**The Mars Question: to what extent can Curiosity and Interdisciplinary Learning Help More Children to engage and connect with STEM?**

This project addresses two challenges for STEM and STEM education: many children enjoy practical science but can’t imagine working in science and further, some children feel out of place in the classroom and are avoiding going to school. We respond by helping children build their sense of belonging to school AND connect to science through their existing subject preferences and interests —art, music, storytelling, technology—using interdisciplinary learning as a bridge to collaboration and belonging.

**The project uses an Epistemic Insight pedagogy** to deepen children's understanding of how science works, that science has strengths and limitations and how science and other disciplines and professions ‘team up’ to build a fuller understanding;

The resources include hands-on science and an online interactive – and collectively support teachers in helping children explore the scenario of preparing a team of astronauts to live on Mars.

The first step is a hands-on activity in the classroom – drawing attention to the role of observation in science. We then introduce the Epistemic Insight Discipline Wheel, guiding children to explore how different disciplines contribute to the big question “How do we prepare to live on Mars?” As they delve into each discipline in turn, children see not only *what we know*, but also *how we know it*, *and what it’s like to think like an expert in that discipline.* This leads into Astronaut Training, where children collaborate, create wearable tech, and imagine future roles—scientists, artists, engineers—on a Mars mission.

Most importantly, the project aims to help every child recognise that “people like them” have vital roles to play in shaping our shared future. Whether they love drawing, enjoy counting, are curious about the past, or like asking big questions, children discover their interests and strengths matter.

**Theory of Change –Building Engagement in STEM, enthusiasm for technology used wisely and a sense of Belonging in a Science-Orientated World**

* **Problems**: Children perceive science as a book of facts, especially where science is associated with closed 'recipe investigations'; they don’t see an opportunity for their interests and strengths to make a difference in science. Social anxiety and low self-esteem in STEM reduce students sense of agency and belonging.
* **Interventions**: hands-on that foster scientific curiosity, interactive that contextualises science in a multidisciplinary arena, design and creativity activities that connect children to science projects through their passions.
* **Outcomes**: Increased engagement in STEM, recognising that when it is used wisely – technology helps us make a better world, a stronger sense of belonging to a science-orientated world.

**Learning Objectives for Children (Teacher Input and Assessment Guide)**

**1. Recognising the Role of Observation in Science – and the limitations of science enquiry.**

* **Objective:** Children can explain that observation is central to scientific inquiry and that science can directly answer questions that suit its methods.
* Role of teacher: give children a practical hand-on activity in the classroom to experience for themselves “thinking like a scientist” and making observations. Share with children a PowerPoint that explains three ways scientists observe Mars - (telescopes, rovers, orbiters).
* Role of the interactive - emphasises that observation is at the heart of science and that that scientists are fundamentally observers of the natural world – this means that scientists can directly answer the question “Which planet is hotter, Earth or Mars?” and “Does Mars have liquid water on its surface,
* **Indicators of Success: Children**
	+ Can explain that observation is the ‘most important’ word when we think like a scientist.
	+ Can explain three ways that scientists observe Mars (telescopes, rovers, orbiters).
	+ Can explain that using observations, scientists can tell us which planet is hotter – Earth or Mars.

**1. Understanding the limitations of science and why we need Interdisciplinary Collaboration**

* **Objective:** Children can explain that science alone cannot answer a complex question – like how to prepare to live on Mars. It requires many different disciplines to work together to prepare a team to live on Mars.
* Role of game: By engaging with the Mars Discipline Wheel, children discover that complex challenges require collaboration across many fields – scientists observe Mars through telescopes and rovers, mathematicians calculate supplies needed, engineers design spacecraft, artists help us imagine life on another planet, and historians teach lessons from past explorations.
* Role of the teacher: encourage children and give other examples to help children distinguish between questions that science can answer directly and those it can only inform. Point them to why we need more disciplines than only science – eg now that we know Mars is dry and cold, a mission to Mars will need gardeners to create ‘green’ living spaces that work for people.
* **Indicators of Success: Children**
	+ Can name at least three disciplines involved in preparing to live on Mars (e.g., science, engineering, art, history).
	+ Can explain how each discipline provides essential knowledge to prepare to live on Mars.
	+ Can explain that as well as being a collaboration between the disciplines – this is also a collaboration between experts in those disciplines who must appreciate why the mission as a whole depends on each of the roles.

**3. Building their Personal Connection to a career in space-science – and sense of belonging in school science**

* **Objectives:** Children see how their preferred subjects and interests mean that they can collaborate on a project to prepare astronauts for Mars.
* Children are engaged and making individual contributions to class discussions
* **Role of teacher: Astronaut training activity in the classroom**
* **Indicators of Success: My Discipline, and how my discipline can influence our shared scientific future**
	+ The teacher calls out scholarly specialists eg “where are my scientists, where are my historians” and each child puts up their hand when they hear a specialist they feel connected to.
	+ They write or present how their discipline helps solve a challenge that helps us move to Mars.
	+ Optionally, they role-play as a specialist contributing to a Mars mission.

**4. expressing Identity and Belonging**

* **Objective:** Children can explain that people like them can help to direct the futures of science and society – and can tell the story of how by talking about themselves.
* **Indicators of Success:**
	+ Can explain how their preferred subject and personal interests (drawing, counting, reading about the past) – means they belong in a team preparing astronauts for Mars.
	+ Show increased confidence and enthusiasm about expressing their ideas, listening to others and participating in group activity.
	+ Explain that and why they enjoyed the activities (game and classroom) and what additions or changes they would like.

**Summary for Teachers**

* **Science focuses on observations and directly answers questions that suit its methods.**
* **Science alone cannot resolve complex questions – this need multiple disciplines.**
* **Children learn to recognise that different disciplines make different contributions to knowledge.**
* **Children identify which are their preferred disciplines – are you a scientist, a historian etc**
* **Children understand that their own subject choices and interests are a pathway to a career working with science and technology**

**How We Assess Progress: Learning Objectives by Activity**

Each activity is designed with clear learning objectives that support both disciplinary understanding and personal development. Teachers and researchers assess progress through observation, student outputs, and reflection prompts.

| **Activity** | **Assessable Learning Objectives** |
| --- | --- |
| *Hands-on science: Can water flow uphill?* | Explain that making and talking about observations is key to how we ‘think and work as scientists.’ |
| *Teacher-led presentation: How do observations help astronomers learn about Mars?* | Explain that astronomers use orbiters, rovers, and telescopes to get observations that help them to say whether there is water on Mars |
| *Interactive Discipline Wheel: How do we prepare to live on Mars?* | Explain that this is a ‘big question’ we cannot answer using science alone. Use the Interactive Mars explorer to explore how people with different jobs and interests work together to plan a mission to Mars.  |
| *Astronaut training* | Explain that creating and performing together helps people to notice each other and builds trust in the team. To explain that we can use technology to boost our creativity. Explain how technology can help a team of astronauts to coordinate their movements and become a stronger team. |
| *Wearables Workshop:* Fitband is a bracelet that detects movement (acceleration) and uses the data for a display or to change music. Students experiment with Fitband to create choreographed performance. | Explain that we can use technology to boost our creativity. Explain how technology can help people to notice each other and build trust in a team. Come up with design changes for Fitband to make it work for a new purpose or to extend how it works. Recognise that there are ethical questions to address when using Fitband – and that we need to be clear what data can be gathered and how it will be used. |
| *Mars or Wearables Poster Takeaway* | Add a personal touch to a wearable tech or a Mars mission project and explain how it works using ideas and experiences gained in the workshops. |

**Sample Questions and Expected Answers**

| **Activity** | **Question to Ask the Child** | **Sample Answer Showing Understanding** |
| --- | --- | --- |
| **Chromatography** | What did you observe is happening to the colours?  | “I observe that the colours are moving, carried by the water. |
|  | Which of these are key words for science – choose up to 3 (observation, experiment, explosions, labcoats, maps)Which of these is the most important key word for science observation, experiment, explosions, labcoats, maps)  | observation, experimentobservation  |
| **Astronomy Presentation** | How do scientists find out whether Mars has water on its surface?What makes this a good question for science. | “They use tools like rovers and telescopes to observe Mars.”“It’s a good question for science because we can work out an answer using observations”. |
| **Discipline Wheel** | Why do we need more than one discipline to answer a question like, can we live on Mars? | “Because this is a big question – and artists, engineers, and others can help in different ways.” |
| **Wearables Workshop** | How did your discipline help your team design something for Mars? | “I like music, so I helped design a wearable that uses rhythm to help astronauts move together.” |
| **Mars Poster Takeaway** | What did you learn about your role in the Mars team? | “My favourite subject is art, and I saw how it can help with designing things for space — it was fun to see how art can help.” |

**Pre and Post Survey with Multiple Choice**

| **Q#** | **Question** | **Options** | **Activity that supports progress** |
| --- | --- | --- | --- |
| 1 | Which of these are key words for science – choose up to 3 Which of these is the most important key word for science  | Observation (correct), experiment (correct), explosions, labcoats, maps Which of these is the most important key word for science observation (correct), experiment, explosions, labcoats, maps) | Chromatography, Astronomy Presentation |
| 2 | Can science answer every big question on its own? | A. Yes, science knows everythingB. No, science needs help from other disciplines (correct)C. Only if scientists are very cleverD. Yes, with enough experiments | Astronomy Presentation, Discipline Wheel |
| 3 | Which of these explains what is a discipline – like science? | A. it’s rule you must followB. it’s a type of foodC. It’s a way of finding out about the world (correct)D. it’s a beaker | Discipline Wheel |
| 4 | Why do we need more than one discipline to answer “Can we live on Mars?” | A. Because Mars is very far awayB. Because different disciplines can tell us different things (correct)C. Because science is boringD. Because astronauts need food | Discipline Wheel, Wearables Workshop |
| 5 | What is your favourite subject or discipline? | A. ScienceB. ArtC. MusicD. [Open choice – child selects] (correct if child names a discipline) | Discipline Wheel |
| 7 | Do you think people like you can help solve big questions in the future? | A. No, only scientists canB. Yes, everyone has something to offer (correct)C. only if you know how to swimD. Only adults can help | Mars Poster Takeaway |

This questionnaire is designed to gather teacher feedback following the intervention.. Please answer each question based on your observations and experiences. Please skip any questions you don’t want to answer

**Teacher Survey – Epistemic Insight CPD Session**

Thank you for attending today’s CPD session on the Discipline Wheel and Epistemic Insight. This survey helps us understand how the session supports your teaching practice and addresses key learning objectives from our project. Your feedback will guide future CPD design and research.

**Participant Information and Consent**

This section explains your rights and how your data will be used.

* ☐ I consent to participate in this research evaluation
* ☐ I would be willing to complete a follow-up survey in 3 months' time

**Section A: About You**

This section helps us understand your teaching context.

* **A1.** How many years have you been teaching?
* **A2.** Which age range do you currently teach?
* **A3.** What type of school do you work in?
* **A4.** How would you describe your school's location?
* **A5.** Which subjects do you regularly teach?

**Section B: CPD Session Experience**

This section gathers feedback on the session’s delivery and content.

* **B1.** How would you rate today's session overall?
* **B2.** Which parts of today's session did you find most valuable?
* **B3.** How clearly was the Discipline Wheel concept explained?
* **B4.** How useful do you think the Discipline Wheel will be for your teaching?
* **B5.** Give some examples of what you learnt that strike you as important (open)

**Section C: Confidence and Implementation**

This section explores your confidence in applying what you learned.

* **C1.** How confident do you now feel about implementing the suggested lessons?
* **C2.** How likely are you to use the Discipline Wheel approach in your teaching over the next term?
* **C3.** Which disciplines would you most like to integrate using the Discipline Wheel approach?
* **C4.** What if any are the barriers to implementing these approaches in your classroom?

TEACHER POST INTERVENTION:

Three months later – follow up

Can you say something about school? (eg size, character, social and environmental setting, challenges, ethos,  proportion of children who are on FSM)

Overall did anything surprise or interest you about the project and children's reactions?

How valuable was this project for children’s learning - please score from very (5) to Not at all (0): 5, 4, 3, 2, 1

the project includes a hands-on science activity to teach about observation in science. – if you used this activity -

Overall did anything surprise or interest you about the activity and children's reactions?

How valuable was this activity for children’s learning - please score from very (5) to Not at all (0): 5, 4, 3, 2, 1

If you chose not to use the activity, why not?

2. The project uses an Interactive to explain how different disciplines help us to prepare a mission to Mars – if you used this activity -

Overall did anything surprise or interest you about the activity and children's reactions?

How valuable was this activity for children’s learning - please score from very (5) to Not at all (0): 5, 4, 3, 2, 1

If you chose not to use the activity, why not?

3. the project recommends asking children to put their hands up to identify with different areas of scholarship eg “where are my historians, where are my scientists” – if you used this activity -

Overall did anything surprise or interest you about the activity and children's reactions?

How valuable was this activity for children’s learning - please score from very (5) to Not at all (0): 5, 4, 3, 2, 1

If you chose not to use the activity, why not?

4. Children helped to design 'astronaut training' to explore how adults with different jobs and interests work together. – if you used this activity -

Overall did anything surprise or interest you about the activity and children's reactions?

How valuable was this activity for children’s learning - please score from very (5) to Not at all (0): 5, 4, 3, 2, 1

If you chose not to use the activity, why not?

Any comments?

5. Follow up posters – the project recommends that children can make posters about planets and wearables to help children express their ideas and see that they can contribute to STEM – if you used this activity -

Overall did anything surprise or interest you about the activity and children's reactions?

How valuable was this activity for children’s learning - please score from very (5) to Not at all (0): 5, 4, 3, 2, 1

If you chose not to use the activity, why not?