Unit 5 Space Exploration

***Science in Action* Notes**

Space Links: **NASA** http://www.nasa.gov/home/index.html

2.0 Technological developments are making space exploration possible and offer benefits on Earth.

http://www.astro.washington.edu/larson/Astro101/lectures/OriginTime/origin_universe.html

2.1 Getting There: Technologies For Space Transport

The ***gravitational escape velocity*** had to be achieved (**28,000 km/h**), if humans were to venture into space.

The Achievements of Rocket Science

http://www.grc.nasa.gov/WWW/K-12/TRC/Rockets/history_of_rockets.html

(History of Satellites) http://inventors.about.com/library/inventors/blsatellite.htm

(Space Transport Firsts)) http://www.tbs-satellite.com/tse/online/thema_first.html

400 B.C	- Archytas used escaping steam to propel a model pigeon along some wires
1st Century	- Chinese used gunpowder to propelled ‘flaming arrows’
17th Century	- Polish General uses solid fuel rockets in war
Early 1900’s	- Konstantin Tsiolkovskii suggested liquid fuel be used for rockets
1920’s	- Wernher Von Braun developed the V-2 rocket for war
1926	- Robert Goddard launched the world's first liquid-propellant rocket.
Oct. 4, 1957	- Sputnik was launched by the Russians
Nov, 1957	- Laika (a dog) survived in Earth orbit for 7 days
1961	- Explorer I launched by USA
1962	- Alouette launched by Canada
1969	- First man on the moon
1981	- First launch of the Shuttle

The Science of Rocketry

The science of rocketry relies on a basic physics principle that you learned in Grade 7.

For every action – There is an equal and opposite reaction

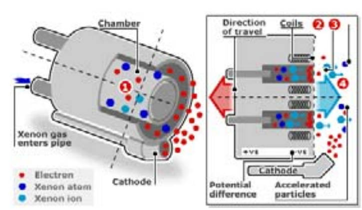
There are three basic parts to a Rocket:

http://www.grc.nasa.gov/WWW/K-12/airplane/rktparts.html

- The **structural and mechanical elements** are everything from the rocket itself to engines, storage tanks, and the fins on the outside that help guide the rocket during its flight.
- The **fuel** can be any number of materials, including liquid oxygen, gasoline, and liquid hydrogen. The mixture is ignited in a combustion chamber, causing the gases to escape as exhaust out of the nozzle.
- The **payload** refers to the materials needed for the flight, including crew cabins, food, water, air, and people.

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. The thrust is 10,000 times weaker than traditional engine fuels, but it lasts an extremely long time. The amount of fuel required for space travel is about 1/10 that of conventional crafts.



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.

Shuttles	Space Probes	Space Stations
		
Shuttle Launch	**Mariner 10**	**International Space Station**
Shuttles transport personnel and equipment to orbiting spacecraft	Space probes contain instrumentation for carrying out robotic exploration of space	Space Stations are orbiting spacecraft that have living quarters, work areas and support systems to enable personnel to live in space for extended periods

The Next Step

Manned interplanetary space missions, possibly to Mars or Jupiter (one of it's Moons), or the colonization of the moon are ideas that have surfaced recently. Building a remote spacecraft-launching site (on the Moon, or on the International Space Station) is the first step to enable interplanetary flight to become a reality and will reduce the cost dramatically. 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.

2.2 Surviving There: Technologies For Living In 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.

Hazards Of Living In Space

Environmental Hazards

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.

Psychological Challenges to Confined Living

Long trips can present psychological difficulties, as can the claustrophobic feeling of such tight living conditions.

The Body and Microgravity

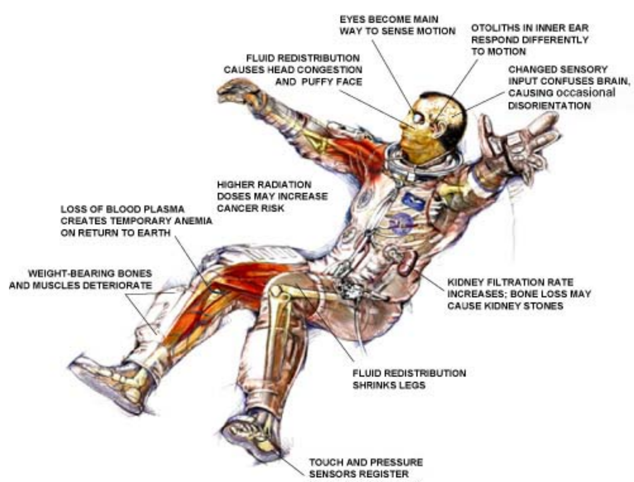
Living in microgravity can cause problems because of the effects of weightlessness on the human body.

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.

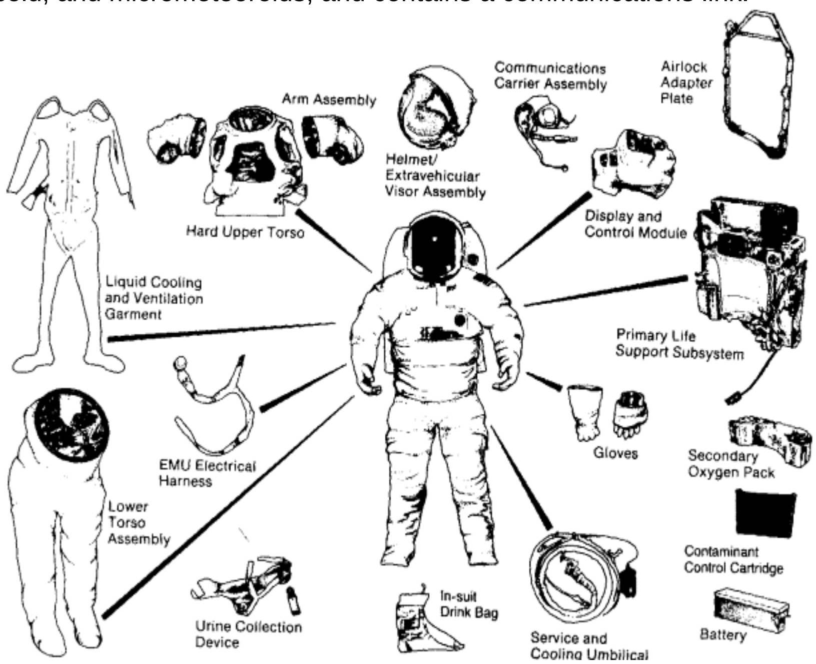
Muscles weaken and shrink.

Depth perception is also affected.



The Space Suit

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.

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 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.

Learn what it takes to be an astronaut, by reading **Dr. Roberta Bondar's** story on p. 426 in the **Science In Action 9** textbook.

2.3 Using Space Technology To Meet Human Needs

Satellites

Satellites can be **natural** – small bodies in space that orbit a larger body (the moon is a satellite of the Earth), and they can be **artificial** – small spherical containers loaded with electronic equipment, digital imaging and other instruments that are launched into Earth's orbit to perform one of four functions:

Communication Satellites

These satellites provide 'wireless' technologies for a wide range of applications. Digital signals have resulted in clearer communications and more users. **Anik 1** (launched by Canada in 1972) transmitted the first television broadcasts by satellite.

Satellites for Observation and Research

A ***geosynchronous*** orbit is one that enables a satellite to remain in a fixed position over one part of the Earth, moving at the same speed as the Earth. Numerous applications are now possible including:

- Monitoring and forecasting weather
- **LANDSAT** and **RADARSAT** (*are not in geosynchronous orbit*) – follow ships at sea, monitor soil quality, track forest fires, report on environmental change, and search for natural resources.
- Military and government surveillance

Remote Sensing

Those satellites in low orbits perform remote sensing – a process in which digital imaging devices in satellites make observations of Earth's surface and send this information back to Earth. The activities include providing information on the condition of the environment, natural resources, effects of urbanization and growth. This information is usually used for planning purposes.

Satellites as Personal Tracking Devices (GPS)

The **Global Positioning System** (**GPS**) allows you to know exactly where you are on the Earth at any one time. The system involves the use of **24** GPS satellites positioned in orbit, allowing for **3** to always be above the horizon to be used at any one time. The three GPS satellites provide coordinated location information, which is transmitted to a GPS receiver (hand-held) to indicate the person's exact position on the Earth.

"Space Age" Inspired Materials And Systems

Many materials that were originally designed for a space application have practical applications on the Earth. These are called '**spin-offs**'.

The table of '**spin-offs**' on p. 431 provides some examples in the fields of computer technology, consumer technology, medical and health technology, industrial technology, transportation technology, and public safety technology.