Your Mission
MARS DIARY

ACTIVITY 4.4
SPACE LAB

From the Chapter Four of the Mission Mars Diary

marsdiary.org/activities/space-lab

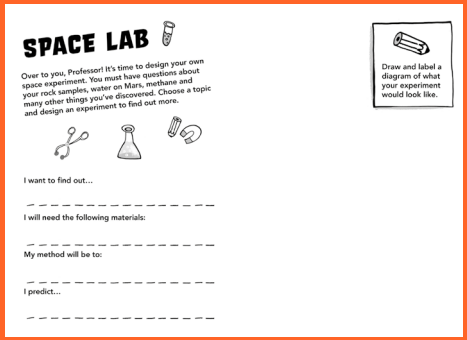
LEARNING LEVEL

KS2, P5-7, Y4-6

CURRICULUM LINKS & DIFFERENTIATION IDEAS

View detailed curriculum links for England, Scotland, Northern Ireland and Wales in the Teacher Toolkit, plus differentiation ideas for your region and year level.

marsdiary.org/resources/#teacher-toolkit


SPACE LAB

Over to you, Professor! It's time to design your own space experiment. You must have questions about your rock samples, water on Mars, methane and many other things you've discovered. Choose a topic and design an experiment to find out more.

I want to find out...

I will need the following materials:

My method will be to:

I predict...

Draw and label a diagram of what your experiment would look like.

Resources Required

- There are plenty of video and internet resources that can provide children with additional information about the presence of methane on Mars. This link https://www.youtube.com/watch?v=-0K1jkLZiZQ from Space@Nasa provides child-friendly information of methane on Earth and Mars if children have not completed previous activities.
- Workbook
- Drawing equipment

Background to this Activity

Designing an experiment to test a hypothesis is a fundamental part of scientific enquiry. This chapter builds up to this concluding challenge by laying the foundations for students to investigate the presence of methane on Mars. To finish this chapter, they must consider how they find out where – or whom – it was coming from!

Methane is an organic molecule present in gaseous form in Earth's atmosphere. More than 90% of methane on Earth is produced by living organisms. Methane has already been detected on Mars, which is why scientists believe that there may be alien life on the Red Planet. But methane can be produced in more than one way. On Earth, scientists discovered microbial life living 2-3 kilometres beneath the surface of the Witwastersrand basin in South Africa. These microbes produced methane. If similar microbes lived beneath the Martian surface, it would explain the presence of methane on Mars. Alternatively, the methane could have been produced by microbes which lived on Mars millions of years ago, and is being released into the atmosphere today as the surface temperature and pressure changes, which would indicate that there was once life on Mars.

But methane can also be produced inorganically or geologically, by hot springs or volcanoes, and this does not indicate that life once existed. The methane may have been produced millions of years ago but was trapped below the surface for a long time. Certain chemical reactions are possibly taking place under the Martian surface to produce methane, which is then released into the atmosphere.

Confirming the presence of methane on Mars is one of the goals of the ExoMars Mission. The ExoMars Trace Gas Orbiter, which was launched on 14 March 2016 and reached Mars seven months later, is measuring and mapping methane and other gases on Mars. When the ExoMars rover arrives on the Red Planet in 2020, it will look for signs of life by drilling into Martian rock. This will help scientists discover whether the methane has been produced biologically or geologically.

Researchers propose three hypotheses to explain observed methane peaks of seven parts per billion measured by the Curiosity rover in Gale Crater, which is 10 times higher than background values. The neat thing is that the hypotheses are testable.

The first hypothesis suggests that the soil in Gale Crater absorbs methane when dry and releases it to the atmosphere when the relative humidity in the Martian soil is high enough for perchlorate salts to attract water vapour from the atmosphere and dissolve in that water. The second hypothesis – the most exciting one – suggests that microbial life on Mars is the cause, and that microorganisms convert organic matter in the soil to methane when the microbes are in liquid solutions. The third hypothesis is that the bursts of methane are produced by deep subsurface aquifers.

Fortunately, the Curiosity rover should be able to find out which explanation is the most likely one. If either of the first two hypotheses are right, the methane variability is seasonal and should repeat every year. The methane abundance should peak in early winter if it's due to inorganic adsorption; if it's biological in origin, it should peak in late winter. And sporadic spikes would favour

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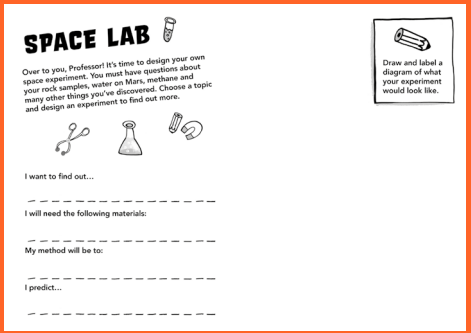
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the third hypothesis. Of course, there could be other explanations not considered by the authors.

Running the Activity

Ensure that children understand that scientists have already proved the presence of methane on Mars.

Discuss – with appropriate video resources – the different hypotheses about where the methane is coming from on Mars.

Allow children time to discuss in pairs/small groups how they would go about investigating where the gas is coming from.

Give children time to share their ideas – this could be done using think/pair/share or by selecting individuals to explain their ideas to the class.

Remind children of the three hypotheses and ensure they can match a prediction to their experiment.

Give time to complete the planning sheet – children should be encouraged to label their diagram and be able to explain their experiment.

Questions for the Class

- How is methane produced on Earth?
- How have scientists concluded that methane is present on Mars?
- Where do scientists think the methane on Mars is coming from?
- How do scientists plan to investigate where the methane on Mars is coming from once ExoMars arrives in 2010?
- What conclusions can be drawn from the fact that there is methane on Mars?

Additional Challenges / Extension Activities

When working scientifically, more able pupils should be given the opportunity to work more independently to draw their own conclusions.

These pupils could be given time to research any of the following aspects in order to better understand the scientific process:

- How scientists plan to investigate methane using ExoMars
- The ecological problems caused by methane on Earth
- The type of data gathered by space probes and rovers
- How space probes and rovers communicate with centres back on Earth
- Other space probes and rovers

Ideas for Differentiation

Lower:

Some children will need additional support and may benefit from being placed in adult-supported groups when discussing initial ideas.

Children could be given a series of options from which they could select the most appropriate when designing their own experiment.

Some children, who may struggle to design their own experiment, could be given a series of planned experiments alongside explanations of the three hypotheses of where the methane is coming from. They would then match up the experiments and the hypotheses and explain their reasoning.

Upper:

More able pupils may benefit from forming groups with equally able children with whom they can discuss more complex ideas when designing their experiment.

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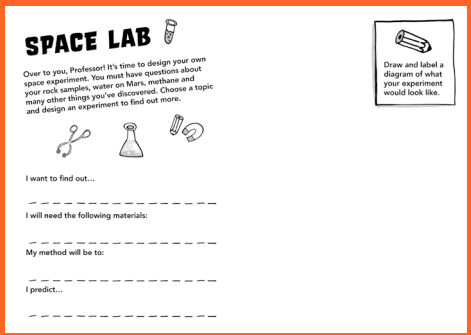

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Useful Links

The filmed interview with John Grotzinger – a Curiosity project scientist – that appears in this article (published in 2014) about the research conducted by NASA's Curiosity rover, explains why methane is of interest to scientists, and what future missions (i.e. ExoMars) might do: https://www.space.com/28019-mars-methane-disovery-curiosity-rover.html

ESA clip from 2016 explaining how the ExoMars mission will research the presence of methane. Please note that the year given for the rover's arrival in this clip is 2018, however the rover will now arrive on Mars in 2020. This clip includes an animation of the rover collecting rock samples: https://www.youtube.com/watch?v=SvKUe_q0ZC4

Find more great space-themed STEM resources at https://www.stem.org.uk/esero