



# SPACE WEEK

Our Planet • Our Space • Our Time

## Resource Book for Teachers TOPIC: **Space Wants to Kill You!**

**Introduction:** This resource booklet outlines some of the hazards of space to humans

**Curricular links Junior Cycle Science:**

Earth and Space 8 ... examine some of the current hazards and benefits of space exploration...

Biological World 6 ... evaluate how human health is affected by ... environmental factors...

## Habitability in Space

When we talk about “habitability” in space, it is often a very general term.

*What are the minimum conditions in space that would allow some form of organism to survive?*

The most common minimum condition for life-as-we-know-it to survive is to have temperatures that are somewhere between the freezing and boiling points of water. Some forms of alien life could perhaps be able to survive without such conditions (there are “extremophiles” on Earth for example that can survive in hot springs of boiling water). But when we examine “habitability” we only have examples of Earth-life to go by. See [this education resource](#) from ESA.

We humans, with our delicate fleshy bodies, are not particularly adaptable to extreme conditions. This is easy to forget when we see astronauts living on the International Space Station for months at a time. Astronaut Alan Bean, the 4<sup>th</sup> man to walk on the Moon, once said that when he was in space, he often thought that just on the other side of the spacecraft window is death. Death was lurking just a few centimeters away and only very complex and expensive technology was allowing him to survive in the airless vacuum of space.

So, before we examine habitability in space, it may be useful to examine why space is so ‘in-habitable’ and downright hostile to humans and other similar life forms that evolved on our mostly temperate water planet with a protective atmosphere and magnetic field. So, let’s examine what would happen to your fleshy, organic body if you were suddenly flung into space completely unprotected...

## Immediate Effects:

**Asphyxiation** - You would be unconscious in 15 seconds when deprived of all oxygen. Then you die in about 2 minutes. *Why 15 seconds?*

*It typically takes 15 seconds for your circulatory system to deposit oxygen from your last breath into your cells. Once that's gone, your brain will black out due to oxygen deprivation. After about 90 seconds to 2 minutes your cells start to die.*

*If you hold your breath when launched out into the vacuum of space, the greater pressure inside will make them expand like an over-inflated balloon. Unlike a balloon, a lung can only expand so much before it becomes damaged beyond functioning.*

**Depressurization** – If you were suddenly exposed to the vacuum of space, should you hold your breath?

*Why or why not?*

View: Balloon in a vacuum chamber on [YouTube](#).

## What else will the lack of air pressure do to you?

Vacuums suck. (No, literally. That's why a "vacuum cleaner" is useful. It sucks things up.) In the vacuum of space, blood and fluids will literally be sucked out of your body. Fluid will come out of your bodily openings and where there are no openings it will try to come through your skin and you will swell up to a grotesque parody of yourself.

View: Don't do this at home! (Warning... grossness factor at least 9 out of 10!) Arm in a vacuum chamber on [YouTube](#). Also see [What Happens if a Hole Gets Blown in Your Spaceship? Amazing Vacuum Chamber Space Simulation!](#)

Under low pressure, bubbles of gas will form in your blood and interfere with your circulation. Eventually, your blood will boil because at the lower pressure the boiling point will be below body temperature. Also, all the fluids that are sucked out of your body (like your tears) will boil and bubble on your skin. It's probably a good thing that you'll be unconscious!

View: Boiling Water at 23 °C on [YouTube](#).

Activity: Boil room temperature (or slightly warmer) water in a syringe. See [video and guide from the Exploratorium](#).

**Inertia** – Why are astronauts in space always tethered to their spacecraft when they are working outside of it?

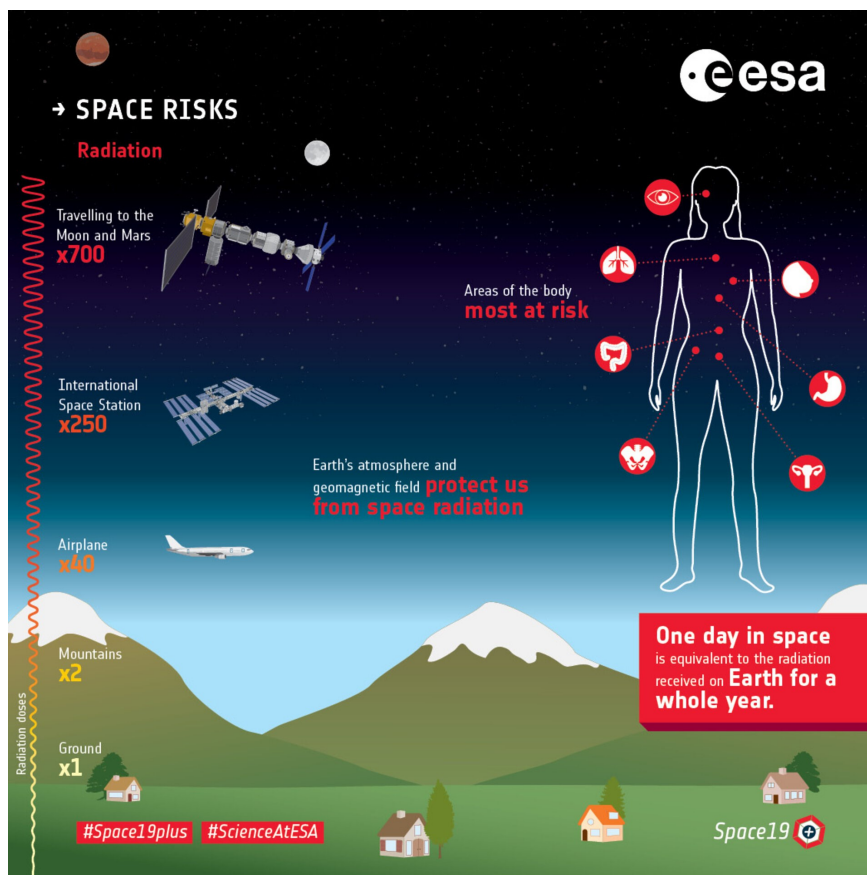
In space there is no friction. So, without a method of propulsion, your linear and rotational motion in space would last indefinitely!

[This terrifying scene](#) from the movie “Gravity” is exceedingly accurate.

Assuming you were smart enough to put on a test-pilot pressure suit with an oxygen supply so that you wouldn’t die quickly from the hazards above, how else could space kill you?

*A similar out-of-control spinning scenario actually occurred in 1966 during the Gemini 8 space mission. A stuck thruster put the small spacecraft into a rapid spin and astronauts Neil Armstrong and David Scott were only moments away from blacking out before control of the spacecraft was regained using the re-entry control system. The astronauts had to immediately return to Earth and both ultimately walked on the Moon several years later!*

Read more [here](#).



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## Medium term effects:

### Freezing or burning –

The difference between sunward and shadow side of an object in space can be more than 200 °C!

**Radiation** – Intense sunburn due to no ozone layer protection.

## Long term effects:

**Radiation** – High energy electromagnetic & particle radiation could cause radiation sickness and cancer!

**Dust** – Moon dust (regolith) can cause catastrophic leaks in spacesuits (no erosion => particles with jagged surfaces). Read how [Breathing it can cause respiratory problems](#) from allergies to “black lung” disease.

**Immune system changes** – Space travel suppresses T-cells and affects our immune system a wide range of ways. View [Your Immune System... In Space video](#).

**Bone mass loss** – on Earth, humans make new bone as fast as they break down old bone. In weightlessness old bone is broken down faster and this causes brittle bones. Crew members on the ISS engage in physical exercise for 15 hours per week to try to reduce these effects. View [Muscle stimulation to enhance astronaut health video](#).

**Vision problems** – changes in eye shape and swelling of optic nerve can cause vision problems. This could result in fatal accidents. View [Studying eye health in space with astronaut Matthias Maurer](#).

**HOW TO STAY MENTALLY HEALTHY IN SPACE**

Astronauts have a stressful, high-pressure job that can be mentally draining. Thankfully, there are various strategies, tools and training to help them stay mentally healthy. Some of these can help you cope with challenging situations here on Earth, too!

**PHYSICAL HEALTH**

Being physically healthy is important to stay mentally well. Eating a healthy diet, exercising every day and sleeping well are key. Special lighting, noise cancelling sleep masks, sleep pods and relaxation time support good sleeping habits.

**RELAXATION AND SELF-CARE**

Astronauts have downtime built into their schedule. They often relax by watching Earth go by. Some read books, play an instrument or listen to music. They can connect with loved ones and spend time writing, meditating or practising their religious traditions.

**SOCIAL ACTIVITIES**

Astronauts live in close quarters for a long time – might as well make it fun! Meals are a great opportunity to socialize and share different cultures. They gather to watch a movie, play games, or celebrate special occasions.

**TRAINING AND PREPARATION**

In addition to technical training, astronauts prepare mentally for space. They learn self-reflection, conflict resolution and accountability, and build team cohesion and trust. Understanding themselves, their individual roles, and the team dynamics are crucial to maintain a healthy living space.

**PSYCHOLOGICAL AND MEDICAL SUPPORT**

Canadian astronauts in space check in with a psychologist every two weeks and regularly speak to their flight surgeon. Care packages filled with sweets, little gifts and reminders of home sent on resupply missions also help boost morale.

**TECHNOLOGIES**

Astronauts have access to devices with their favourite movies, shows, books, playlists, podcasts and audiobooks. Internet phones and virtual reality allow them to stay connected. Technologies like smart watches and shirts track vital signs and sleep patterns.

**ENVIRONMENT**

Keeping the spacecraft clean and organized, and following a schedule help create stability. Astronauts bring photos and items that remind them of home. Growing plants and vegetables also boosts morale and provides good nutrition and fresh oxygen.

Canadian Space Agency / Agence spatiale canadienne

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**Mental health** – being ‘trapped’ in a spacecraft for long periods of time can lead to depression & other psychological problems. Astronauts undertake a [variety of activities](#) to help take care of their mental health. © Canadian Space Agency

# How do you thrive in space?

*Consider what is required:*

## **Need energy for warmth –**

You can't build a campfire on Mars (or any other planet that has no fuel or oxygen.)

Could you use wind power?

Hydro-power needs a water cycle.

Solar power from solar cells or nuclear power need advanced technology.

## **Need food –**

You could grow plants, but consider what is needed for photosynthesis... is there light and water (and soil).

View: [ScienceCasts: Space Gardening](#).

## **Need to communicate –**

Space is silent!

Need a medium to carry sound. View: [Sound disappears in a vacuum chamber](#).

Moon walking astronauts in the 1970's could only communicate via radio transmissions. They learned rudimentary sign language so they could communicate if their radios failed!

View: [Astronauts aboard the ISS also use hand symbols to communicate](#).

## **Acknowledgements & Thanks**

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