Topic 6 - Above the Atmosphere and Under Control

Rockets – Getting Up There

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.

Rockets have been around a long time and were originally used as fireworks and weapons.
http://www.grc.nasa.gov/WWW/K-12/TRC/Rockets/history_of_rockets.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

Rocket Fuel

Rockets need combustible fuel to make them fly. All fuels create exhaust which comes out the end of the rocket. The speed of the exhaust leaving the rocket is called the *exhaust velocity*, which determines the *range* of the rocket. The *gravitational escape velocity* had to be achieved (**28,000 km/h**), if humans were to venture into space.

Robert Goddard launched the first liquid fuel rocket in 1926. The rocket was *staged* (having more than one section that drops off once its fuel is used up, making the rest of the rocket lighter and able to fly higher.

The V-2 Rocket

Werner von Braun built the 1st ballistic missile for the Germans during World War II (1942). A ballistic missile is a bomb that is powered by a rocket engine. The V-2 rocket successfully found a target that was 200kms away. The Americans captured von Braun and his rocket team. As a result of their work NASA was born.

The Russians were not far behind as Sergi Korolev designed the *Vostok, Voshkod and Soyuz* rockets which carried 'cosmonauts' into space first.

Computers – Making Adjustments

In the 1960's the Americans and the Russians were racing to launch spacecraft into orbit using rockets. They needed to use computers to calculate and control their orbits. The first computers on the ground (which filled large rooms) controlled the spacecraft in orbit. As computers became smaller they were put onboard the spacecraft and worked with computers on the ground to control the flight. Their vital role was to calculate orbits, locate satellites (and space junk), collect, store, and analyze data and to maneuver around these obstacles in orbit.

Rockets are used to blast spaceships into orbit but cannot send them on long journeys throughout the solar system. A technique called *gravitational assist* is a method of acceleration which enables a spacecraft to achieve extra speed by using the gravity of a planet. The planet's gravity attracts the craft causing it to speed up and change direction (a slingshot effect), sending it on to the next planet.

Computers improve our ability to see the stars better. *Charge coupled devices* (CCD's) record these images, by converring light signals into digital format. They are then sent by a computer where they are processed in ways that can remove 'noise' and sharpen images. The Hubble Space telescope gets a clearer view of the stars, because it isn't affected by the Earth's atmosphere.

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

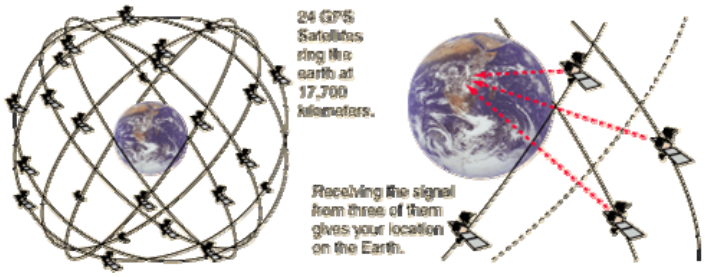
Remote Sensing

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) Global Positioning System (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.

History of Satellites http://inventors.about.com/library/inventors/blsatellite.htm
Space Transport Firsts http://www.tbs-satellite.com/tse/online/thema_first.html