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## Space and Education

Space is a topic which can be used to inspire and engage children with Science, Technology, Engineering and Maths (STEM) from a young age; outer space can fascinate even very young children<sup>1,2</sup>. It features in the UK curriculum at both primary and secondary school level<sup>3</sup> and there are a variety of methods and programmes that aim to use space and space exploration to encourage children to take an interest in STEM and pursue related careers<sup>1,4</sup>. Children can benefit from being provided with conceptual tools to help them understand astronomical concepts, such as Earth's sphericity<sup>2</sup>.

## Minecraft as a learning tool

Minecraft is an extremely popular computer game which involves building with virtual blocks that have a wide range of textures and properties<sup>5</sup>. With many analogies to real-world features and processes, it allows children and young people to visualise and explore concepts through the creation of structures; for example, the formation of the volcanic glass obsidian (Fig. 1) can be explained using the equivalent process – lava contacting with water at the point of eruption – in the game<sup>6</sup>. Concepts such as space can be difficult to understand, particularly for children and young people, because it is so far removed from our everyday experience. Minecraft can be used to facilitate improved understanding<sup>5</sup>.

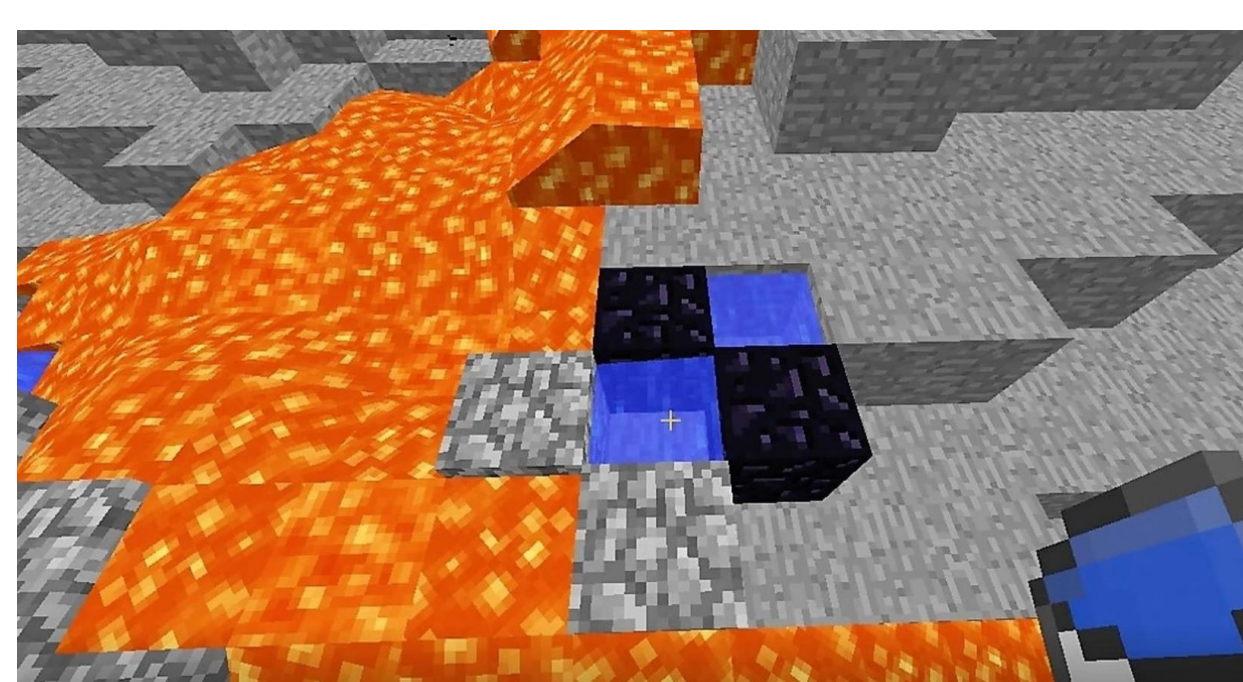


Fig. 1. (Top) Sample of obsidian, which can form when lava erupts into water. (Bottom) Obsidian (black blocks) forming in Minecraft, when lava erupts into water.

The game is used as a learning tool around the world, in both formal and informal educational contexts and across a wide range of subjects<sup>7</sup>. It is particularly relevant to science-based learning due to its parallels to real-world processes and environments<sup>8,9</sup>. Almost limitless creations can be built, enabling visualisation of, experimentation with and communication about topics which cannot feasibly be brought into classrooms in 'real-world' situations<sup>5</sup>. This includes learning about and visualising space and astronomical features, which can be explored by constructing depictions in Minecraft.

## The Science Hunters approach

The Science Hunters outreach project engages children and young people (CYP) with science using Minecraft. CYP who may face barriers to accessing educational opportunities, such as Special Educational Needs, low socioeconomic status background or being in care ("Widening Participation") are particularly supported to understand and engage with scientific concepts<sup>5</sup>.

In Science Hunters Minecraft sessions, topics are briefly introduced via hands-on, interactive discussion. CYP are then set topic-related building tasks or challenges in Minecraft and supported to direct their own approach to this. They construct understanding and meaning from information given, within the context of the game. Thus, utilising a learner-centred constructivist approach<sup>10,11</sup>, anchored instruction<sup>12</sup> and constructionism<sup>13</sup> are applied by contextualising the themed building challenge in a real-world situation and building upon existing knowledge to explore the topic and advance understanding<sup>5</sup>.

Previous research on the project's approach demonstrates that Minecraft can engage children who do not show a strong interest in science<sup>14</sup>, and that taking part in sessions in schools significantly improves knowledge and understanding of the topic covered<sup>15</sup>.

## Minecraft space sessions

A variety of space topics have been explored in Science Hunters Minecraft sessions, including 'What is space?', 'Building a rocket', 'Planets', 'Alien lifeforms', 'Can we survive on the moon?' and 'Blood moons'. Delivery of these sessions has occurred at Minecraft Clubs for CYP in care and for CYP with Special Educational Needs. The clubs are attended by approximately 50 CYP aged 5-18 years, plus their parents and carers. Sessions can also be delivered in schools and at public events.

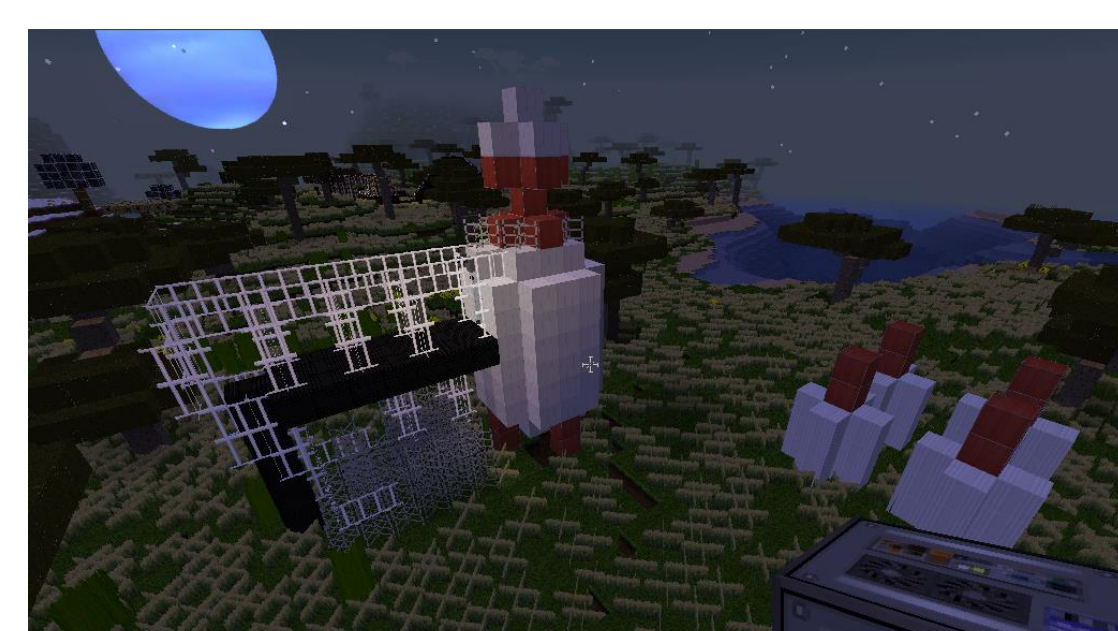


Fig. 2. Image of a rocket and launcher built by a Minecraft Club participant.



Fig. 3. A participant building in Minecraft at a Minecraft Club.

## Exploring space in Minecraft

During 'Blood moons' sessions, causes of lunar eclipses (Fig. 3) are discussed, then the concept of refraction is introduced (Fig. 4) to explain how a blood moon occurs. Participants then build a simple blood moon (Fig. 6) or a model of a lunar eclipse with refracting light (Fig. 5) depending on their ability in Minecraft and what most interests them.

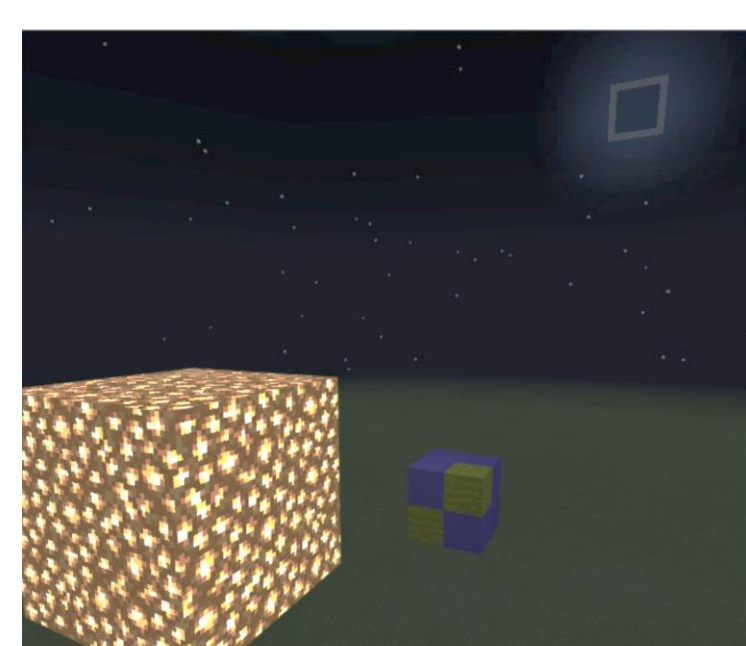


Fig. 4. A lunar eclipse in Minecraft, showing the sun, Earth and eclipsed moon

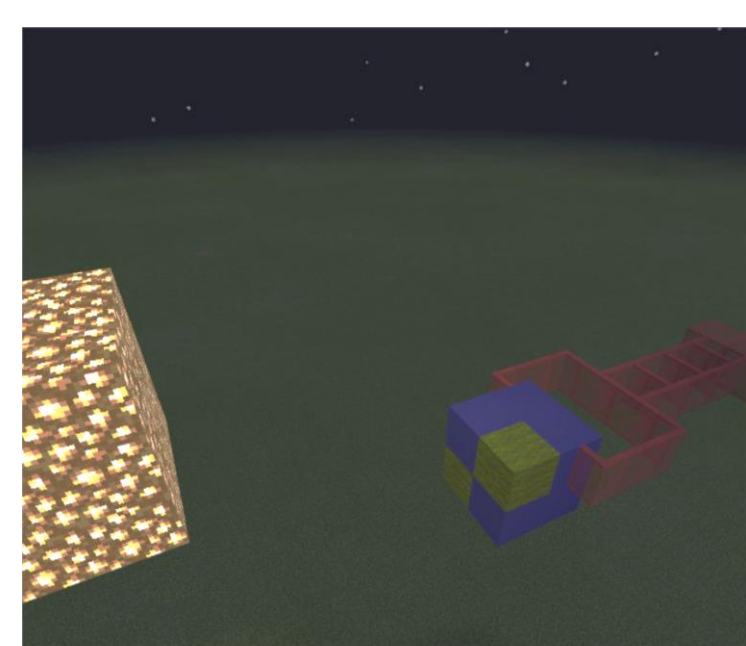


Fig. 5. Light from the sun being refracted through the Earth's atmosphere, filtering blue light and leaving red light to strike the moon

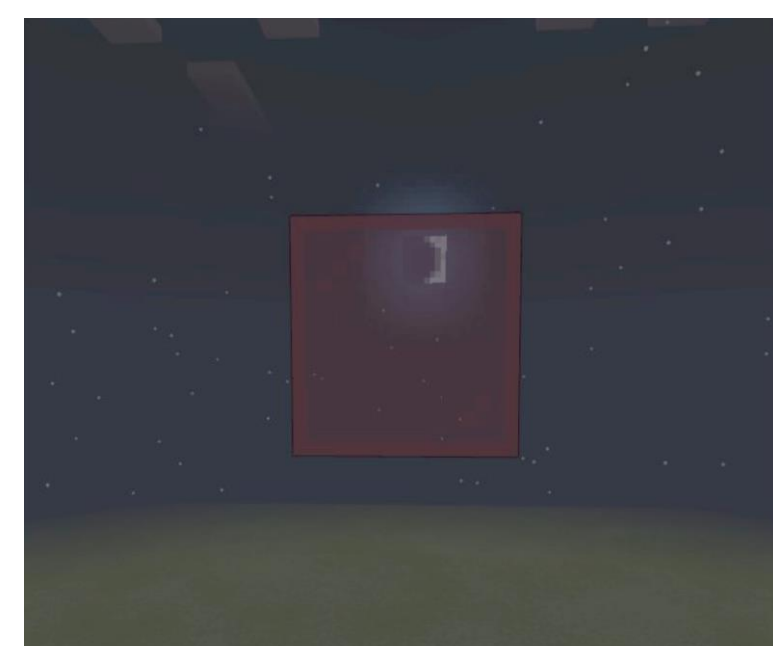


Fig. 6. A simple blood moon, built using Minecraft's moon and a pane of red glass.

Another session explores whether it would be possible to move to the moon, and what it might look like if we did. The moon environment and the history of humans on the moon are introduced, followed by exploration around what we would need to make a permanent lunar base. Topics include: what the base would look like (Fig. 7), growing food (Fig. 8) and recycling our waste (Fig.9). In line with the Science Hunters approach, participants are given creative freedom to construct and problem-solve for themselves using the information provided.

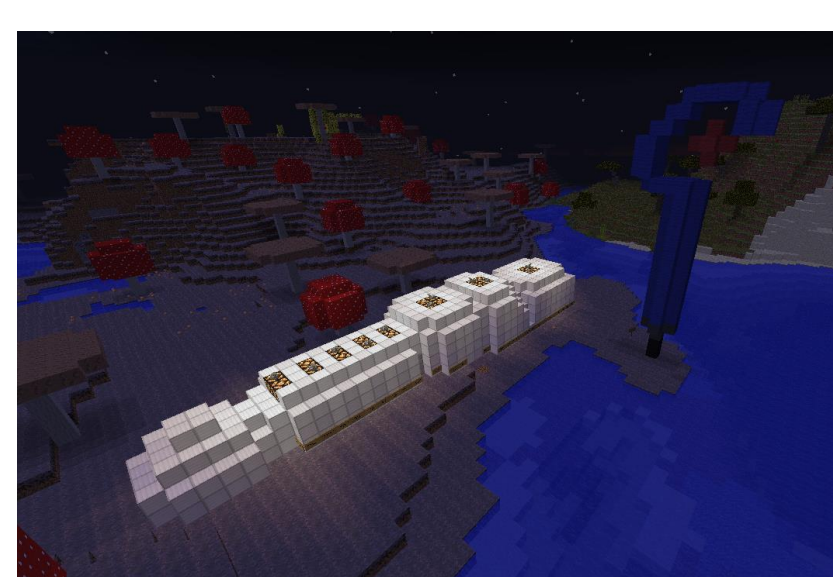


Fig. 7. Participant's creation of their imagining of a permanent lunar base.



Fig. 8. Growing food on the moon inside the lunar base.

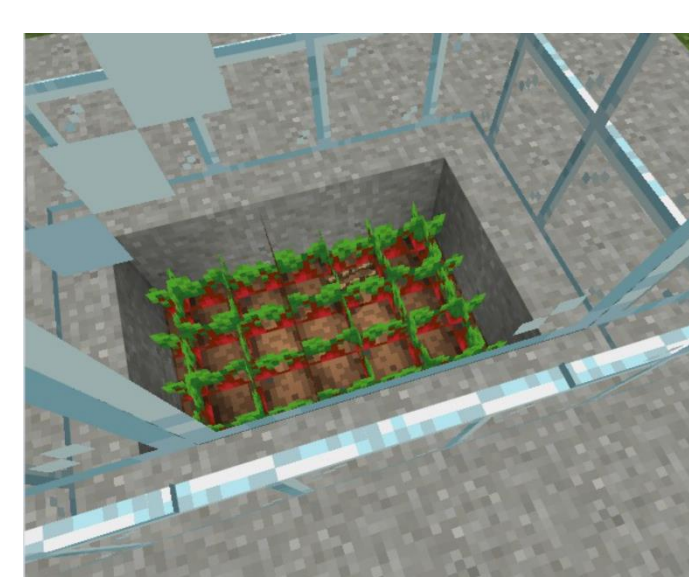


Fig. 9. A moon-based composter for recycling human waste.

## Outcomes

Space topics are popular with CYP participating in Science Hunters sessions and have been frequently delivered at the project's Minecraft Clubs in the five years since their inception. Feedback collected at the end of each year from accompanying parents/carers indicate that sessions on space are some of the most well received and memorable science sessions:

"He has picked up some interesting facts, like the relative sizes of planets and the sun."

"Habitats. Planets. Life cycle of a plant. Space. He learns something at each session."

"My son is very interested in space and planets so has particularly enjoyed learning more."

Feedback collected at the end of each year from participants align with adults' testimonials that topics on space have been well received and memorable:

"Learned about science e.g. gravity"

"I learnt that landing on Mars is impossible as a human."

"I learnt that people going to Mars can take 60% of the [bad] radiation they can handle in their whole life."

"Minecraft is good for teaching physics; links between game and real world"

"I have learnt lots about Mars"

When asked what topics they would like in the future, those related to space – particularly exploration and survival – were a popular request.

## Conclusion

The computer game Minecraft provides a method for CYP to visualise the world outside our planet. Use of the game in Science Hunters educational sessions, in combination with topic introductions, enables CYP to understand more about the nature of space, how it works, and how it is explored and studied. Topics related to space are popular with session participants, and feedback data indicate that they subsequently feel that they have learnt about the space topic, and created positive associations with them.