Your Mission MARS DIARY

ACTIVITY 3.1
WEATHER ON MARS

From the Chapter Three of the Mission Mars Diary
marsdiary.org/activities/weather-on-mars

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.

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WEATHER ON MARS

The weather on Mars is very different to Earth, so you'd better be prepared! Create a weather report showing a day on Mars and make sure it's colourful and visual to help your crew understand the conditions they'll be facing.

Hi explorers,

I'm Stephen Lewis and I study the weather on Mars. I've collected 24 hours of data from the Curiosity rover on Mars. Use it to create an infographic.

Can you include some comparisons to the weather on Earth?

Zap for Mars weather data

Resources Required

- Smartphone or device for Zap code (optional – see Useful Links)
- Square paper

Background to this Activity

In this activity, students will think about what weather is and how is occurs. They will learn that only planets with atmospheres have weather. Students will also have to think about how we forecast the weather on Earth and what sort of information is made available to allow humans to plan their activities. Why do we need to know what the weather will be like and how does this change for different planets?

Even though Mars is called the Red Planet, it's much colder than Earth. This is because it's further away from the sun than Earth and also because its atmosphere is much thinner than Earth's, so it isn't able to trap the sun's heat the way that Earth's atmosphere can.

There's no rain on Mars because of the low temperature and pressures. This doesn't mean there's no precipitation though. Water can only exist on Mars as vapor or ice. Thin clouds do form in the atmosphere and precipitation falls in the form of snow. The snow that reaches the Martian surface is primarily carbon dioxide snow, but small traces of frozen clouds carrying water have been observed in Mars's upper atmosphere in the past, and these have produced snow at high altitudes. This snow however didn't reach the Martian surface.

Mars has annual dust storms which are sometimes so large they can be seen through telescopes on Earth. These storms cause problems for robots on Mars, often covering the solar panels of robotics with dust and jeopardising their energy supply. Dust also gets into the machinery, which can affect its functionality. Sometimes the high-speed wind creates 'dust devils'.

Running the Activity

Watch a local weather report from the BBC website (found in the weather section). Discuss why it is important that we know what the weather will be like. Ask the children to discuss in pairs or as a small group the features of the report. How is the weather presented? Make a whole class list of the different weather features mentioned in the report (e.g. temperature, sun, wind, rain, fog, snow, storms). Explore how these phenomenon are formed.

Can any of the children predict what the climate might be like on Mars? Encourage the children to consider the effects of:

- Mars's position from the Sun
- The thinner atmosphere

Use the Zap code to access the Martian weather data and share it with the children. Make observations about the data. Explain how the low temperatures influence the weather on Mars. There is no rain, but there are clouds made of water vapor. They can produce snow which doesn't reach the planet surface. Winds create dust storms which can be seen by telescopes on Earth.

Give the children the choice to produce a bar graph (histogram) or a line graph based on the information. They can then include further details to create a colourful and visual weather report for a day on Mars.

Questions for the Class

- Where does weather come from?
- Why is collecting weather data important?
- How is weather data collected from Mars?
- What is the most effective method of presenting the weather data?
- Can you explain the differences between the weather on Earth and Mars?

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LEARNING LEVEL

KS2, P5-7, Y4-6

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- How do these weather conditions affect the ExoMars rover?

Additional Challenges / Extension Activities

Annotate the graph with observations on the data.

Research different weather conditions around the globe. Identify reasons why they vary.

Prepare and film a TV weather report for Mars (optional – use a green screen and project an image of Mars as a backdrop).

Create a poster all about the climate of Mars.

Ideas for Differentiation

Lower:

- Prepare axis for the children to produce a bar graph.
- Using a word bank, write a weather report for Mars.
- Create data 'buckets' by banding data into the following ranges, for example: 0-10 degrees, Minus 1 - minus 10 degrees, Minus 11-minus 20 degrees
- To simplify as much as possible, group data into no more than seven 'buckets'.
- Highlight to children that temperatures are often represented in colour on weather maps or reports using sequential/diverging colour scales, where colours represent numbers (e.g. https://www.e-education.psu.edu/geog486/node/1867). Ask them to devise their own colour chart, allocating a colour to each 'bucket'.

Upper:

- Choose the best method for displaying the data collected- bar graph or line graph.
- Allow the children to conduct further research into the climate of Mars to include in their reports
- Write a weather report for Mars.
- Discuss how different pars of an infographic can be represented by different: Colours, Sizes, Shapes, Textures
- Ask children to draw another weather report using one of these alternative methods of data representation.

Useful Links

Zappar Content: Download or view the Zappar content for this activity on its webpage (URL to the left) or access it via the Zap.

Daily weather reports from Curiosity available @MarsWxReport on Twitter and on http://cab.inta-csic.es/rems/en/weather-report-mars-year-33-month-11/#slide-to-main

Animated clip by NASA about climate on Mars: https://youtu.be/wObc1LlFALk

ZAP! Students can independently access multimedia resources using the Zappar mobile/tablet app. See Zappar instructions at the link below and note that the mobile/tablet will need to be on a WIFI connection: marsdiary.org/resources/#teacher-toolkit

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Your Mission MARS DIARY

ACTIVITY 3.2
BREAKING NEWS

From the Chapter Three of the Mission Mars Diary
marsdiary.org/activities/breaking-news

LEARNING LEVEL

KS2, P5-7, Y4-6

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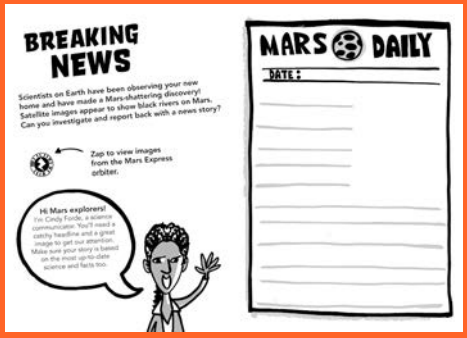

Resources Required

- Smartphone or device for Zap code (optional – see Useful Links)
- Microscopes, Petri dishes or slides, rocks, water samples, newspaper report writing frames, pens, paper

Background to this Activity

The discovery of water on Mars gives scientists their clearest sign yet that there may be life on Mars – both now and in the past. Students will need to think about the Martian past and how the planet has changed over time as well as considering the importance of water to life and why scientists believe water is such a key part of discovering life on another planet.

Scientific evidence suggests that 4 billion years ago, Mars was a green planet like Earth. This means it would have had an atmosphere similar to Earth's. Scientists are now looking for evidence that there was – or is – life on Mars, which is one of ExoMars's primary objectives. ExoMars will collect rock samples which scientist will study for signs of life.

NASA's MAVEN spacecraft, which is orbiting Mars and collecting information about the Martian atmosphere. This will help scientists understand why Mars's atmosphere changed, turning it from a green planet to a frozen desert.

Running the Activity

Open the lesson with a drama – teacher announcing that water has been found on Mars! Can you now investigate and find out more?

Children should have background knowledge about how water is essential to life and what water is used for on Earth. Revise this information and discuss why it is such a big discovery that water has been discovered on Mars.

Carry out experiments in stations so that all children get to experience all activities:

- Water from 'Mars' on a Petri dish to be investigated under microscope
- Rocks both dry and wet to look at under the microscope
- Compare dried fruit to normal fruit – a bit like how Mars is now that the water has all gone from Mars.

Children can talk about their findings in groups.

Discuss what could have happened to Mars for its atmosphere to have changed. Children could make suggestions about what life on Mars would have looked like bacteria, plants, animals.

During literacy time children could be looking at newspaper reports and their basic features. Have the discovery of water as a newspaper headline and ask children to write a newspaper report about it, including their findings when looking through the microscopes. These could be redrafted and displayed on the wall.

Questions for the Class

- Why is water essential to life?
- What things do we use water for?
- How do different living things depend on water?
- What could have happened for Mars to have changed to become a frozen desert.
- What did you see in your experiments?

Additional Challenges / Extension Activities

Heat/freeze water to see it change state. How could this help us to discover what happened on Mars?

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ACTIVITY 3.2
BREAKING NEWS

From the Chapter Three of the Mission Mars Diary
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LEARNING LEVEL

KS2, P5-7, Y4-6

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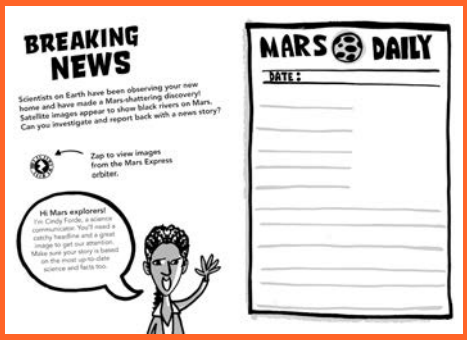

Ideas for Differentiation

Lower:

- Children could be guided through observations and given pointers of what to look for like organisms, marks that running water might have made on rocks and the effects of removing water from fruit like in dried fruit. Would the same effect be seen in water removing from a planet?

Upper:

- Children could research what they have seen through their microscopes.
- Children could collect water from different sources to look at under the microscopes.
- Children could also find out about how deserts are formed on earth and think about how this could apply to other planets.

Useful Links

Zappar Content: Download or view the Zappar content for this activity on its webpage (URL to the left) or access it via the Zap.

Based on research conducted by NASA's MAVEN spacecraft, this clip shows the evolution of Mars from a green planet 4 billion years ago to the frozen desert we know today: https://youtu.be/sKPrwY0Ycno The spacecraft shown at the end of the clip is MAVEN.

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Your Mission MARS DIARY

ACTIVITY 3.3
MIGHTY MONS

From the Chapter Three of the Mission Mars Diary
marsdiary.org/activities/mighty-mons

LEARNING LEVEL

KS2, P5-7, Y4-6

CURRICULUM LINKS & DIFFERENTIATION IDEAS

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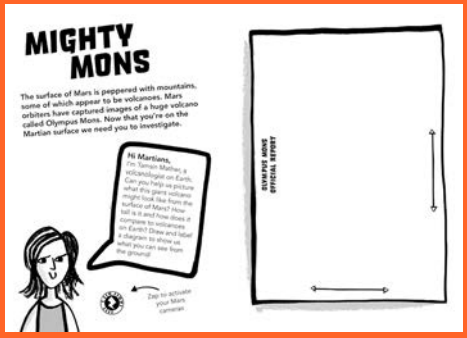

Resources Required

- Smartphone or device for Zap code (optional – see Useful Links)

Background to this Activity

This activity introduces students to the study of rock formations and how a planet is shaped by the presence of geological features. By creating a diagram of a volcano, students will familiarise themselves with the impact that landscape has on the potential for life. It also challenges students to interpret an image from above and recreate it as seen from the ground.

The Martian surface is very rocky. Its highest mountain is Olympus Mons, which is also the highest known volcano in our solar system. It is approximately 25 kilometres high, which is more than twice the height of Mount Everest, rising to 8.848 kilometres, or Hawaii's Mauna Kea – Earth's tallest volcano – which rises almost 10 kilometres above the sea floor, although only 4.2 kilometres of it is above sea level.

Olympus Mons stretches across about 600 kilometres in width, which is roughly the size of France!

On Earth, most volcanoes are formed by the movement of tectonic plates. Magma from within the Earth works its way up to the surface, where it erupts in the form of lava and ash deposits. Some volcanoes, like those in Hawaii, form where there is a hot spot in the Earth's mantle under the crust. These form chains of volcanoes as the crust moves over the mantle hot spot below.

There are no tectonic plates on Mars, which means Olympus Mons was formed in a similar way to Hawaii: from a hot spot. On Earth, the movement of tectonic plates prevents a steady build-up of lava, resulting in eruptions which create small islands as the plate drifts across a hot spot. On Mars, the hot spots and the planet's crust don't move, which means that chains of volcanoes don't form – lava flows to the surface and continues to pile up, forming one huge volcano. Olympus Mons is a shield volcano. It was formed by lava slowly flowing down its sides, which means it has a low, squat appearance, with sides that are at an average incline of five percent only.

Olympus Mons has taken about 3 billion years to form but it is still a relatively young volcano compared to the age of the solar system (4.5 billion years). This means that it may still be an active volcano, with the potential to erupt, although we have not seen any evidence of active volcanism on Mars today.

Running the Activity

Explain to children that they will be drawing a diagram of Olympus Mons as it would look from the surface of Mars. Look at the satellite photos provided and ask them to identify any interesting features, such as how this volcano compares to volcanoes on Earth. Students may notice how wide and flat the volcano is compared to the pointy, high volcanoes we are used to seeing. Discuss why this might be in relation to tectonic plates and hot spots (as explained above).

Examine the size of the volcano from above and compare to France, Italy, Arizona – all comparable in size. If working digitally, use Google Earth or something like this: http://brilliantmaps.com/olympus-mons-v-france/. You might also find it helpful to demonstrate the size using props in the classroom – two balls, one about double the size of the other: to show Earth (bigger) and Mars (smaller). Overlay a piece of paper the size of France on both balls to show just how much land mass the Olympus Mons takes up.

For the front-on view, ask students to research Olympus Mons and collect data that will help them draw their picture. They will need to find out how high it is, and compare that to a mountain on Earth (e.g. Mount Everest). They will also need to note any physical characteristics they can find out.

Your Mission MARS DIARY

ACTIVITY 3.3
MIGHTY MONS

From the Chapter Three of the Mission Mars Diary
marsdiary.org/activities/mighty-mons

LEARNING LEVEL

KS2, P5-7, Y4-6

CURRICULUM LINKS & DIFFERENTIATION IDEAS

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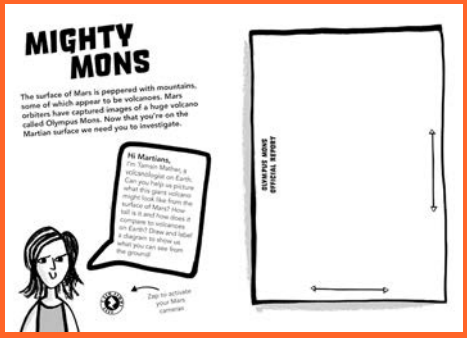

Ask students to create an image in their books of Olympus Mons. These can be drawn or created using collage. Different paper, cut out and overlaid, would show a nice comparison between Olympus Mons and Mount Everest.

Questions for the Class

- How are volcanoes formed?
- How are hot spots formed?
- What is the difference between active, dormant and extinct volcanoes?
- How can we tell if a volcano is active, dormant or extinct?
- Where are there active volcanoes on Earth? When was the last eruption?

Additional Challenges / Extension Activities

Olympus Mons is the highest known volcano in the solar system, but what is the highest known mountain? Ask students to research and present their findings.

Answer: Rheasilvia, on the protoplanet Vesta in the Asteroid Belt, is a mountain (non-volcanic) just a few hundred metres taller than Olympus Mons.

Ideas for Differentiation

Lower:

- Overlay a grid on the page and create a four figure grid for scale.
- Create a model of their drawing that is five times the size. Calculate height and width x 5.

Upper:

- Overlay a grid on the page and create a four figure grid for scale.
- Create a key, using symbols to explain the features on the map.
- Create a model of their drawing and a larger scale, calculated based on a suggested ratio (e.g. 5:1).

Useful Links

Zappar Content: Download or view the Zappar content for this activity on its webpage (URL to the left) or access it via the Zap.

Five-minute clip about super volcanoes on Mars, produced by Nature Video: https://www.space.com/35528-mars-volcanoes-2-billion-years.html

Image of Olympus Mons vs Arizona: https://img.purch.com/h/1400aHR0cDovL3d3dy5zcGFjZS5jb20vaW1hZ2VzL2kvMDAwLzAyNi84OTYvb3JpZ2luYWwvb2x5LWF6LmpwZz8xMzYyNzgwMTg0

Image of Olympus Mons vs France: http://brilliantmaps.com/olympus-mons-v-france/

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Your Mission MARS DIARY

ACTIVITY 3.4
DESIGN YOUR MARS ROVER

From the Chapter Three of the Mission Mars Diary
marsdiary.org/activities/design-your-mars-rover

LEARNING LEVEL

KS2, P5-7, Y4-6

CURRICULUM LINKS & DIFFERENTIATION IDEAS

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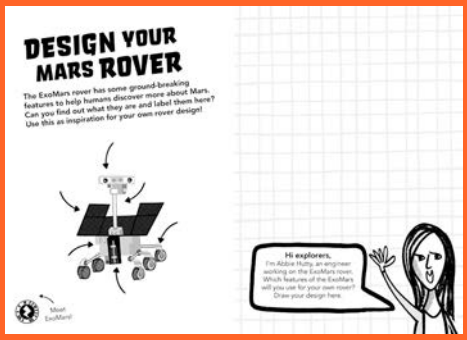

Resources Required

- Smartphone or device for Zap code (optional – see Useful Links)

Background to this Activity

In this creative and technical design challenge, students will have to think about what functions they require a rover to deploy while working together on the surface of Mars. Students will have to consider the differences between human and robotic exploration – and think about the strengths and weaknesses of both kinds.

The ExoMars rover, which is being developed by the European Space Agency, will travel to Mars in 2020 to look for signs of life. It will collect samples with its drill and will analyse them, sending data and information back to Earth. Unlike the rovers currently on Mars, the ExoMars rover is capable of both moving across the Martian surface and studying Mars in depth. It will be able to establish the physical and chemical properties of Martian samples, including those below the surface of the terrain.

The drill on ExoMars can reach a depth of two metres. Once a sample is collected, it will investigate the minerals and chemicals in the sample, using its analytical laboratory.

The rover uses solar panels to generate power, and is designed to withstand the cold conditions on Mars. It has six wheels which can pivot independently, to help it move across the rocky terrain. It also has a camera system, so that scientists on Earth can help it locate the best sites for drilling.

Running the Activity

Watch the ESA clip (see Useful Links). Working in small groups, make some notes on the design of the ExoMars rover and how it functions on the surface of Mars. Feed these group ideas back to the whole class.

Explain to the children that they are going to label the different parts of the ExoMars rover and consider why the rover needs them. Review each part using the information below (see Solutions to Activities). Explain to the children that they are going to think about designing their own rover. First of all they need to consider what role it will take:

- To collect rocks from the surface
- To drill into surface to take deeper samples
- To monitor weather conditions (in planets with atmospheres)
- To measure temperatures and atmosphere composition below/above surface
- For observation
- To search for extraterrestrial life

Once the children have decided on their rover's purpose they can consider the necessary design features (e.g. power, movement, information collection).

Solution to the Activity

Parts of the ExoMars rover:

- Solar array panels to produce all the energy I need to recharge my batteries. There are no plug sockets on Mars!
- Body – My body is a completely sealed box so that all my instruments and computers are kept warm and protected from the Martian environment like cold temperatures and sand.
- Pivots – Each pair of my wheels is attached to a pivot so that all my wheels stay touching the ground even while I drive over rocks and through gullies.
- Cameras – Two cameras let me see where I'm going.

Your Mission MARS DIARY

ACTIVITY 3.4
DESIGN YOUR MARS ROVER

From the Chapter Three of the Mission Mars Diary
marsdiary.org/activities/design-your-mars-rover

LEARNING LEVEL

KS2, P5-7, Y4-6

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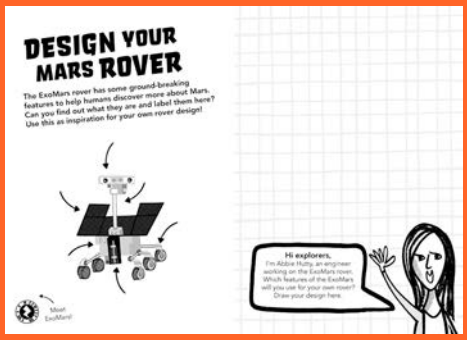

- Long neck
- Wheels
- Drill

Questions for the Class

- What parts can you see on the ExoMars rover?
- How do the different parts make the rover effective?
- What role does your new rover have?
- What parts do you think any rover would need?
- Can you explain why certain features have been chosen? Why is your rover suited to Mars?

Additional Challenges / Extension Activities

Make a 3-D model of the rover design. You could incorporate electronic including lights and motors.

Explore how rover designs have developed over time as more missions have been sent to Mars.

Investigate how the rover might need adapting to visit other planets.

Ideas for Differentiation

Lower:

- Write instructions on how the rover works
- Annotate design sketches

Upper:

- Write an explanation about how the rover works
- Develop design sketches using exploded diagrams and cross section drawings
- Sketch a range of alternative ideas before selecting the best option

Useful Links

Zappar Content: Download or view the Zappar content for this activity on its webpage (URL to the left) or access it via the Zap.

Interactive diagram of NASA's Mars rover 'Curiosity': https://mars.jpl.nasa.gov/msl/mission/rover/

ESA clip showing animation of ExoMars collecting rock samples, and also the Martian terrain: https://youtu.be/SvKUe_q0ZC4?list=PLbyvawxScNbvS4TUXFpaxXwUgzZUd7Pzx

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