## Topic 8 - People In Space

The race for space supremacy began just over 50 years ago. As a result many technologies were fast-tracked to make sure whoever developed them first, would make it into space first.

Space travel can have its dangers. A launch can be affected by many dangers, including highly explosive fuel, poor weather, malfunctioning equipment, human error and even birds. Once in flight, the spacecraft can be affected by floating debris, meteoroids and electromagnetic radiation (coronal mass ejections – or, solar flares).

Over 4000 missions have been sent into space. **Micrometeorites** are constantly bombarding spacecraft and the International Space Station. They travel at extremely high velocity and can cause great damage. Once they enter the atmosphere, they usually burn up.

*Space junk* refers to all the pieces of debris that have fallen off rockets, satellites, space shuttles and space stations that remain in space. This can include specks of paint, screws, bolts, nonworking satellites, antennas, tools and equipment that is discarded or lost. Some debris in space will enter the atmosphere and will not totally burn up. When this occurs, it may land in populated areas and cause loss of life or damage to property.
Some satellites, or decommissioned space stations, that re-enter the atmosphere have radioactive parts and can contaminate a very large area, costing a lot of money and hours to clean it up. Some burn up in the atmosphere and those parts that don't fall into the ocean, making recovery and clean-up less costly.

Russian Space Station MIR

Re-entry and burn-up

Re-entering Earth's atmosphere also has it dangers (as proven by the Colombia disaster). The re-entry path the spacecraft takes must be perfect, otherwise, if it is too shallow - it will bounce off the atmosphere, and if it is too steep – it will burn-up.

### Breaking Free of Earth's Gravity

The energy it takes to get up into orbit and stay there is huge. Gravity must be overcome and to do so, takes a speed of 8km/s. This is called *escape velocity*. Even when the gravity of the Earth is overcome, there are other hazards in this *'unfriendly to humans'* space environment, which can cause a mission to fail and possibly be a disaster, resulting in loss of life, economic setbacks and many years of work.

There are tragedies that bring to life the true dangers of space travel, such as:

| 1967 | 1986 | 2003 |
|---|---|---|
| – 3 astronauts of **Apollo 1** died during a training exercise | – 7 astronauts died when the **Space Shuttle Challenger** exploded shortly after launch | – 7 astronauts died when the **Space Shuttle Columbia** broke apart during re-entry |
|  |  |  |
| **Details** | **Details** | **Details** |

Other accidents or lost missions have occurred that have cost many millions of dollars and thousands of hours of work, including most recently, the European Rover on Mars -Beagle- that did not return any data, or signal, after it landed. Sometimes decisions may have to be made that will ultimately determine if missions are to fail.

## The Space program – Notable Achievements

### Sputnik
The Soviet Union was the 1st to successfully orbit a satellite - *Sputnik 1* in 1957

### Vostok
The first person in space was also a Russian. *Yuri Gagarin* orbited the Earth in *Vostok 1* at an altitude of 302 km for 108 minutes. In 1963 *Valentina Tereshkova* was the 1st female to travel into space in *Vostok 6*.

### Freedom 7
Project Mercury brought the first American - *Alan Shepherd* - into orbit on May 5, 1961, aboard *Freedom 7*. Shepherd flew a suborbital flight, which is just above the atmosphere, but not completely in orbit. The 1st orbital flight was made by *John Glenn* in 1962.

### Moon Landing - Apollo 11
The Apollo 11 lunar (Moon) landing almost didn't occur, because the original landing site was found to be too rocky. With a precise amount of fuel, an alternate landing site had to be chosen on the first try, or the mission would be scrubbed. In the summer of 1969 *Neil Armstrong* and *Edwin Aldrin* were the 1st humans to set foot on another place in space, when they landed on the Moon.

*' One small step for man, one giant leap for mankind '*

### Meeting In Space
The Apollo/Soyuz joint mission was tested in 1975. It was the first international space mission. The universal docking model was tested and was successful.

### Life Support Compatibilities http://www.mobilelife.com
To make the system work required the docking module to act as a life raft, replenishing oxygen and getting rid of carbon dioxide. The Americans and Soviets approached the compatibility problem a little differently.

| | Soviet System | American System |
|---|---|---|
| Cabin atmosphere | 80% nitrogen, 20% oxygen at normal air pressure | 100% oxygen at 1/3 air pressure |
| Advantages | Simple, minimal fire hazard | Less decompression issues |
| Disadvantages | Decompression danger | Fire danger, explosion |
| Oxygen replenishment | Chemical reactoions with solid chemicals | Oxygen in high pressure containers |

### Shuttle, Space probes and Space Stations
There are three main types of spacecraft in use:

**Shuttles** transport personnel and equipment to orbiting spacecraft**.** Columbia was the 1st in 1981

**space probes**
carry instrumentation
for exploration of space

**International Space Stations** are orbiting space centers where research, experimentation, and further exploration can be carried out by people living there for extended periods of time

The '**Canadarm**' was launched in **1981** and has served a very useful purpose on many missions, including launching and retrieving satellites for use or repair, fixed the Hubble Telescope and put modules of the International Space Station together.

## Canadian Contributions to Space Exploration and Observation

http://www.spacenet.on.ca/

**Canadian Space Agency Website:** http://www.space.gc.ca/asc/eng/default.asp

Canada also launched satellites into orbit:

- **Alouette 1** in **1962** – one of the first satellites launched for non-military use
- **Anik 1** in **1972** – communications across the entire country
- **1973** – Canada was the 1st nation to broadcast television signals via satellite

**Brief Summary of Canada's Contributions in Space**:

- **1839** – Sir Edward Sabine establishes the 1st magnetic observatory and discovers that the Aurora Borealis is associated with sunspot activity
- **1962** – 3rd nation to launch a satellite
- **1969** – supplied landing gear for Apollo 11
- **1981** – **Canadarm 1** used for the first time in space
- **1984** – 1st astronaut – Marc Garneau
- **1992** – 1st female astronaut – Roberta Bondar
- **1997** – Technology for the **Mars Pathfinder Mission** - *Sojourner* rover ramp
- **2001** – Chris Hadfield - 1st Canadian to walk in space – he helped deliver the **Canadarm 2** to the **International Space Station**.

## The International Space Station - A Home In Space

Outside Earth's atmosphere, life-support systems have to be artificially produced. Clean water, fresh air, comfortable temperatures and air pressure are essential to life. All these support systems, including a power supply to operate them, must be operational on the International Space Station at all times.

### *Recycling Water*

Almost 100% of the water in the station must be recycled. This means that every drop of wastewater, water used for hygiene, and even moisture in the air will be used over and over again. Storage space is also a problem, making recycling essential for survival.

The main functions of the life-support systems include:

- Recycling wastewater
- Using recycled water to produce oxygen
- Removing carbon dioxide from the air
- Filtering micro-organisms and dust from the air
- Keeping air pressure, temperature and humidity stable

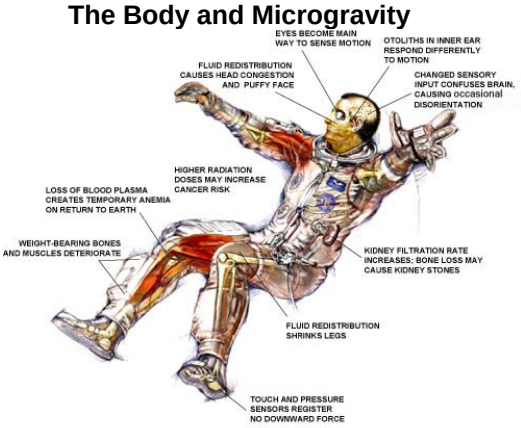
### *Producing Oxygen*

**Electrolysis** of water (remember **$H_2O$** can be split into hydrogen and oxygen). The astronauts use the oxygen and the hydrogen is vented into space.

To survive in space (which is a cold vacuum), technologies have needed to be developed to overcome the hazards of this harsh environment. A manned flight to Mars would last 2 to 3 years, which is a long time to be in an enclosed environment.

Space is a vacuum with no air or water. Cosmic and solar radiation, and meteoroids are the greatest dangers. Because there is no atmosphere, the temperatures in space have both extremes - from extremely hot, to extremely cold. There is also no atmospheric pressure to help regulate the astronaut's heartbeats. Long trips can present psychological difficulties, as can the claustrophobic feeling of such tight living conditions.

## The Body and Microgravity




Living in *microgravity* can cause problems because of the effects of *weightlessness* on the human body.

**Bones** have less pressure on them and so they expand. They also lose calcium and become more brittle.

The **heart** doesn't have to pump as hard to circulate blood.

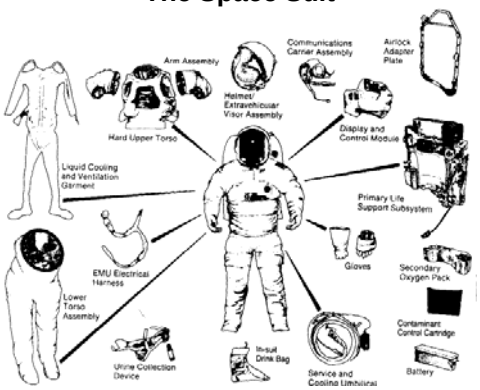
**Muscles** weaken and shrink.

**Depth perception** is also affected.

The *space suit* is a mobile chamber that houses and protects the astronaut from the hostile environment of space. It provides atmosphere for breathing and pressurization, protects from heat, cold, and micrometeoroids, and contains a communications link.

The suit is worn by the astronauts during all critical phases of the mission, during periods when the command module is not pressurized, and during all operations outside the command and lunar modules whether in space, in the International Space Station, or on the moon.

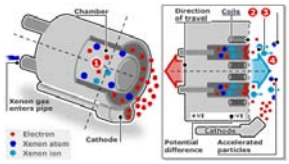
## The Space Suit

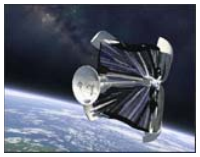



Learn what it takes to be an astronaut, by reading **Robert Thirsk's** story - p. 430 in the **Science In Focus 9** textbook.

## The Future of Space Transport Technology

Ion Drives are engines that use xenon gas instead of chemical fuel. The xenon is electrically charged, accelerated, and then released as exhaust, which provides the thrust for the spacecraft.



Solar Sail Spacecraft use the same idea as sailboats. They harness the light of the Sun. The Sun's electromagnetic energy, in the form of photons, hits the carbon fibre solar sails, and is transmitted through the craft to propel it through space. These spacecraft could travel up to 5 times faster than spacecraft today.

A manned interplanetary journey would begin best in space, likely from a space station.

The **International Space Station** could be such a platform to begin the exploration of other planets – most likely MARS and possibly one of Jupiter's moons. As more space stations are built the reaches of space will soon be within our grasp.Private developers and companies are even planning tourist flights and possibly hotels and amusement parks in space, or, on the Moon.