Intended Use of Resources

This project has been designed so that teachers from different STEM areas can pick and choose sections relevant to their subject area to work on. All activities in this package do not need to be completed to get value from the package – each activity can be completed as a stand-alone or can be approached, as a team, as a larger project. The package has potential to be extended into a much longer project to include curriculum points from different STEM subjects.

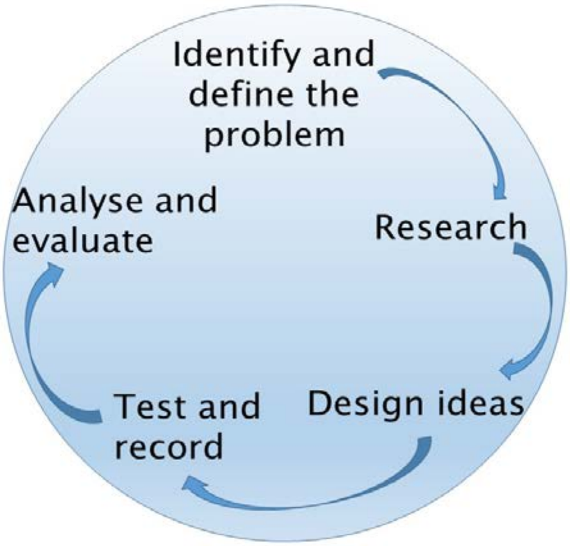
There are three **student workbooks - Open, Guided and Scaffolded,** that go along side this resource; all have the same suggestions for activities, however they have been written and edited to provide differentiated learning options to support good teaching practice**.** Teachers may pick and choose which versions they give which students, and may wish to edit them further to address their learning needs. Due to the differentiation of the workbooks, the **Open** activities will enable more syllabus links to be addressed, which is why each activity has its own syllabus links key. However, if you wish to give a truly open-ended investigation then you could just give the students the challenge and background information section of the Student Workbook.

The Woodside Australia STEM Project aims to be accessible and supportive for teachers and students, please contact us if you have questions, require assistance or would like to arrange an incursion or a professional development workshop - www.wasp.edu.au

Life on Mars – Teacher Resource

The Challenge

During the late 19th and early 20th centuries, it was believed by some that there were "canals" on Mars, this implied intelligent beings were living on the planet. This was found to be untrue as technology advanced and we were able to get more detailed pictures of the Martian surface. These pictures showed no evidence of infrastructure, however, many scientists believe there is other evidence to suggest there once was, and possibly still is, life on Mars.
The student challenge is to investigate factors which might help us to plan a mission to Mars, in search for life.



Background Information

Mars is our neighbouring planet and has some similarities to Earth. Like Earth, it is a rocky (terrestrial) planet and a Martian day is also only very slightly longer than an Earth day (24 hours and 37 minutes). However, there are also lots of important differences.

Earth's average distance from the Sun is 151.64 million kilometres, whereas for Mars it is 212.39 million kilometres. This means that the Sun's rays are weaker and the average temperature is markedly cooler. The diameter of Mars is also nearly half that of the Earth. Due to its size it also has a lower gravitational pull, and this is part of the reason it has a very thin atmosphere.

NASA started Mars exploration in 1960 with an attempted Mars flyby using Marsnik 1 (https://nssdc.gsfc.nasa.gov/nmc/spacecraft/display.action?id=MARSNK1).This attempt failed and it wasn't until the Mariner 3 mission in 1964 that NASA had their first successful flyby of Mars, sending back images of the Martian surface to Earth. Since then there have been numerous failed and successful missions, which have helped scientists learn more about the red planet.

Sometimes we get lucky and we don't even have to fly to Mars to get samples of the planet as many Martian meteorites have been found on Earth. These meteorites help us understand more about the composition of the planet and can provide evidence of life. One very famous meteorite is the Alan Hills 84001 meteorite, which was found in Antarctica in 1984. You can see from the image below it looks like it contains worm-like bacteria. The chemistry of the rock initially indicated that there could be biological traces, however, it was very unclear if this could have been from its time on Earth's surface. Current thinking is that the structures are chemical and not biological, although there are still some scientists who are sceptical about that.

Figure 1. Alan Hills 84001 Meteorite with worm like structures. ((NASA, 1996)

Life on Mars – Teacher Resource

Activities

This booklet contains extra information on each activity including syllabus links, the overall activity objective, suggestions for recommended equipment or alternative ways to run investigations as well as useful resources and website links. Please note that any reference websites provided in the entirety of our resource documents were current at the time of publication. Please advise if links are no longer accessible.

The syllabus links have been colour coded – please see the colour key below:

Covered in Scaffolded, Guided and Open student workbook
Covered in Guided and Open Student workbook
Covered in Open student workbook

List of Activities

An initiative supported by Woodside and ESWA

Life on Mars – Teacher Resource

Background Research

Objective

In this activity students will gain more understanding on what signs of life are and why it may be difficult to sustain life on Mars. Students will make comparisons between Mars and Earth and will start to realise that if there is life on Mars it would probably be simple and not easy to find.

Life as we know it needs an energy source and water to sustain it. Due to its size Mars has lost most of its atmosphere, which means it has no liquid water on its surface. However, there is evidence of water below the surface. The lack of atmosphere also makes the temperature of Mars much colder and means that harmful radiation can reach the surface. This makes it even harder for life to be sustained on Mars.

Subject area	Australian syllabus links
Science	ACSSU043 Living things have structural features and adaptations to survive in their environment. ACSSU078 The Earth is part of a system of planets orbiting around a star (the Sun)

Useful website:

- NASA website with facts about Mars
  https://mars.nasa.gov/all-about-mars/facts/
- Information on the temperature of Mars
  https://www.space.com/16907-what-is-the-temperature-of-mars.html
- Website for students about the signs of life
  https://www.bbc.co.uk/bitesize/guides/z9hyvcw/revision/1
- NASA website explaining the significance of the Goldilocks zone
  https://exoplanets.nasa.gov/resources/323/goldilocks-zone/

Chronology of Mars Exploration

Objective

In this activity, students will create an interactive timeline of successful Martian missions. The Open version of this activity gives the option of doing this digitally.
This activity focuses on research skills. It encourages students to focus on key information.
This activity also involves students working with scales, to ensure their timeline will fit on piece of paper without taking up too much space.
This could work very well as a group activity so that each student must research a few missions, dividing the task between them.
The Open activity also involves students calculating the fraction of successful missions completed, as well as discussing if there has been more success in missions with time.

Subject area	Australian syllabus links
Science	ACSSU078 The Earth is part of a system of planets orbiting around a star (the Sun) ACSHE083 Scientific knowledge is used to solve problems and inform personal and community decisions
Technologies	WATPPS29 Develop and communicate alternative solutions, and follow designs ideas, using annotated diagrams, storyboards and appropriate technical terms. WATPPS31 Develop negotiated criteria to evaluate and justify design processes and solutions ACTDIP016 Collect, store and present different types of data for a specific purpose using software. WATPPS27 Define a problem, and set of sequences steps, with users making a decision to create a solution for a given task WATPPS29 Develop and communicate alternative solutions and follow design ideas, using annotated diagrams, storyboards and appropriate technical terms. WATPPS32 Work independently, or collaboratively when required, to plan, develop and communicate ideas and information for solutions. ACTDIP020 Implement and use simple programming environments that include branching decisions) and iteration (repetition)

Life on Mars – Teacher Resource

Mathematics	ACMMG108 Choose appropriate units of measurement for length, area, volume, capacity and mass. ACMNA101 Solve problems involving division by a one digit number, including those that result in a remainder. ACMNA102 Compare and order common unit fractions and locate and represent them on a number line ACMSP119 Construct displays, including column graphs, dot plots and tables, appropriate for data type, with and without the use of digital technologies. ACMSP120 Describe and interpret different data sets in context ACMNA101 Solve problems involving division by a one digit number, including those that result in a remainder.

Useful website:

- Video explaining timelines for kids

  https://www.youtube.com/watch?v=o50HA6QTxj0

- How to create a timeline in PowerPoint
  Office Timeline

Martian Landings

Objective

Students will consider where might be the best location to land a rover on Mars to look for evidence of life.

This investigation allows students to consider the difficulties involved with landing a rover on Mars. They research how rovers have successfully landed on Mars in the past and why the landing site must be chosen very carefully. Rovers are usually covered in an inflatable sack that allows them to bounce until they finally settle. This means that they can end up far from the intended landing site (up to 1 km away). If the surface is sloping it could be even more – so they must find a flat site.

Rovers are very slow and only travel around 40 metres per day. This means it is important that they land close to any sites of scientific interest otherwise they may stop working before they manage to make it there.

Rovers are also powered by sunlight (solar panels). This means that it is best if they are located somewhere where they will get plenty of sun (near the equator and far from the poles). As you can see on Google Mars, this is where rovers have been in the past. Unfortunately, this is far from where there is evidence of water.

Students will use Google Mars to select their landing sites. In the Guided and Open booklets, students are required to explain why they have chosen these sites.

Subject area	Australian syllabus links
Science	ACSSU043 Living things have structural features and adaptations that help them survive in their environment ACSSU078 The Earth is part of a system of planets orbiting around a star (The Sun) ACSIS093 Communicate ideas, explanations and processes using scientific representation in a variety of ways, including multi-modal texts.
Design Technologies	ACTDEK019 How people address competing considerations when designing products, services and environments.

Life on Mars – Teacher Resource

Useful websites:

- NASA website explaining the conditions required for life to thrive
  https://mars.nasa.gov/programmissions/science/goal1/

- Information explaining what evidence of water/life could be
  https://spaceplace.nasa.gov/mars-spirit-opportunity/en/

- YouTube video and NASA website explaining more about how rovers land on Mars
  https://www.youtube.com/watch?v=XRCIzZHpFtY,
  https://spaceplace.nasa.gov/mars-sojourner/en/

- NASA website explaining how solar panels are used to provide energy for the rovers
  https://mars.nasa.gov/mer/mission/rover/energy/#:~:text=Rover%20Energy&text=The%20main%20source%20of%20power,sol%20(a%20Martian%20day).

- Google Mars (like Google Earth but on Mars)
  https://www.google.com/mars/

Parachute Design

Objective

The aim of this experiment is for students to investigate how the size of a parachute relates to the speed at which an object falls. This can then be related to landing a rover safely on Mars.
For the Scaffolded and Guided students, they are given a list of equipment and a method. The Open students must design their own investigation.
When evaluating the investigation students should consider variables which could affect the results such as: if they always dropped the parachute from exactly the same height; if the parachute was opened up before it was dropped; was there any wind that could move it?

Subject area	Australian syllabus links
Science	ACSIS231 With guidance, pose clarifying questions and make predictions about scientific investigations. ACSIS086 Identify, plan and apply the elements of scientific investigations to answer questions and solve problems using equipment and materials safely and identifying potential risks. ACSIS087 Decide variables to be changed and measured in fair tests, and observe measure and record data with accuracy using digital technologies as appropriate ACSIS090 Construct and use a range of representations, including table and graphs, to represent and describe observations, patterns or relationships in data using digital technologies as appropriate. ACSIS218 Compare data with predictions and use as evidence in developing explanations ACSIS091 Reflect on and suggest improvements to scientific investigations
Technologies	ACTDEK020 Forces can control movement, sound or light in a product or system WATPPS27 Define a problem, and set of sequenced steps, with users making a decision to create a solution for a given task WATPPS28 Identify available resources

Life on Mars – Teacher Resource

Mathematics	ACMMG108 Choose appropriate units of measurement for length, are, volume, capacity and mass. ACMSP118 Pose questions and collect categorical or numerical data by observation or survey ACMSP119 Construct displays, including column graphs, dot plots and tables, appropriate for data type, with and without the use of digital technologies.

Extremophiles

Objective

Students research the hazards for life on Mars and consider why it would be difficult for life to exist there. They research extremophiles (life that can exist in extreme conditions).

In the Open book, students are asked to discuss if any of these extremophiles might be able to survive on Mars and imagine what they think life on Mars could be like.

Subject area	Australian syllabus links
Science	ACSSU043 Living things have structural features and adaptations that help them to survive in their environment ACSSU078 The Earth is part of a system of planets orbiting around a star (the Sun) ACSIS093 Communicate ideas, explanations and processes using scientific representations in a variety of ways, including multi-modal texts

Useful websites

- An explanation what an extremophile is and examples of different types
  https://www.britannica.com/science/extremophile

Science
Technology
Engineering and
Mathematics

Coding a Rover

Objective

In this activity students use materials to design a maze for another group to navigate through using a robot. On the route they should set up some "sites of scientific interest" where the robot must do some sampling (this could be coding the robot to rotate in a circle for example).

Each group should have a go at navigating through another groups maze. If there is time you can run time trials and see which group is the fastest.

The aim of this activity is to aid students with coding as well as give students a better understanding of how difficult it can be to navigate a rover over the Martian surface.

Subject area	Australian syllabus links
Technologies	WATPPS27 Define a problem, and set of sequenced steps, with users making a decision to create a solution for a given task ACTDEK020 Forces can control movement, sound or light in a product or system ACTDIK014 Digital systems have components with basic functions that may connect together to form networks which transmit data ACTDIK015 Data is represented using codes ACTDIP019 Design, follow and represent diagrammatically, a simple sequence of steps (algorithm), involving branching (decisions) and iteration (repetition) ACTDIP020 Implement and use simple programming environments that include branching (decisions) and iteration (repetition)
Mathematics	ACMN098 Identify and describe factors and multiple of whole numbers and use them to solve problems ACMMG113 Use a grid reference system to describe locations. Describe routes using landmarks and directional language.

Useful websites

- Ideas for mazes

https://www.youtube.com/watch?v=8gSKCijQfos
https://www.youtube.com/watch?v=iB1GJvsPV_o
https://www.youtube.com/watch?v=uWDhNM8L_zg
https://www.youtube.com/watch?v=Ro7T3q14uDY

- Article discussing the issues communicating with rovers
https://mars.nasa.gov/mer/mission/timeline/surfaceops/navigation/

- NASA game for students to try driving a Martian rover
https://mars.nasa.gov/gamee-rover/

Designing a Martian Rover

Objective

Students will research previous rovers and use their knowledge from the activities already undertaken to help them design and build a model Martian rover.

Students can do this individually or work as groups. The models will depend greatly on the equipment and time available. Models could simply be made with cardboard. They could also use robots, adapt remote-controlled toys.

Students will evaluate their models and consider how they could improve them.

Subject area	Australian syllabus links
Technologies	WATPPS27 Define a problem, and set of sequenced steps, with users making a decision to create a solution for a given task ACTDEK020 Forces can control movement, sound or light in a product or system WATPPS28 Identify available resources available WATPPS29 Develop and communicate alternative solutions, and follow design ideas, using annotated diagrams, storyboards and appropriate technical terms WATPPS30 Select, and apply, safe procedures when using components and equipment to make solutions WATPPS31 Develop negotiated criteria to evaluate and justify design processes and solutions WATPPS32 Work independently, or collaboratively when required, to plan, safely develop and communicate ideas and information for solutions
Mathematics	ACMMG108 Choose appropriate units of measurement for length, area, volume, capacity and mass. ACMMG111 Connect three dimensional objects with their nets and other two-dimensional representations

Bibliography

Figure numbers from scaffolded booklet

Figure 1: Image of Alan Hills meteorite. Accessed at https://web.archive.org/web/20051218192636/http://curator.jsc.nasa.gov/antmet/marsmets/alh84001/ALH84001-EM1.htm on 4/6/2020