“Space Age” Materials and Systems

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

Applications on Earth of technology needed for space flight have produced thousands of "spinoffs" that contribute to improving national security, the economy, productivity and lifestyle. It is almost impossible to find an area of everyday life that has not been improved by these spinoffs. Collectively, these secondary applications represent a substantial return on the national investment in aerospace research. We should be spending more.

Examples can be found in the fields of computer technology, consumer technology, medical and health technology, industrial technology, transportation technology, and public safety technology.

Life-Support systems have to be artificially produced in space. 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. 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 and keeping air pressure, temperature and humidity stable
Oxygen is produced in space by the **electrolysis** of water - **H_2O** can be split into hydrogen and oxygen. Astronauts’ use the oxygen and the hydrogen is vented into space (could possibly be developed into fuel for the space craft in the future).

Satellites

Satellites can be **natural** – small bodies in space that orbit a larger body (the moon is a satellite of the Earth), or they can be **artificial** – small spherical containers loaded with electronic equipment, digital imaging and other instruments that are launched into Earth’s orbit **-** 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.
They are designed to perform one of four functions: Communication - Observation and Research - Remote Sensing and GPS.
Global Positioning System allows you to know exactly where you are on the Earth. The system uses 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.

Telescopes

In 1608, Hans Lippershey made one of the first telescopes – but it was Galileo Galilee who made practical use of it. Optical telescopes are ‘light collectors’. The series of lenses or mirrors enable the optical device to collect and focus the light from stars. There are two types of optical telescopes. The first telescope designed was a simple **refracting telescope**. It uses two lenses to gather and focus starlight. There is a limit to the size of lens that a refracting telescope can have. Diameters over 1 meter will cause the lens to warp. **Reflecting telescopes** use mirrors instead of lenses to gather and focus the light from the stars. A process called **‘spin-casting’** today makes mirrors, by pouring molten glass into a spinning mould. The glass is forced to the edges, cooled and solidified. Mirrors as large as 6m across have been made using this method. One of the newest innovations for ground-based optical reflecting telescopes is the use of **segmented mirrors** (uses several lightweight-segments to build one large mirror).

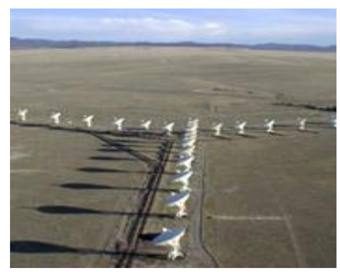
Interferometry

The technique of using a number of telescopes in combination is called interferometry. When working together, these telescopes can detect objects in space with better clarity and at greater distances than any current Earth-based observatory.

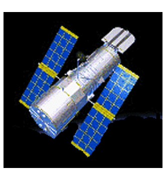
Radio Telescopes - Radio waves are received from stars, galaxies, nebulae, the Sun and even some planets. With the development of radio telescopes, astronomers gain an advantage over optical telescopes, because they are not affected by weather, clouds, atmosphere or pollution and can be detected day or night. Much information has been gained about the composition and distribution of matter in space, namely neutral hydrogen, which makes up a large proportion of matter in our Milky Way galaxy. Radio telescopes are made of metal mesh and resemble a satellite dish, but are much larger, curved inward and have a receiver in the center.

Radio Interferometry

By combining several small radio telescopes (just like they do with optical telescopes) greater resolving power can be achieved. This is referred to as radio interferometry, improving the accuracy and performance of the image in making radio maps. The greater the distance between the radio telescopes the more accurately they can measure position. Arrays, like the ***Very Large Array*** in Sorocco, New Mexico use 27 telescopes arranged in a Y, to improve accuracy even more.



The Hubble Space Telescope (HST)



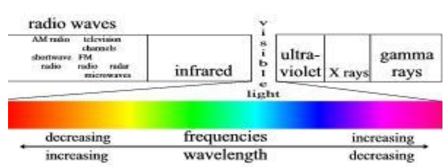
http://hubble.nasa.gov/

http://hubblesite.org/

The HST makes one complete orbit of the Earth every 95 minutes. To improve the views of space, astronomers are able to access images from a telescope in space. Free from the interferences of weather, clouds humidity and even high winds, the Hubble Space Telescope, launched in 1990, orbits 600 kms above the Earth, collecting images of extremely distant objects. It is a cylindrical reflecting telescope, 13 m long and 4.3 m in diameter. It is modular (parts can be removed and replaced) and is serviced by shuttle astronauts.

ELECTROMAGNETIC ENERGY

Besides the visible light that optical telescopes can give us, other forms of **electromagnetic energy** can also give us information about objects in space. This energy travels at the speed of light, but has different wavelengths and frequencies from those of visible light.



Energy with a short wavelength has a high frequency. Gamma rays are the most dangerous and radio waves are the safest. Visible light is measured in micrometers with 1 micrometer equal to 1 millionth of a meter.

Using Electromagnetic Energy To View Objects in Space

Ultraviolet radiation is absorbed by the atmosphere and therefore cannot be studied very well from Earth. A distant planet orbiting a distant star cannot be seen because of the bright light from its star. However, when viewed in the infrared spectrum through a radio telescope, the stars brightness dims and the planets brightness peaks. The Keck Observatory in Hawaii is actively searching for planets, with its radio telescope. Other discoveries include fluctuations in microwave energy left over from the formation of the universe; X-rays emitted from black holes and pulsating stars; and huge bursts of gamma rays appearing without warning and then fading just as quickly.