

FEATURE ARTICLE

# IT IS ROCKET SCIENCE!

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The International Space Station water recovery component of the Environmental Control and Life Support System.

Credit: NASA

**D**EBATES on how much budget should be allocated to space research are commonplace in most countries. After the initial success of Russia and USA in space exploration, each country wanted to prove its mettle in the field. But today, concerns are raised on Governments spending too much in enhancing capabilities of the nation in space research rather than addressing the more urgent necessities like healthcare and agricultural research.

But, unlike the common perception, space technologies are not limited to space only. There are many technologies that have evolved from space research, which are now used in daily life. Since 1976, NASA, the National Space Research Organization of USA, publishes *Spinoff*, an annual publication that chronicles commercial products and services which have been developed as byproducts of space research by NASA. *Spinoff* has documented more than 2000 such technologies that affect our daily life, in various fields ranging from health and medicine to public safety, to communications. Let's have a look at some of these.

## Environment & Agricultural Resources

**1. Water Purification:** According to a report by the WHO (World Health Organization), at least 2 billion people globally get contaminated water for drinking. It is estimated that by 2025, half of the world's population will be facing water scarcity. NASA's Marshall Space Flight Center developed a cutting-edge technology to provide clean drinking water to astronauts aboard the ISS (International Space Station). This system filters wastewater from respiration, sweat and urine of astronauts to make it suitable for drinking.

A novel component is the Microbial Check Valve (MCV), an iodinated resin that restricts the growth of microbes in the water. The main benefit is that it does not require power

for operation. In addition, it iodizes the purified water and thus enhances its nutritional value. The water purification technology uses chemical adsorption, ion exchange and ultra filtration processes to yield safe, drinkable water.

Water purification systems using this technology are installed throughout the world, in countries like Mexico, Central and South America, Pakistan and India.

**2. Solar Cells:** Solar energy is the most abundant, pollution free energy available ubiquitously. But harnessing it for the benefit of humankind is a problem as conventional solar cells provide very less efficiency. A major part of the ISS is its solar panels. It has 8 wings, each containing about 33000 solar cells! But the efficiency of these solar cells is only about 14%. NASA's Photovoltaics Division is dedicated to research on solar cells to make them more efficient. Advances in Nanotechnology brought about the development of carbon nanotube based solar cells which resulted in increasing the surface area of panels, which in turn, increased the area of absorption of sunlight, thus producing more energy. Also, these panels are self cleaning, they require no maintenance.

To develop remotely piloted aircraft to fly at high altitudes for long durations, highly efficient and lightweight solar cells are required, which should also be cost-effective. NASA has developed single crystal silicon solar cells that fit the bill perfectly and which provide up to 50% more power than conventional solar cells. A multitude of consumer products benefit from these new advancements.

## Food Safety and Enrichment

**1. Space-safe Food:** Astronauts cannot carry large quantities of food during spaceflight. The food has to be absolutely free of toxins and disease-producing bacteria. The 1995



Credit: NASA

space shuttle Columbia mission included an experiment to demonstrate how food could be grown in greenhouses by astronaut pioneers on the moon.

Following this mission, NASA developed a device called an ethylene scrubber. This device circulates the greenhouse air through tubes coated in titanium dioxide and then exposes it to ultraviolet light. As a result, the ethylene gas emitted by plants is converted to water and carbon dioxide, which helps the plant to grow better. Additionally, this device destroyed air borne pathogens such as viruses, mold, bacteria and fungi. The systems incorporating this device do not create harmful byproducts such as ozone. Not only is this advanced technology used by commercial food companies, it is available for home use also.

**2. Enriched Baby Food:** These days, all infant food supplements advertise that it is enriched with DHA and/or ARA. DHA is an acronym for Docosa Hexaenoic Acid and ARA is Arachidonic Acid. These are omega 3 fatty acids that are primary structural components of the human brain, cerebral cortex, skin and retina.

It will be interesting to know how these supplements were discovered by NASA! NASA researchers were trying to create oxygen in outer space through the process of photosynthesis. The algae used was bread mold. They discovered that certain micro algae contain essential fatty acids that are present in human breast milk. These are DHA and ARA. Now, most baby foods are enriched with these components and doctors especially recommend them for proper growth of prematurely born babies.

**3. Freeze Drying:** Many cartoons show a small morsel of food in a plate, which when sprinkled with water, grows

into a heap of tasty dish. This has now been transformed from fiction to fact, thanks to space research. In earlier space missions, astronauts ate their food from aluminum tubes, similar to toothpaste containers. This food took up less space, while at the same time, could be stored for a long time, both characteristics which are desirable for prolonged space missions.

Now, after extensive research, NASA scientists have developed the technique of freeze drying, which makes the food weigh only one-fifth of its weight before drying. At the same time, its nutrition value does not diminish more than 2%. In this process, the food is instantly frozen and vacuum packed. This removes most of the moisture from the food. To make it eatable, a suitable amount of water is added. Akin to fiction, the food regains its original flavour, texture and appearance.

## Health and Medicine

**1. Infrared Ear Thermometers:** IRAS stands for Infrared Astronomical Satellite. This satellite, developed by the Jet Propulsion Laboratory of NASA, was launched into space to measure the temperature of stars and planets, by sensing the infrared radiation emitted by these celestial bodies. The same technology was adapted to create the IR ear thermometers which measure the thermal radiation emitted by the eardrum. This is ideal for use with infants and comatose patients. Also, as the thermometers do not come in contact with the body, there is no risk of infection to other patients.

**2. LASIK:** It is an acronym for Laser Assisted In Situ Keratomileusis. It is commonly known as Laser eye surgery. The laser technology was initially developed for docking



Credit: spinoff.nasa.gov

of space vehicles to service satellites. The high precision achieved by using lasers was also used for target tracking and control of firing of weapons. Due to its extraordinary accuracy, the same technique is effectively used in surgery for removing various ophthalmic defects.

**3. Artificial Limbs:** There are many innovations in space science in robotics and shock absorbing materials. This has led to the development of artificial muscle systems with robotic sensing capabilities. The prostheses are evolving to



Artificial limbs

be lightweight and more flexible and durable due to advances in space research.

**4. Heart Pump:** Every year, thousands of patients throughout the world await heart transplants. Donor hearts are not easily available. In the meantime, to keep the patient alive, NASA, in collaboration with leading cardiac surgeons, has developed a Ventricular Assist Device, commonly known as a heart



Ventricular Assist Device

pump. This heart pump is only 10% the size of other devices and can operate up to 8 hours on batteries. This enables the patients to continue with their daily routine unhindered.

### Ventricular Assist Device

**5. Invisible Braces:** In its research on ceramics as protection of IR (Infra Red) antenna from heat seeking missile trackers, NASA has developed a ceramic known as Translucent Polycrystalline Alumina (TPA). This material is now used in teeth braces for teenagers all over the world, making their smiles beautiful!

### Comfort and Lifestyle

**1. Scratch Resistant Lenses:** Who wouldn't want sunglasses that are resistant to scratches, thus making them more durable? NASA developed the technology for protecting space equipment and helmet visors of astronauts from scratches initially, which is now used extensively in eyeglasses of all types.

**2. Space Blankets:** In 1964, NASA developed blankets that keep the astronauts warm by reflecting Infrared radiation. These blankets were also very light in weight. Nowadays, these blankets are often a part of first aid kits of rescuers.

**3. Temper Foam:** It is also known as memory foam. It is foam that matches the pressure exerted on it and slowly returns to its original shape once the pressure is removed. There is no shock or bounce on sudden impact; a three-inch foam pad has the ability to absorb the impact of a 10-foot fall by an adult.

It was initially developed to protect aircraft passengers in case of air crash by the AMES research laboratory of NASA. Nowadays it is used in many industries in varied applications, such as automobiles, motorcycles, sports safety equipment, furniture and in human and animal prostheses. Amusement park rides, horseback saddles and archery targets also make extensive use of this magical springback foam. Temper foam technology has brought about custom-moldable materials offering the natural look and feel of flesh, as well as preventing friction between the skin and the prosthesis, and heat/moisture buildup.

These are but a few examples of how space research has helped to improve the quality of life of millions of people. The GPS that we use every day while commuting, the portable cordless vacuum cleaner, remotely controlled ovens in our homes, the high fidelity cameras in our cell phones and many such technologies are spinoffs of space research.

So, "Rocket Science" is not limited to an elite few; it touches and improves the life of the common man also.

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