

# Space Careers Wayfinder

## Humans in Deep Space

### Background

From the second a crew enters a space craft, they are faced with countless hazards and challenges. Even before the craft leaves the Earth's surface, they find themselves atop huge cylinders filled with highly flammable fuels, typically around 400,000 kilograms or 300,000 litres. As the craft accelerates to a top speed in excess of 40,000 km/h, crew members experience a gravitational force around 3 G – this is three times the force normally felt on the earth's surface.

Once off the ground, the crew face higher levels of radiation, the effects of microgravity, hostile space environments etc.

### The task

Use the internet and other sources to complete the following table, identifying the hazards and challenges faced by a crew in deep space. These might have physiological and psychological effects. Describe how the risks are minimised.

Hazard/Challenge	Effect/Impact	Mitigation
Launch pad potential explosion/fire	Fatality, critical or severe injury.	Mission abort protocol. Launch pad water deluge systems.
Radiation	Cancer, central nervous system damage, cardiovascular disease, degenerative tissue defects.	Forecasting the sun's solar energetic particle ejections. Magnetic shields.
Earth's gravitational force at take-off	Reduced flow of blood to the eyes. Reduced flow of blood to the head with possible blackout.	Gravity suit which contains an air bladder. Air bladder inflates preventing blood pooling in the feet and legs.
Collision with other objects in space	Fatality, critical or severe injury.	Track space debris and other active objects in space. Preventative measures and launch trajectories determined and implemented to avoid objects in space.
Microgravity	Loss in bone density and muscle mass. Increased fluids in the head causing vision impairment and increased pressure on the brain.	Aerobic and resistive exercise. Pressure cuffs/lower body negative pressure suit.
Hostile environment (Temperature and vacuum in deep space)	Air drawn from lungs causing suffocation, water in the body would boil with swelling of body tissue.	Environmental control and life support system. Temperature and pressure-controlled space suit with a built-in life support system.
Isolation	Cognitive dysfunction, behavioural changes, mental disorder.	Psychological screening and rigorous assessment including Temperament Structure Scale (TSS) and a NEO Personality Inventory-Revised (NEO PI-R)  Intensive training in space analogue environments.
Medical situation/emergency	Injury, illness, possible fatality.	Training SMART medical systems including telemedicine. Flight surgeon who oversees health care and medical training of crew, and conducts weekly private medical conference with each crew member.
Water and food	Starvation, dehydration potentially fatal consequences.	Recycle urine and sweat. Extract CO <sub>2</sub> and process to make water and methane. Dehydrate food to reduce weight.
Breathable air and essential items	Suffocation from lack of oxygen, asphyxiation from contaminated air. Muscle and bone wasting	Initially liquid oxygen in tanks eventually splitting water into hydrogen and oxygen, air filtration system. Exercise equipment etc.
Personal hygiene and bodily functions	Dental caries, unpleasant odours, bacterial infections	Sanitisers, change of clothing, follow human waste disposal process and protocol.
Power supply	Life support systems fail, means of manoeuvring space craft lost.	Solar panels, batteries, fuel cells.
Navigation	Spacecraft and crew lost indefinitely resulting in fatality, collision with another object.	No GPS beyond medium Earth orbit. Sophisticated radios, large antennas, computers, and precise timing equipment. Pulsars are being explored as a means of navigation.
Communication	Psychological impact on crew, impact available support from groundcrew.	Deep Space Networks, development of optical communication systems using laser technology.

# Australian Curriculum

## Science

Compare the role of body systems in regulating and coordinating the body's response to a stimulus, and describe the operation of a negative feedback mechanism (AC9S9U01)

Investigate how advances in technologies enable advances in science, and how science has contributed to developments in technologies and engineering (AC9S9H02), (AC9S10H02)

Examine how the values and needs of society influence the focus of scientific research (AC9S9H04), (AC9S10H04)

Write and create texts to communicate ideas, findings and arguments effectively for identified purposes and audiences, including selection of appropriate content, language and text features, using digital tools as appropriate (AC9S9I08), (AC9S10I08)