MARS Exploration Design Challenge

Resource Package Grades 7-9+

concept creation

Acknowledgements

C2C would like to acknowledge the much appreciated support by Xavier College in developing the Pilot C2C in Space program in 2010, within Year 9 Science. In particular, we would like to thank the outstanding assistance of Science teachers, Deryck Pinchbeck, David Marner and Catherine Castles in working with the author on behalf of Concept to Creation to put aspects of this material together. Other contributors includes the invaluable support of David Chan, University of South Australia who reviewed the engineering components of this manual and Para Hills High School teacher Derek Fuller, who has been a great mentor for piloting new programs in SA schools, including reviewing this one.

Curriculum materials supplied by the Victorian Space and Science Centre (VSSEC), namely OzeSat and the Solar Energy for Space Exploration guides provided by the National Aeronautics and Space Administration (NASA) have also contributed greatly to this program. Much acknowledgement also needs to go to Tobias, Adamus and Kuthumi, for inspiring new consciousness education. Furthermore, C2C are very grateful to Alastair Preece for the final graphical touches and organisational details of this resource package that brings to life the art of visual communication.

-Janine Elizabeth Slocombe

on behalf of Concept to Creation

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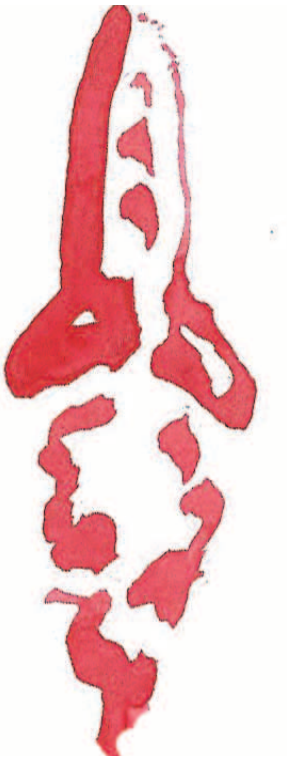

Preface

This C2C in Space resource is intended to give teachers from any educational background whether it be science, technical studies or the arts, the tools to implement a hands-on inquiry based program for grade levels 7 to 9 with extension opportunities to grade 12.

The MARS Exploration Design Challenge has been created in the context that any endeavour for humans to explore space, brings in knowledge and learning about any topic that you can think of that applies to focused topics on Earth. The only difference is that creating a space related challenge involving human exploration means that students have a new exciting context to learn similar concepts to drive creativity, imagination and innovation. These attributes only truly come from giving students the opportunity to discover a passion to learn and expand from their own findings.

How to use the Design Challenge

In essence, what you can do with this MARS Exploration Design Challenge, is only limited by your imagination. For instance, the final prototype product that a Mission Team of students may decide to produce may be as simple and broad as a hairdryer to accommodate comfortable living in a Martian Habitat or a scientific instrument like a soil moisture probe to find water on the Martian surface. It does not matter, the students just have to choose something that requires a power source and has the ability to collect data. The innovation comes from studying the complexity of living and working in an extreme and remote environment such as Mars, since there many design challenges that need to be considered by

Preface (continued)

a Mission Team that comprises of students role-playing real scenario project leader positions to find answers to these challenges.project leader positions to find answers to these challenges.

The design challenge is divided into several colour-coded sections, each with teacher preparation guidelines, various suggested implementation activities and student worksheets for a range of year levels and abilities. The C2C in Space program can easily slip into any subject to be taught giving greater emphasis to any of the wide scope for resource materials provided.

Project Timeframe

This C2C in Space program assumes that you will be engaging in minimum of 10 week program consisting of 3-4 classes per week. It is recommended that at least 50% of the classes is hands-on C2C work and that 25% of information taught in one theory lesson per week, directly relates to the students understanding of the projects principles to develop mastery skills.

MARS Exploration Design Challenge

Overview

Those who will face the challenge of stepping away from Earth to explore the solar system are currently studying at schools and universities, or just beginning their careers. The challenge over the coming decades is to create and implement a sustainable programme of exploration, utilisation and settlement of the solar system, and in doing so, greatly enhancing innovative solutions for our planet earth.

The challenge of sending humans out into a hostile environment for long periods by its very nature t requires an interdisciplinary and multidisciplinary approach, where different fields within science and technology will increasingly work hand in hand and meld with fields of economics, industry, politics and society.

The basis of this inquiry-based MARS Exploration Design Challenge requires students to work in collaborative project Mission Teams of 3-5, to propose, design, construct and present a prototype (model) of a product that could be used by astronauts living and working on Mars as early as in 2030.

To prepare student teams to produce a final designed product, students undertake a very real industry focused investigation. Students role play and discover how scientists, engineers, industrial designers, bio-medical researchers and other professionals, collaborate to approach creative and exciting solutions for the space industry.

This material provides students with the potential to learn and develop high level hands on project management and team work skills in a complex environment and develop industry solutions for human life and exploration using the extreme environment model, Mars as a basis for driving creatively driven independence and innovation in our society.

This C2C in Space resource package provides students with a highly creative inquiry-based learning opportunity to be imbedded into current curriculum for grades 7-9+ in various STEM subjects (Science, Technology, Engineering and Maths) as well as Technical and Social Studies. Further extension opportunities are open for higher year levels due to the flexible technical and research capabilities of this program.

MARS Exploration Design Challenge

Curriculum Standards

The C2C in Space project principles of design and manufacture are not included in the Science Educational Standards, however, understanding the concepts of studying astronomy; the unique position of the Earth and Mars in the solar system and studying energy; transfer of energy, electricity and circuits is required for students in grades 7-9 .

The study of photovoltaics (solar panels) and satellite telecommunications can be an extension and opportunity to demonstrate innovative practical applications of many standards in Physical Science Grades 7-9. Likewise, the context of providing a highly applied group project is designed to extend the students creativity and innovation to understanding STEM learning outcomes in science, technology, engineering and mathematics.

This program meets all the standards required for undertaking Technical Studies, Grades 7-9, examining competing values in designed products, processes and systems, clarifies relationships amongst people, product and quality of life, including analysing various technological futures.

Introduction

Currently, teams of various space industry professionals including university students are investigating and testing in laboratories, workshop areas, simulated space habitat modules and conducting fieldwork expeditions in extreme environments to determine how to extend longer voyages into space and to more distant plants from Earth such as Mars.

The four major Space Industry focuses to accomplish this adventurous mission into space are:

Goal 1: Determine if Life Ever Arose On Mars

The search begins with determining whether the Martian environment was ever suitable for life.

Goal 2: Characterize the Climate

Understanding its present climate and what its climate was like in the distant past, and the causes of climate change over time.

Goal 3: Characterize the Geology

Investigating how Mars become the planet we see today and what accounts for the differences and similarities between Earth and Mars.

Goal 4: Prepare for Human Exploration

Getting astronauts to the Martian surface and returning them safely to Earth is an extremely difficult engineering challenge.

Main Criteria for MARS Exploration Design Challenge

In alignment with space industry mission priorities, students will design, build and test the functionality and usability of items such as space exploration tools, instruments or equipment to be used during a human exploration Mission for living and working on Mars.

This will require students to learn about living and working activities in a habitat base for astronauts and during Martian environmental field expeditions. Students will also learn about the use of satellites in remote sensing to collect electronic data and also various energy sources available to power their appliance or equipment on Mars.

To further define the scope of this challenge and to make full use of the curriculum material developed, **it is recommended that all student projects are based on the following parameters:**

a. Product to be designed is for a human-based mission on Mars comparing Martian and Earth environments

b. Prototype (model of product) must either have the potential or ability to collect scientific or technical data in a Mars base station (space habitat module) or planetary field environment AND

c. Prototype has the capacity to utilise a power source to operate product, taking into consideration power sources suitable for use in a Martian environment

C2C In Space Modules

Within this resource package, there is one major module (Design Challenge) and two sub-modules (introductory workshop material) to assist with the concept and understanding required to undertake the challenge to a high competency level. Each module has suggested workshop and assessment activities as outlined below:

Module 1: Mars Exploration Design Challenge

Design Prototype for Manufacture
Misson Team Portfolio
Individual Reflection Journal
Poster / Presentation of Prototype

Sub Module 2: Energy Systems

Investigate MARS energy systems to power product

Solar Cells in Space workshops: Investigate solar energy and experimental design

Sub Module 3: Remote Sensing

Investigate different types of Remote Sensing technology

Satellites in Space workshops: Investigate remote sensing capabilities of OzeSat (prototype) and experimental design to collect data from product

C2C In Space Modules (continued)

During the introductory stages of Module 1, it is suggested that Modules 2 and 3 (both or either) are undertaken to enable students to:

1. First grasp the concept of what prototype design types and energy sources maybe usable in an extreme Martian environment.
2. Examine and design various functional testing parameters and energy requirements of a product or system in a multi-skilled team approach to develop the best outcome.
3. Learn how to research a topic and generate innovative ideas as individuals and in a team environment before deciding on a prototype of choice.

Bringing Concepts Together

To make the scenario as real as possible for Mars Human Exploration voyages for extended periods under extreme environmental conditions, students are encouraged to learn as a basis, the differences between Earth and Mars in terms of:

- Distance between planets in relation to the sun to include spatial awareness of the solar system and the effects of gravitational forces on life forms
- Atmospheric conditions including air pressure, temperature and humidity including the effects of radiation, gases and natural hazards such as cyclones/dust storms on life
- Landform, terrain including geological features of the planets for mobility and sourcing natural resources
- Energy and remote sensing systems for propulsion, telecommunication, data handling and life support systems available for earth and space exploration
- Basic social science including psychology for living in confined situations and teamwork communication for dealing on earth and extreme environments

It is presumed that the depth of knowledge required and emphasis placed in each of these subject areas will depend on factors such as the year level, and subject that the MARS Exploration curriculum is integrated within. There are also suggested alternative activities outlined in each module in situations where for instance, the use of equipment such as the OzeSat may not be desired to achieve particular learning outcomes or within a designated time frame to undertake the C2C in Space program.