FUTURE TRAVEL

Research Project
For Teachers **p2&3**, for Students **p4**

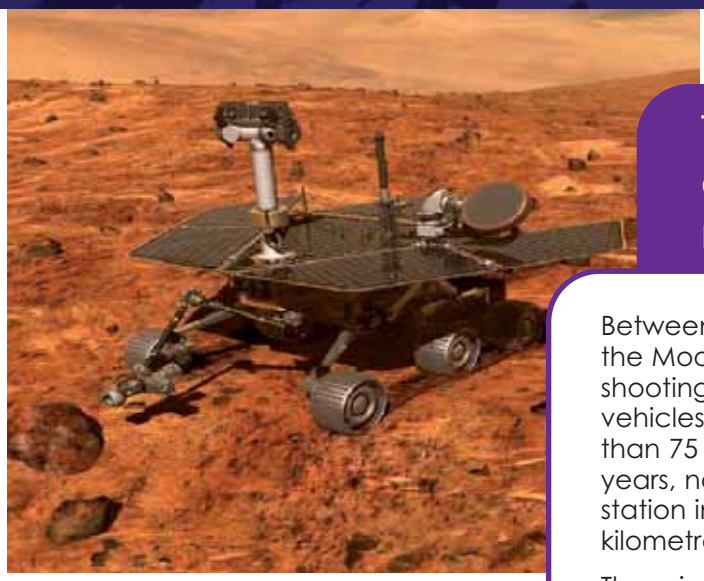
HEALTH AND SAFETY

Students should be encouraged to make their own risk assessment before they carry out any activity, including surveys. In all circumstances this must be checked by a competent person. Students using specialised equipment should be supervised at all times.

Combustion of fuels requires careful risk assessment and close supervision. Students should plan and carry out their project, but all practical work must be vetted.

Students may want to set up unorthodox experiments and you may need to seek specialist advice. Organisations such as CLEAPSS and the Royal Society of Chemistry are able to help.

FUTURE TRAVEL:
Gold **Research** Project - For Teachers



The final frontier - exciting exploration or Martian madness?

Between 1969 and 1972, twelve astronauts walked on the Moon. Since then we've sent space probes sling-shooting across the Solar System, and landed. Rover vehicles to roam the red brown surface of Mars more than 75 million kilometres away. Yet, in the past 35 years, no human has ventured further than a space station in low Earth orbit, only a few hundred kilometres up.

There is talk of astronaut missions to Mars, but can we, and should we, realise these dreams?

HAVE YOU EVER WONDERED?

...what technology, resources and commitment would be needed to land people on another planet?

You might like to imagine yourself in a situation such as...

You have read that both NASA and the European Space Agency (ESA) plan to send astronaut missions to Mars in 20-25 years time. Becoming a scientist or engineer on such a project seems to offer exciting career prospects, but first you want to find out more about what helping to develop a Mars mission might involve. So you decide to **research information** on:

- the various branches of science and engineering that combine to make interplanetary human space flights feasible, and how each contributes to the overall success of the project
- details of some specific aspects of the project that you might consider taking up as a career.

POSSIBLE EQUIPMENT, MATERIALS AND RESOURCES

Though primarily a 'theoretical' research project, some time could usefully be spent in the laboratory - to illustrate, and explain or clarify, aspects being investigated theoretically. Equipment to follow up the suggestions above might include:

- ion-exchange resins, activated carbon, conductivity meter and ionic analysis reagents
- reagents and instruments for:
  - chemical analysis of minerals likely to be found in Mars soil
- two-way voice and text communications link, with stopwatch to time simulated transmission delay before responding to received instruction

Experience of using sophisticated instrumental techniques may possibly be arranged through the mentor, local company or university.

Prompts

The **Student Brief** gives some triggers to start students thinking. They should realise that each trigger implies several items to research and compare. Encourage them to identify these themselves. However, if necessary, prompts such as those below might be given, to point students in suitable directions.

- The scientific principles of space travel and the problems to be overcome
  - In addition to technological aspects, what physiological and psychological problems would astronauts face during a Mars mission?
  - Consider some less obvious aspects, such as: is it feasible to wash clothes in space?
- The major roles of biologists, chemists and physicists in planning a space mission
  - Who is responsible for aspects such as:
    - calculating launch 'windows' and flight paths
    - designing life-support systems, including waste disposal / recycling
- The various branches of engineering / technology involved
  - As well as spacecraft design and construction, consider aspects such as:
    - control and guidance systems
    - communications systems
- How planning an astronaut mission differs from planning non-human space exploration
  - What are the consequences of having to:
    - provide living accommodation within a spacecraft?
    - anticipate breakdowns / faults, accidents or medical emergencies beyond the reach of a rescue?
    - Do humans require different launch conditions from inanimate payloads?
- The types of research and development activities these careers might involve
  - What types of activities would you expect to be involved in as a suitably qualified new recruit?
  - What types of qualifications and experience would you need to enter such a career?

Suggestions for supporting students

Though primarily based on secondary data, the Research project is likely to provide a more meaningful experience if the student also undertakes some practical work. Possibilities include investigating:

- recovery and purification of used water
- food analysis to develop long-term diets that are nutritionally correct and varied
- applications of on-board equipment that might be carried, for instance -
  - analytical techniques, such as gas analysis, auto-titration, colorimetry and spectrometry
  - physical instruments, such as magnetometer, altimeter / rangefinder, stereo camera
- communications problems caused by the time delay of signals between Earth and Mars
- possible flight paths / trajectories using transfer orbits

Gold Award students are required to have an external Mentor (normally a scientist or engineer) for their project. The Mentor's role is to provide guidance and support.

A Mentor with knowledge and/or experience of space related science or technology would be ideal. The Mentor might be involved in…

- academic or industrial research into, for instance:
  - some aspect of spacecraft technology or space exploration
  - physiological or psychological effects of long-term space travel
  - development of instruments for planetary exploration and analysis
  - long-distance communications

Contact your Local Coordinator for guidance.

Internet search

- UK Space Agency
  ukspaceagency.bis.gov.uk/default.aspx
- Science & Technology Facilities Council
  stfc.ac.uk
- Rutherford Appleton Laboratory Space science and technology department
  http://www.stfc.ac.uk/ralspace/default.aspx
- NASA www.nasa.gov/exploration
- European Space Agency www.esa.int
- National Space Biomedical Research Institute
  nsbri.org
- Careers in space
  ukspaceagency.bis.gov.uk/8422.aspx

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So you decide to **research information** on:

- the various branches of science and engineering that combine to make interplanetary human space flights feasible
- details of some specific aspects of the project that you might consider taking up as a career.

Some things to think about...

- The scientific principles of space travel and the problems to be overcome
- The major roles of biologists, chemists and physicists in planning a space mission
- The various branches of engineering involved
- How planning an astronaut mission differs from planning non-human space exploration
- Specific aspects of the project that particularly interest you as a possible career
- The types of research and development activities these careers might involve

Health and Safety

Should you decide to carry out any experiment or practical activity:

(a) find out if any of the substances, equipment or procedures are hazardous

(b) assess the risks (think about what could go wrong and how serious it might be)

(c) decide what you need to do to reduce any risks (such as wearing personal protective equipment, knowing how to deal with emergencies and so on)

(d) make sure your teacher agrees with your plan and risk assessment

NOTE: Your teacher will check your risk assessment against that of your school. If no risk assessment exists for the activity, your teacher may need to obtain special advice. This may take some time.

(e) if special tools or machines are needed, arrange to use them in a properly supervised D&T workshop.

(f) if you are creating foodstuffs that are likely to be consumed, arrange to make them in a food technology room, under hygienic conditions.