Time: 10:00 am to 3pm SYDNEY time
Duration: 5 hours a day for 6 days
Target group for the course: 12 to 16 year olds (10 or 11 year olds welcome if they have capability)
Mode of Delivery: Online virtual delivery at your home or location of choice

Course Outline

Space Exploration and Space Teams Introduction

The first lesson will be given by former NASA astronaut, Dr. Gregory Chamitoff, who will discuss the vision of space exploration and share his experiences from living and working in space. The second lesson will introduce students to the Space Teams competition and explain the structure of the program. For the 2021 challenge, students will be journeying to a rogue planet, called Vulcan, that is passing through our solar system. Upon visiting Vulcan, they will be exploring the planet for resources that could potentially allow their base to sustain human life indefinitely. The activity for this lesson is to become familiar with the design software, called SpaceCRAFT, by virtually exploring the solar system.

Focus of the sessions	Content
The vision of Space Exploration	Presentation about living and working in Space by former NASA astronaut Greg Chamitoff
The Space Exploration Challenge	Introduction to the program, guided tour of the SpaceCRAFT software, direction for downloading and forming teams.
Setup and Exploration	Students access the platform, create an account, form teams, explore the SpaceCRAFT platform.

Planetary Science

This lesson teaches students about our solar system, the planets within it, as well as other bodies such as asteroids and moons. Solar system formation and the interactions of planetary properties (mass, gravity, distance from the sun, temperature, pressure, and composition) are discussed. The student activity is to design and visit their own planet with SpaceCRAFT.

Focus of the sessions	Content
Space Science Tutorial	Learn about the universe, solar system, planets and other astronomical objects. Basic concepts about formation, atmospheres, gravity, radiation, and composition.
Planetary Builder Tutorial	How to build a planet using SpaceCRAFT
Build Your Planet	Using SpaceCRAFT, each student creates and explores their own planet. Students can visit each other's planets.
Planetary Science Lecture	Lecture by a NASA subject matter expert on the formation, exploration and study of planetary bodies.

Spacecraft Design and Assembly

This lesson will teach students about the systems needed to operate spacecraft in the vacuum of space, travel to distant planets, and maintain life support for the crew. The students will learn about the importance of design decisions, such as selecting the best propulsion system, choices for how to generate power, and minimizing the mass while maximizing resources, as they build their interplanetary spacecraft.

Focus of the sessions	Content
Spacecraft Design Tutorial	Learn about how to design a spacecraft. What are the systems? How does it work? What do you need to reach your destination? Basic concepts of power systems, life support, guidance and control, thermal management, propulsion…
Spacecraft Builder Tutorial	How to build your own interplanetary ship using SpaceCRAFT

Build Your Spacecraft	As a team, students use SpaceCRAFT to create their own interplanetary ship. Artificial Intelligence helps to guide their work by giving them feedback on their design. Students can continue designing and improving their score while competing with other teams.
Spacecraft Design	Lecture by a subject matter expert on spacecraft missions.

Orbital Mechanics and Remote Sensing

The first part of this lesson will focus on teaching students about orbital mechanics, gravity, and spaceship manoeuvres in space. Students will gain a basic understanding of how spaceships are flown which greatly differs from any other mode of transportation, including airplanes. This knowledge will be applied when the students design the trajectory from Earth to Vulcan, the rogue planet passing through our solar system. (All of this can be done visually - without knowing the math!). The second part of this lesson teaches students about the tools and techniques used for scanning planetary surfaces from a distance using an orbital vehicle (satellite). By choosing their orbit properly, they will gather data on the properties of desirable resources and use this to select an optimal landing and base location to conduct scientific experiments.

Focus of the sessions	**Content**
Orbital Mechanics and Remote Sensing Tutorial	Learn about the motion of the planets and traveling in Space. How do you get around the solar system? Once you get to your destination, what can you learn by studying a planet from Space. Basic concepts of orbital mechanics, trajectory design (even for kids), and remote sensing using various spacecraft instruments.
Orbit Designer Tutorial	How to design your interplanetary trajectory from Earth to the planet Vulcan using SpaceCRAFT. Once you're there, how to scan for resources from Space to decide on a landing site.
Plan Your Flight	As a team, students use SpaceCRAFT to design their interplanetary trajectory. Once at the planet Vulcan they need to establish an ideal orbit for scanning the planet for resources. This is a competitive activity with points scored for better trajectories and better scanning data.
Astrodynamics Lecture	Lecture on planetary exploration missions. Subject matter expert on Trajectory Planning, NASA Johnson Space Center

Atmospheric Entry and Landing

In this lesson, students will experience the complexity of the landing process first-hand. Flying a spacecraft is different than flying an aircraft, and the landing procedure will encompass everything for a safe descent from orbit. Each student will improve their piloting skills while using aerobraking to slow their spacecraft from orbital speeds for a smooth and safe landing.

Focus of the sessions	**Content**
Spacecraft Entry, Descent & Landing Tutorial	Learn about how spacecraft control their flight in Space and in planetary atmospheres. How does a spacecraft differ from an airplane? Basic concepts of aerodynamics and flight control, flight instruments, atmospheric entry and landing.
Spacecraft Landing Tutorial	How to fly your spacecraft to a safe landing on the planet Vulcan.
Land Your Spacecraft	Students depart from their interplanetary ship and fly the lander into the Vulcan atmosphere to a safe landing at their desired landing coordinates. Using guidance cues and flight instruments they can obtain higher scores depending on the precision of their approach and accuracy of their landing. They are competing with other teams.
Piloting a Spacecraft	Lecture on spacecraft piloting. Subject matter expert - NASA Astronaut Shuttle Pilot

Habitat Construction

Once on the planet surface, students will learn about the components that are crucial in the design of a habitable base (including, for example, power, water, food, and oxygen). They will learn how to construct a base that will satisfy the requirements to support human life, and to conduct exploration and scientific experimentation on the planet's surface.

Focus of the sessions	Content
Habitat Design Tutorial	Learn about how to design a habitat that can support human life on another world. What systems do you need? How do they work? How can you use resources from the planet to support life? Basic concepts of space system architecture, designing for the local environment, protection from radiation and other hazards, utilization of local resources, and sustainability.
Habitat Builder Tutorial	How to build your own habitat for long-term life support and surface operations using SpaceCRAFT.
Build Your Habitat	As a team, students use SpaceCRAFT to create their own surface habitat on Vulcan. Artificial Intelligence helps to guide their work by giving them feedback on their design. Students can continue designing and improving their score while competing with other teams.
Planetary Habitats	Lecture on the design of deep space habitats. Subject matter expert - NASA Habitat Architect

Surface Exploration

This lesson will focus on teaching students the survival skills and methods for living on a planet other than our own. Spacesuit activities and robotic teleoperations will be used for exploratory missions to locate resources needed for long time survival on Vulcan.

Focus of the sessions	Content
Surface Exploration Tutorial	Learn planetary rovers, tele-robotics, and EVA (extra-vehicular activity). How do you perform scientific exploration on a new planet? What do you hope to find? What kind of measurements do you take? How do you study samples? What resources might you be looking for and how would you extract and utilize them? Basic concepts of mission operations on a planetary surface for purposes of science and resource utilization. How does your exploration results impact the sustainability of your habitat?
Exploration Tutorial	How to conduct your robotic and EVA exploration using the tele-operation station, holo-table and EVA sample analysis probes.
Explore Vulcan	As a team, explore the region around your habitat and identify resources that can be used to extend the life of your habitat. Use rovers and EVA crew members to gather data while competing with other teams to find the most resources.
Planetary Surface Exploration	Lecture by a NASA JPL subject matter expert on Mars robotic exploration.

Final Event

Once all activities are completed successfully, a final determination is made regarding the sustainability of the habitat the students designed. How long can they remain on Vulcan before having to return to Earth? At the end of the program, there is a live streamed event to recognise what the students have learned and accomplished throughout the challenge. Awards will be announced, and strategies discussed.