existing principles adapted and new ones added, following an analysis of these discussions. The final principles represent the position that most participants, from across the four locations, were happy with. Below we take each final principle in turn below, describing the values that sit behind them and highlighting where there were dissenting views.

Future Space exploration and activity should be governed by an International Space governance body, with people from different backgrounds, and representation from all countries to create the rules, enforce the rules and hold countries and commercial actors to account. There should be negative repercussions for those who break the rules.

As previously noted, throughout the dialogue workshops there were consistent references to an international 'UN-like' governance agency or body with overall responsibility for creating the rules (i.e. around behaviour in space, space workers' rights, and how to respond to a discovery of life), and holding countries and commercial actors to account.

Participants raised the importance of ensuring diversity within this body, to ensure that rules are being created by people from different backgrounds.

> **"It should all be diverse… when you're creating UN or people doing justification for certain missions, it should be diverse. It's vital there is no bias…. when I say 'diverse', I mean people from different backgrounds… I think in general when you create an organisation it should be made of different people."**
> Workshop 2, Cornwall.

There was discussion over whether there should be *equal* representation from all countries, even if this was felt to be difficult to achieve. No clear conclusion was reached among participants across the dialogue hence this was not included in the final principle. There were participants who wanted equal representation from all countries, but others who argued that it would be unfair for less active counties to have an equal say. One suggestion was instead to have a bicameral system with one 'chamber' made up of those who contribute the large majority and another chamber for those who contribute less.

> **"I've a slight hesitation on equal representation because not everyone has got equal skin in the game. Russia, US, China, India or whoever is putting stuff up there doing things is on the front and has put a lot of money and things into it already. So for, I don't know, Tuvalu to have an equal vote having put nothing into it seems a little stretching."**
> Workshop 2, Glasgow.

Underpinning this principle, and suggested by some groups but not all, was the idea of learning from what works well on earth. For example, the management of Antarctica and the International Seabed Authority (ISA).

Consider a licensing model for the management of Space territories – managed by the International Space governance authority for land/resources.

The suggestion of a licensing scheme to manage land and resources in Space evolved during workshop two, because of lengthy discussions sparked by the scenarios about if/how land should be divided and owned.

> **"I'd like it to be owned by no one, so no countries can say they own a bit of anything, that it's all open to, you know, maybe signs can help it so that countries can't legally say they own this part of Mars or whatever."**
> Workshop 2, Wrexham

While not a universal view, as there were some participants who saw benefits in countries or companies claiming ownership to territory in space (as discussed earlier), a common view was that a licensing scheme should be taken forward which would negate the need for permanent ownership of territories in Space. This would allow countries or companies to use territories in Space for specified periods of time, and under specific conditions and licenses could be removed if conditions were breeched.

> **“Make it part of their license that if it's found that their shipments had it [accidental/leaks] then that could affect the licensing agreement that they had, so that they would put tighter restrictions into what they're doing and what's shipping out.”**
> Workshop 2, Cornwall.

Laws, rules, and activities should not disproportionately benefit countries who have greater financial resources or power.

Throughout the dialogue, and as participants discussed increased activity in Space, there was a growing emphasis placed on the importance of ensuring fair use of Space which does not exacerbate existing inequalities.

> **"There's no point in exploring space if it's going to make life worse for people on Earth. Even if other people on Earth get better lives, even if you're producing a quality of life for other people, it's not worth it."**
> Workshop 2, Glasgow.

After much discussion, most participants landed on a view that there should be fair distribution of the benefits of Space exploration and Space activity.

Future Space exploration and Space activity should be responsible and underpinned by principles of safety, sustainability, and minimal impact to planets and celestial bodies, life if found, ecosystems and habitats.

Throughout the dialogue participants consistently referred to respect for planets, celestial bodies and life if found. However, towards the end of discussions - and having been through the four scenarios – participants highlighted that the word ‘respect’ would be open to interpretation and thus advised this not be included within this principle. Instead, participants unanimously spoke of the importance of future space exploration being executed responsibly, safely and with minimal impact to planets, celestial bodies and life if found.

While not a universal view, there were participants who recognised that there would need to be different levels of tolerance established to define whether it was *more* acceptable to exploit planets, celestial bodies or life if found. For example, if it might be justifiable to mine a planet if no lifeforms existed there.

> **“Yes, I don't think they can be going over-reckless in terms of, like, exploiting it but I think maybe there's a sliding scale of what is acceptable, depending on what level of habitat you're destroying, maybe not destroying but just impacting on, you know, what level of impact. It might be determined by other factors, I don't know.”**
> Workshop 2, Wrexham.

Ethical and fair return for public benefit: Future activities in Space should be safe, sustainable and ideally benefit humanity.

There were participants who were comfortable with commercial actors profiting from Space activity, even when this activity would not benefit anyone else (for example Space tourism) however this was a minority view.

> **“I don't think everything has to be for the benefit of everybody. I think it's for the benefit of the people who are taking the risk and providing the resources to do it.”**
> Workshop 2, Wrexham.

Most participants recognised that there would need to be commercial gain and profit made by commercial entities, or else they will not invest in space, but there would also need to be benefits to

humanity and Earth from this activity and not *only* commercial gain. Some participants focussed purely on financial benefits back to earth.

> **In terms of not solely being for commercial gain, to be honest I don't mind commercial gain if they're paying taxes but let's throw in a space tax on it.**
> Workshop 2, Glasgow.

> **"It's like we were saying about the Space cruise thing if, you know, rather than having that as purely for commercial gain, all the money that people pay to do that should be reinvested into research, etc."**
> Workshop 2, Wrexham

Participants commonly talked about wider benefits and how these should be distributed fairly, regardless of the upfront investment (or lack of) made by that country, with some noting that these should be proportionate.

> **"You can't say, 'I'm sorry but you can't have the malaria vaccine because you didn't put any money into the rocket going up into space'. You can't do that."**
> Workshop 2, Cornwall.

> **"Yes, but we're taking the cost out, so we're saying the smaller countries don't have to pay in, but they're still going to get benefit from whatever comes out at the other end."**
> Workshop 2, Glasgow.

It was also clear that participants felt that all Space exploration must be underpinned by safety and sustainability. An example provided to this effect was that if the space exploration itself (i.e., a rocket launch) was found to be not sustainable, the company or country should fund initiatives to help people make use of green technologies.

Preservation for research: If anything of interest/significance is found, initially the site should be preserved for research and nothing should be brought back to Earth until deemed safe to do so.

This general principle – which covered life as well as other discoveries such as new resources – was underpinned by discussions that focussed around the need for *some* of a new discovery (i.e., samples) to be offered up for research.

Participants spoke about the need to ensure bio-security, often referencing the lifeforms discovered in the future scenarios, and how important it would be for safety checks to happen in space before anything is brought back to Earth to ensure that there is no risk of contamination and that it is safe to do so.

Participants agreed on the need for transparency around new discoveries and decisions around what intervention – if any – would thereafter take place. To this effect, some felt that there should be a pause if or when there are new discoveries until agreement is reached on what to do next. They likened this to what happens when construction workers are excavating and come across human remains.

If any life is found, there should be global collaboration and majority agreement about what action to take, if any.

Participants raised the importance of the need for global agreement on what action to take if any if life is found, and noted this may depend on what kind of life is found. There was a lot of scepticism about how feasible it would be to reach global collaboration, and that this could take time, so suggestions were put forward to achieve agreement from the *majority* of countries on what action to take, if any. There were participants who felt that it would be useful to know in advance what each countries official position was

on the potential discovery of life and others felt that being prepared was key here – with agreement of what action to take ideally being agreed in advance of life being found.

> **"So you've already done all the global, like, what do you do when maybe, you've done all that and agreed on those protocols."**
> Workshop 2, Cornwall.

Communication about new discoveries or scientific breakthroughs should come from trusted representatives from within the scientific community and be removed from politics.

There was near universal agreement that communication will need to be removed from politics, however this principle evoked discussion in almost all groups about whether scientists are more trusted than politicians. Some participants recognised that scientists can have their own agendas, and others spoke of how they had lost faith in scientists during and since the COVID-19 pandemic.

> **"[Communication] should be driven by and come from trusted representatives from within the scientific community, advising leaders but removed from politics. That didn't work with the pandemic."**
> Workshop 2, Cornwall

This said and it was more common for participants to say that they would trust scientists (especially a trusted representative) to communicate Space related news, such as discoveries of breakthroughs, though some stated that scientists are not always easy to understand.

> **"When I see scientists on TV telling me about stuff, I'm far more inclined to believe them than I am the politicians. I don't know why, maybe it's just a mistrust thing."**
> Workshop 2, Cornwall

There were participants who were keen to see this principle refer to communication removed from commercial interests, and others who wanted communication to be removed from religious beliefs, though as these were not consistent suggestions across the groups and locations, the principle does not reflect this.

Ensure diversity and equity of those working and living in Space and quality of life, human rights, and legal protections for all.

Participants spoke a lot throughout the dialogue about the importance of looking after people who are prepared to work and/or live in such a high-risk environment, and about the need to ensure people from different countries and background all have a good, fair and equal quality of life, human rights and legal protections, to avoid repeating the disparities in equity on Earth.

> **"I would say so because you don't want that huge divide. Well, like I said, you don't want people treated as slaves working up there so you've got to ensure they've got adequate quality of life and working conditions."**
> Workshop 2, Wrexham.

Some participants talked about equal remuneration for workers who do different jobs, for example doctors as well as refuge collection workers, though this was a minority view.

Children and Young People's activity

To allow children and young people to engage with the same key themes as the adult participants in the main workshops (discovery of life, governance in space, sustainability, and industry in space), we collaborated with The Liminal Space to create activity sheets for children to complete. In these, the children and young people were asked to answer multiple choice questions about how they thought humans would live on the Moon in the future, and to also give their opinions on how we should interact with three possible forms of life: microbial, plant, and intelligent extra-terrestrial life.

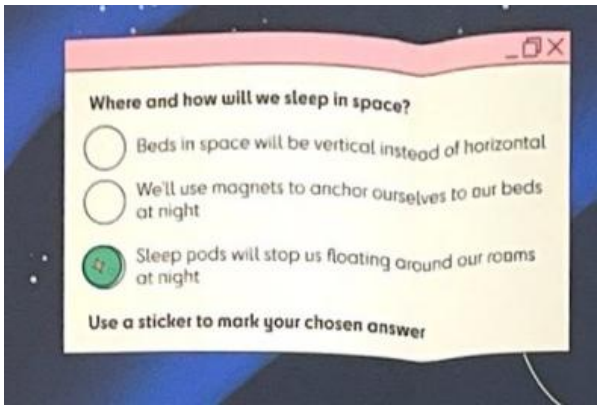
Generally, the children and young people's attitudes were very similar to the adult participant's, particularly around the topic of respecting any other lifeforms, and about the importance of limiting environmental damage done to other planets. It was also apparent that the children's experiences of COVID-19 had highlighted to them the risk of transferring illnesses between people, as this came out as a big concern for them across both activities.

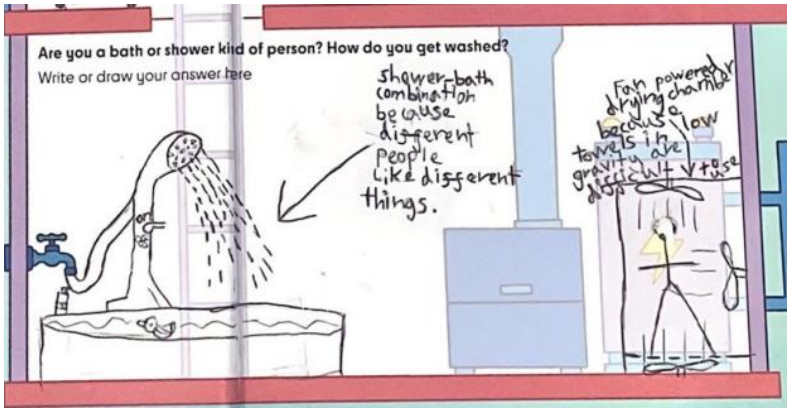
The activities were designed to engage children and young people from the ages of seven to fifteen, therefore some were able to complete the tasks independently, whilst others completed them with their parents, and so may have been informed by their parents' views or experiences of the workshops. The children were also told that they could either draw or write their answers, and so responses will reflect this.

Lifestyle on the Moon

Children and young people generally thought that we would eat the same food on the Moon as we do on Earth, however when asked where we would source this from, some thought that we would likely import our food from Earth whilst others suggested that we would build special farms on the Moon that could grow our food. Others thought we would eat different foods to the ones we eat on Earth, such as plants or fruits that only grow in Space environments.

The children and young people gave a lot of thought to how the lack of gravity in Space could impact how we would carry out everyday tasks. They predicted that we would have special pods created for us to sleep in, so that we would not be moving around constantly at night (which was one of the pre-empted responses to a question they were asked). They also suggested some novel technology to help us clean in Space, such as having a drying chamber in bathrooms that would help us dry-off after a shower, as using a towel would be impractical in a low gravity environment.





The children and young people also wanted to be able to take their pets to the Moon with them. They thought it would be likely that pets would need zero gravity training in order live properly, or that they may need a special passport to travel into Space like humans do on Earth.

Infrastructure on the Moon

When asked how we would travel around on the Moon, the children and young people predicted households would each have electric buggies, rather than a public transport system such as a shuttle train network.

Generally, they thought that we would build homes on the Moon out of lightweight and strong materials, such as Titanium, rather than other multiple-choice options such as building homes from recycled waste or materials mined from Space. When asked, they also predicted that future Space homes will be built in a similar way to how Space stations are currently and would be sealed to recreate the conditions on Earth. However, others thought we might need to take alternative measures such as living underground.

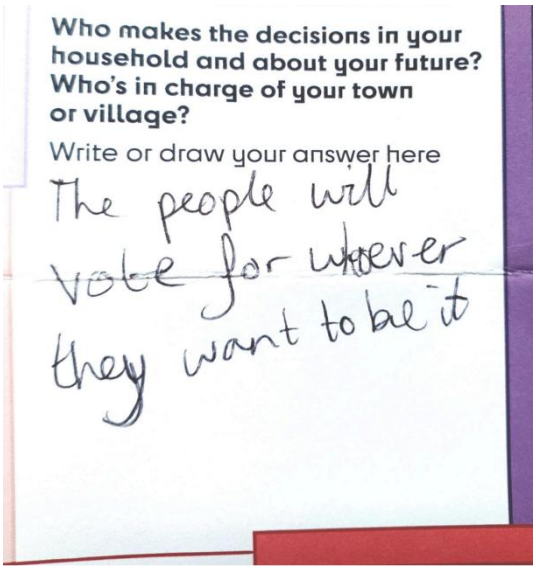
Jobs and money on the Moon

The children and young people thought that there would be a Moon currency that is separate to Earth money that everyone on the Moon would use, rather than having a mix of national Earth currencies. In terms of how this money would be spent, it was thought that there would be special Moon shops for food, clothes and toys, whereas others predicted that there could be computers that would allow us to buy and print out any items we need.

In response to a multiple-choice question, they also thought that most of the jobs on the Moon would be related to science and technology, but other jobs such as teachers and nurses would also be necessary if people were to live in Space.

Governance on the Moon

When asked who they think should be in charge, the children and young people thought that Moon residents should be able to elect officials to be responsible for making decisions for the Moon settlement. The children felt that the systems that we have on Earth should be implemented in space, and families should have the freedom to make decisions for their individual households.



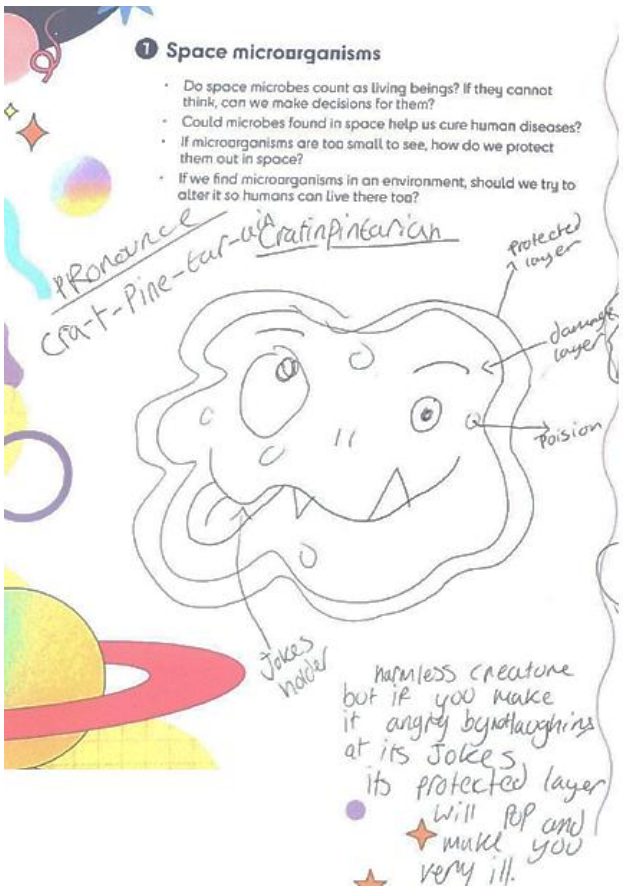
Discovery of life

The children and young people's activity sheets presented a range of questions around the three types of extra-terrestrial life and they were encouraged to write or draw their own answers. The rest of this chapter is structured around those questions, and includes drawings and written answers from the children.

Microbial life

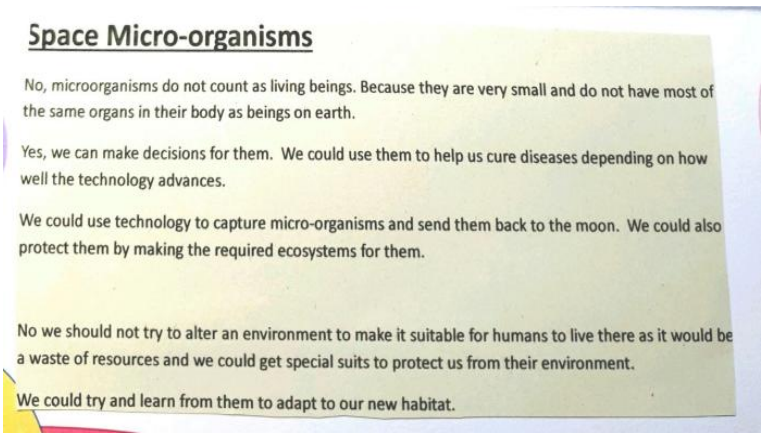
Q: Do Space microbes count as living beings? If they cannot think, can we make decisions for them?

Some children did not think that microbial life needed to be considered as living beings. The children tended to justify this decision by comparisons microbes to human beings, such as how microbes do not experience emotions like humans do, or how they aren't capable of the everyday activities that humans carry out. Those that disagreed thought they should be treated as living beings, even if they are small.



Regardless of agreement on whether microbes count as living beings, there was a general sense that we would have a responsibility to try and protect them from any harm, and that we need to take better care of them than we have done so for the animals and plants on Earth, mirroring concerns raised by dialogue participants.

"We could make sure we don't ruin the environment like we ruined Earth for all the animals and trees".



Q: Could microbes found in Space help us cure human diseases?

The children and young people tended to think that microbes found in Space could be used to help us cure diseases on Earth. They thought we should allow experimentation but that the microbes' environment shouldn't be harmed in the process.

While some came up with suggestions on how to capture microbes for research, others thought it would be very impractical to have to transport the microbes back and forth between Earth and Space to study.

Q: If microorganisms are too small to see, how do we protect them out in space?

The children and young people suggested that we should develop technology on Earth that could help us see microbes better, such as microscopic glasses, and that we should try to create habitats for them to live in. Some of the children disagreed and felt that we would not be capable of making decisions to protect microbes as we are so different from them, and don't have enough knowledge to know what is best for them.

> **"When we are more advanced, we can get robots with microscope lenses to look at them without damaging their environment".**

Q: If we find microorganisms in an environment, should we try to alter it so humans can live there too?

Generally, the children and young people did not think that we should try and alter any microorganism environments so that humans could live there. Similar to that reported by the dialogue participants, this was usually linked to a concern that living or interacting with them may transfer diseases between humans and microbial life, or even cause new diseases that we did not know about previously.

> **"No [we should not alter their environment] because something bad might happen"**

Others thought that we could try to alter their environment to make it safer for humans in the future, but only as a last resort if Earth becomes inhabitable for humans. If this was the case, we should still respect the microorganisms, and make sure their environment remains suitable for them.

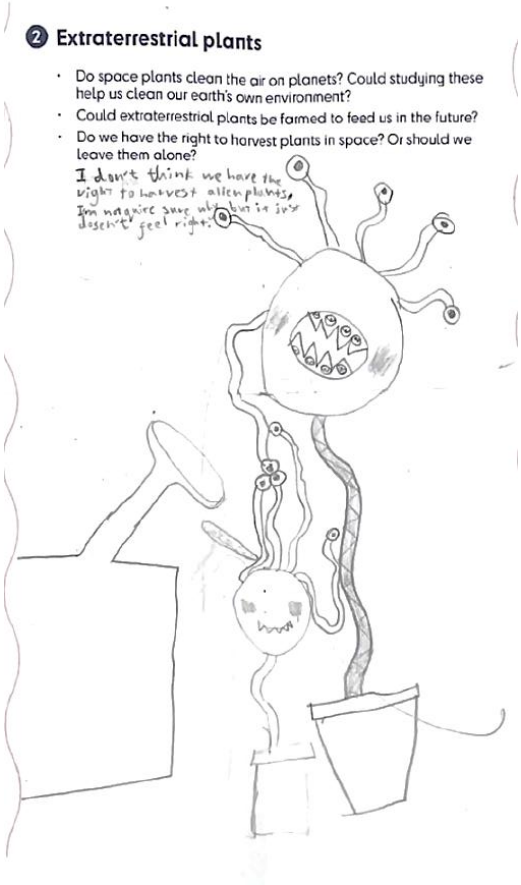
Plant life

Q: Could extra-terrestrial plants be farmed to feed us in the future?

Children and young people thought that farming plants in Space could be very beneficial to Earth and could provide another food source to help feed our growing population. Some also suggested that it would be exciting to have new types of food that previously weren't available to us.

However, there was some hesitation about farming these plants, as we would not know as much about them because they would be different to those on Earth. Children and young people showed particular caution about humans eating these plants, and thought it was very important that scientists study them carefully first.

> **"No we shouldn't farm them they could be poisonous or sticky"**



Q: Do we have the right to harvest plants in space? Or should we leave them alone?

There was no general agreement from the children and young people on whether humans have the right to harvest plants in Space. Some of them felt that we should be allowed to harvest any Space plants, as they don't belong to anyone and they could potentially benefit us on Earth. This was caveated by the feeling that we should not completely deplete environments of their plants and we should attempt to cause as little damage as possible, raising a similar point to those raised by dialogue participants.

> **"I think we should only take small amounts [of a plant] to study"**

Some disagreed and thought that we shouldn't be allowed to harvest plants in Space, and that we could potentially be taking away Space organisms food sources, which would not be fair. Sometimes the children did not have a specific reason as to why they thought we should not harvest plants in Space, but just felt that it was not the right thing for us to do.

> **"I don't think we have the right to harvest alien plants, I am not sure why but it just doesn't feel right"**

Q: Do Space plants clean the air on planets? Could studying these help us clean our Earth's own environment?

The children and young people seemed to think that using Space plants to help Earth's environment was a good idea, as it could allow for animals and humans to live for longer and be healthier. One young person suggested that we could install green houses and polytunnels in Space so that we could grow even more plants that could be used to the air on Earth.

“Plants are good for any environment and would help our Earth’s environment”

Intelligent life

Q: How should we behave towards extra-terrestrial lifeforms? Should they be protected like endangered species here on Earth?

Compared to how the children perceived microbial life, there was a strong sense that any intelligent life found in Space needs to be treated with respect, and they seemed to have stronger feelings about not invading their environment or using them for human benefit.

The children and young people generally felt that we would have a responsibility to protect these lifeforms if they were discovered, but that we need to do so whilst also respecting and protecting their habitats.

“Yes they should definitely be protected like on Earth. There could be an eco-council like we have in our school but a really big one, so they don’t get endangered EVER”

Some of the responses suggested that we should be cautious to interact with any extra-terrestrial life, and that our behaviour towards them should be dictated by how they act towards us. For some, there was a concern that these lifeforms could be a threat to humans, and that we should not protect them if they are hostile to us or cause any danger.

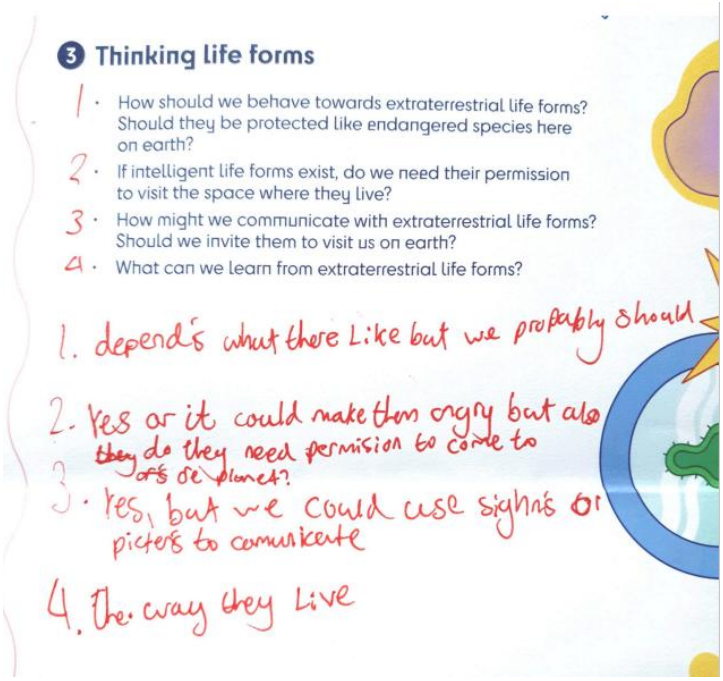
Q: If intelligent lifeforms exist, do we need their permission to visit the Space where they live?

There was a strong sense that we would need to have permission from any intelligent lifeforms to visit their habitats or planets. Some of the children explained that, as humans, we would expect other lifeforms to ask for our permission to visit Earth, and so we should do the same. The children also showed concern that if we visited their habitats without asking, it could make these other lifeforms hostile towards us and cause conflict.

“We need to ask them because they might think we are a threat and shoot or hurt us.”

Q: How might we communicate with extra-terrestrial lifeforms? Should we invite them to visit us on Earth?

The children and young people acknowledged that it could be difficult to communicate with any intelligent life, as there is no common language, and finding a way that everyone could communicate could take a long time. However, some of the children suggested potential methods of communication, such as sign language, or pictures.



Some suggested that we should avoid direct contact with any intelligent life, and that we should not bring them to Earth, for the safety of humans but also for them, as we could transfer diseases to one another.

However, they did seem enthusiastic about the possibility to learn from other lifeforms, and it was thought that they could help us understand more about Space and the different habitats there which was a finding in the dialogue too. The children also felt as though sharing knowledge with extra-terrestrial lifeforms could help us make Earth a better place to live. However, there seemed to be a strong disapproval of conducting any experiments on these lifeforms, especially for human benefit. This appeared to be a hard boundary for them, that should not be crossed.

> **“They can teach us about Space, but no experiments because it is wrong”**

Conclusions

The UK's Space sector is a fast growing, globally competitive industry and Space-based technologies already underpin much of modern-day life with the impact of Space activities on life on Earth set to increase exponentially in the coming decades.

Despite this, conversations and decision-making processes concerning the governance of Space are typically led by a small number of actors, such as leading Space agencies, NGOs, and private companies. There are very few mechanisms that allow the public to contribute to these conversations.

This dialogue sought to understand the public's priorities for using Space safely and sustainably for the benefit of humanity. It has shed light on the public's views and expectations around how Space activities should be governed, how evidence of life (if found) should be treated and how human life in Space should be safely sustained.

This concluding chapter aims to draw out some overarching key messages for future Space policy, and to suggest areas for future public engagement, rather than to repeat the dialogue findings in detail. We end by reflecting on the strengths and limitations of the chosen methodology.

There is a clear steer on the need for global collaboration going forward.

The public was concerned about the lack of rules that currently exist in Space. While they very much appreciate the need to explore Space further, harnessing the many benefits that this could bring to us on Earth, they want to see a set of globally agreed rules and laws created and put in place to enable safe and sustainable activities in Space.

The public accept the presence of commercial actors in Space, indeed participants recognised how industry drives innovation. However, to avoid situations where commercial actors (or countries) are operating without restraint, and being driven purely by profit, these globally agreed laws need to apply to all, and actors need to be held to account and punished if they break the rules.

The public was supportive of the role for an International Space governance body, which is globally inclusive and allows all countries to have a say in significant Space decisions moving forward. This body should be responsible for:

- the allocation of licenses for land/resources (see below);
- creating the standards and rules for behaviour in space;
- regulating behaviour in space;
- creating and implementing rules around space workers rights; and,
- deciding on how to respond to a discovery of life.

The International Space Station was a glimmer of hope for dialogue participants, an example of how global collaboration is possible even where there are conflicts on Earth between collaborating countries.

The rules need to work for, and the benefits distributed among, all of humanity, not just the countries or companies that get there first or are particularly active in Space in the future. This was based on a view

that wealthy countries are likely to have an advantage in reaching Space, and therefore may widen inequality between nations if they are able to set rules in their own favour.

There was an expressed need for scientists to be involved in future governance systems, balancing the inevitable role governments and politics will play in this.

UK Space policy could address this insight by championing global collaboration, and considering global human benefits alongside UK goals in Space exploration. UK policy could consider where the UK can be a 'net-giver'; offering support (e.g. financial, skills, resources) to less advanced countries' Space development in the spirit of fostering trust, alliances and global collaboration.

The public is clear that ownership of territory in Space comes with risks and instead a licensing model could be a solution to this challenge.

While participants recognised that there could be benefits to claiming territory in Space, to pursue important research and to justify investment in Space exploration, they also cautioned the many risks that come with countries or companies claiming territories. While there was not universal agreement on this, a licensing model was a leading popular solution as an alternative to division and ownership of territories in Space.

This would enable progress without giving up control, for the protection of certain areas (for example those where life is found), and a licensing system could include conditions to ensure a proportion of the benefits have a positive impact on humanity. Licensing would also act as a method for regulation and enforcement of Space laws.

UK Space policy could consider how a licensing model might work in practice and champion this model on a global platform.

The need to address issues early on and create the rules before they are needed.

A clear steer from the public is that the rules and laws need to be agreed upon, globally, in advance of increased activity in Space and further Space exploration. For example, by being prepared and having global agreement on how to respond to a discovery of life *before* this happens, rather than reactively creating rules as the discovery happens, or even after the discovery. After much discussion, participants appeared more concerned about the impact humans might have on a lifeform if we discover it, rather than the impact that might happen to humans, hence there would be a need to pre-empt this to avoid unreversible damage.

Similarly, global agreement on what activity to permit in Space and what remedial action to take if this is likely to cause damage to environments and habits on other planets and celestial bodies. A lack of faith in humanity, demonstrated over history, was a key driver for pre-empting the need to prevent environmental damage and act in a sustainable way on the Moon and elsewhere in Space. As well, participants wanted the global Space governance body to manage border and customs on Earth to ensure that anything brought back to Earth from Space was deemed to be safe to do so to avoid damage to Earth.

UK Space policy could address this by initiating and championing early global discussions about shared principles and protocols for Space activity and discovery of life.

Future public engagement on Space.

Dialogue participants explored a range of different industries in Space – including Space-based solar power, Space mining, Space technologies to combat climate chance and lunar activity and exploration. Participants discussed the benefits and downsides of these, and the trade-offs associated with pursuing and investing in these.

Given how huge and evolving these industries are, and how we merely touched upon them in this dialogue – and mostly as part of our education and informing stage - each could lend itself to a whole programme of future public engagement. Arguably, as taxpayers and beneficiaries of these future initiatives and technologies, the public should have a say in how they are rolled out, governed and the benefits distributed.

There were some industries and areas of research that were particularly complex, and participants struggled to fully discuss the implications of them given the technical nature of them, often spending quite some time asking the specialists in the room to explain the basic concepts to them. These subjects included microgravity research and manufacturing. Further engagement could be helpful to explore these with the public and establish the conditions of acceptability.

Another area which we feel warrants further public engagement is Space medicine and personalised medicine. The public placed much importance on the health and wellbeing of those who will eventually work, live and travel in Space. They were also keen to be assured that they would have access to medical care given the effects of the harsh environments on human anatomy. This area feels like a ripe area for future public engagement, particularly given the bioethical issues relating to radiation exposure and reduced gravity.

Strengths and limitations of the methodology.

As with any project of this nature, there are strengths and limitations which are important to note.

Our sense is that public dialogue was the right methodology to explore the complexities of this topic. Many participants came along with low levels of knowledge about certain aspects, such as detail on the range of future industries in Space and the likelihood of discovering life, and the reasons why we might want to continue to search for this. Public dialogue allowed participants to become informed and educated about Space exploration and activities in Space (past, present, and future), ask questions of and interact with a range of specialists, listen to the views of others and over two full days form informed views on the topics. Participants' views evolved over the course of the two days, as they took in new information, and interacted with the future scenarios.

At the same time, the method itself comes with some drawbacks. Public dialogue is about a group of people taking on new information, discussing this and weighing up trade-offs collectively, thinking and acting as citizens rather than just individuals. While the recruitment approach intended to create a diverse sample, we are not able to shed light on whether views differed by age, ethnicity or by other demographics for example.

Using a scenario approach has proven very effective to support participants in their discussions. Participants often commented how the scenarios made the future concepts feel real and helped them to consider what implications Space exploration may have on younger generations. A limitation of this approach, however, is that they partially narrow the discussions to the factors focused on within the scenarios. In many cases, such as this one, narrowing the focus is suitable for the time restrains of a workshop given the breadth of the overall subject matter.

> **"The last scenario we did, I walked out of here being like, 'Well, 2078, that might be my grandchildren, that.' Thinking about these things, it solidified things a little bit for me."**
> Workshop 2, Wrexham (reflecting back on Workshop 1)

Using physical props as stimulus in this project has overall been very helpful for discussion, although some props were far more effective than others. They were effective in prompting deeper thought into the implications of different aspects of Space activity. For example, many participants were strongly against intervening with any lifeform, however the ‘Nebucillin’ trial drug prop softened this stance for them, as it to consider the potential benefits for humanity and weigh these up against the risks.

The impact of props can be limited if the participants find the implications of the prop less important than another part of the scenario, or do not see the implication as surprising or problematic. For example, the Scenario 3 confiscated box prop drew out detailed discussions in some groups about Earth borders and customs, but in other groups participants were much more focused on the broader theme of commercial activity and did not stay focused on the prop for long. It can be a challenge to predict the subjects where a prop will be impactful, and so to get the most from this approach, a range of props are needed.

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