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John Lash

NASA

Spinoffs

Bringing Space down to Earth

Join us in our Search for Extra-Terrestrial Intelligence from your personal computer!

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Some of the most frequently asked questions about the U.S. space program are "Why go into space when we have so many problems here on Earth?" and "What does the space program do for me?" These are legitimate questions and unfortunately not enough people have been made aware of the vast benefits the space program provides that increase the quality of our daily lives. 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.

Out of a \$2.4 trillion budget, less than 0.8% is spent on the entire space program! That's less than 1 penny for every dollar spent. The average American spends more their budget on their cable bill, eating out or entertainment than this yet the benefits of space flight are remarkable. It has been conservatively estimated by U.S. space experts that for every dollar the U.S. spends on R and D in the space program, it receives \$7 back in the form of corporate and personal income taxes from increased jobs and economic growth. Besides the obvious jobs created in the aerospace industry, thousands more are created by many other companies applying NASA technology in non-space related areas that affect us daily. One cannot even begin to place a dollar value on the lives saved and improved lifestyles of the less fortunate. Space technology benefits everyone and a rising technological tide does raise all boats.

One small example is the Hubble Space Telescope. Much maligned at first because

its flawed optics, it still produced better photographs than anything here on Earth. Once fixed, it has produced even more startling scientific data which we have only begun to understand and apply. One of the many spinoffs from the Hubble telescope is the use of its Charge Coupled Device (CCD) chips for [digital imaging breast biopsies](#). The resulting device images breast tissue more clearly and efficiently than other existing technologies. The CCD chips are so advanced that they can detect the minute differences between a malignant or benign tumor without the need for a surgical biopsy. This saves the patient weeks of recovery time and the cost for this procedure is hundreds of dollars vs. thousands for a surgical biopsy. With over 500,000 women needing biopsies a year the economic benefit, per year, is tremendous and it greatly reduces the pain, scarring, radiation exposure, time, and money associated with surgical biopsies.

Below is a "small" sampling of the many other ways that space technology has improved our lives and benefited mankind. It is truly a remarkable list and not nearly complete but I believe you will begin to appreciate the answers to "Why do we go to space" and "What does the space program do for me?" So the next time you hear these questions being asked, you will be able to explain it.

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Computer Technology - NASA Spinoffs

GROUND PROCESSING SCHEDULING SYSTEM - Computer-based scheduling system that uses artificial intelligence to manage thousands of overlapping activities involved in launch preparations of NASA's Space Shuttles. The NASA technology was licensed to a new company which developed commercial applications that provide real-time planning and optimization of manufacturing operations, integrated supply chains, and customer orders.

SEMICONDUCTOR CUBING - NASA initiative led to the Memory Short Stack three-dimensional semiconductor package in which dozens of integrated circuits are stacked one atop another to form a cube, offering faster computer processing speeds, higher levels of integration, lower power requirements than conventional chip sets and dramatic reduction in the size and weight of memory-intensive systems, such as medical imaging devices.

STRUCTURAL ANALYSIS - This NASA program, originally created for spacecraft design, has been employed in a broad array of non-aerospace applications, such as automobile industry, manufacture of machine tools, and hardware designs.

WINDOWS VISUAL NEWS READER (Win Vn) - Software program developed to support payload technical documentation at Kennedy Space Center, allowing the exchange of technical information among a large group of users. WinVn is an enabling technology product that provides countless people with Internet access otherwise beyond their grasp, and it was optimized for organizations that have direct Internet access.

AIR QUALITY MONITOR - Utilizing a NASA-developed, advanced analytical technique software package, an air quality monitor system was created, capable of separating the various gases in bulk smokestack exhaust streams and determining their

amount of individual gases present within the stream for compliance with smoke emission standards.

VIRTUAL REALITY - NASA-developed research allows a user, with assistance from advanced technology devices, to figuratively project oneself into a computer-generated environment, matching the user's head motion, and, when coupled with a stereo viewing device and appropriate software, creates a telepresence experience.

Other spinoffs in this area include: Advanced keyboards, Customer Service Software, Database Management System, Laser Surveying, Aircraft controls, Lightweight Compact Disc, Expert System Software, Microcomputers, and Design Graphics.

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Consumer/Home/Recreation - NASA Spinoffs

ENRICHED BABY FOOD - A microalgae-based, vegetable-like oil called Formulaid developed from NASA-sponsored research on long duration space travel contains two essential fatty acids found in human milk but not in most baby formula believed to be important for infants' mental and visual development.

WATER PURIFICATION SYSTEM - NASA-developed municipal-size water treatment system for developing nations, called the Regenerable Biocide Delivery Unit, uses iodine rather than chlorine to kill bacteria.

SCRATCH-RESISTANT LENSES - A modified version of a dual ion beam bonding process developed by NASA involves coating the lenses with a film of diamond-like carbon that not only provides scratch resistance, but also decreases surface friction, reducing water spots.

POOL PURIFICATION - Space technology designed to sterilize water on long-duration spacecraft applied to swimming pool purification led to a system that uses two silver-copper alloy electrodes that generate silver and copper ions when an electric current passes through them to kill bacteria and algae without chemicals.

RIBBED SWIMSUIT - NASA-developed riblets applied to competition swimsuits resulted in flume testing of 10 to 15 percent faster speeds than any other world class swim-suit due to the small, barely visible grooves that reduce friction and aerodynamic drag by modifying the turbulent airflow next to the skin.

GOLF BALL AERODYNAMICS - A recently designed golf ball, which has 500 dimples arranged in a pattern of 60 spherical triangles, employs NASA aerodynamic technology to create a more symmetrical ball surface, sustaining initial velocity longer and producing a more stable ball flight for better accuracy and distance.

PORTABLE COOLERS/WARMERS - Based on a NASA-inspired space cooling system employing thermoelectric technology, the portable cooler/warmer plugs into the cigarette lighters of autos, recreational vehicles, boats, or motel outlets. Utilize one or two miniaturized modules delivering the cooling power of a 10-pound block

ice and the heating power of up to 125 degrees Fahrenheit.

SPORTS TRAINING - Space-developed cardio-muscular conditioner helps athletes increase muscular strength and cardiovascular fitness through kinetic exercise.

ATHLETIC SHOES - Moon Boot material encapsulated in running shoe midsole improve shock absorption and provides superior stability and motion control.

Other spinoffs in this area include: Dustbuster, shock-absorbing helmets, home security systems, smoke detectors, flat panel televisions, high-density batteries, trash compactors, food packaging and freeze-dried technology, cool sportswear, sports bras, hair styling appliances, fogless ski goggles, self-adjusting sunglasses, composite golf clubs, hang gliders, art preservation, and quartz crystal timing equipment.

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Environmental and Resource Management - NASA Spinoffs

MICROSPHERES - The first commercial products manufactured in orbit are tiny microspheres whose precise dimensions permit their use as reference standards for extremely accurate calibration of instruments in research and industrial laboratories. They are sold for applications in environmental control, medical research, and manufacturing.

SOLAR ENERGY - NASA-pioneered photovoltaic power system for spacecraft applications was applied to programs to expand terrestrial applications as a viable alternative energy source in areas where no conventional power source exists.

WEATHER FORECASTING AID - Space Shuttle environmental control technology led to the development of the Barorator which continuously measures atmospheric pressure and calculates the instantaneous rate of change.

FOREST MANAGEMENT - A NASA-initiated satellite scanning system monitors and maps forestation by detecting radiation reflected and emitted from trees.

SENSORS FOR ENVIRONMENTAL CONTROL - NASA development of an instrument for use in space life support research led to commercial development of a system to monitor an industrial process stream to assure that the effluent water's pH level is in compliance with environmental regulations.

WIND MONITOR - Development of Jimsphere wind measurement balloon for space launches allows for making high resolution measurements of the wind profile for meteorological studies and predictions.

TELEMETRY SYSTEMS - A spinoff company formed to commercialize NASA high-data-rate telemetry technology, manufactures a high-speed processing system for commercial communications applications.

PLANT RESEARCH - NASA research on future moon and Mars bases is investigating using plants for food, oxygen, and water to reduce the need for outside supplies. This research utilizes Hydroponics (liquid nutrient solutions) instead of soil.

to support plant growth and finds applications for vegetable production on Earth.

FIRE RESISTANT MATERIAL - Materials include chemically-treated fabric for sheets, uniforms for hazardous material handlers, crew's clothing, furniture, interior walls of submersibles and auto racer and refueler suits.

RADIATION INSULATION - Aluminized polymer film is highly effective radiation barrier for both manned and unmanned spacecraft. Variations of this space-devised material are also used as an energy conservation technique for homes and offices. The materials are placed between wall studs and exterior facing before siding or between roof support and roof sheathing. The radiant barrier blocks 95% radiant energy. Successful retrofit installations include schools and shrink wrap ovens.

Other spinoffs in this area include: Whale identification method, environmental analysis, noise abatement, pollution measuring devices, pollution control devices, smokestack monitor, radioactive leak detector, earthquake prediction system, sewer treatment, energy saving air conditioning, and air purification.

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Health and Medicine - NASA Spinoffs

DIGITAL IMAGING BREAST BIOPSY SYSTEM - The LORAD Stereo Guide Breast Biopsy system incorporates advanced Charge Coupled Devices (CCDs) as part of a digital camera system. The resulting device images breast tissue more clearly and efficiently. Known as stereotactic large-core needle biopsy, this nonsurgical system developed with Space Telescope Technology is less traumatic and greatly reduces pain, scarring, radiation exposure, time, and money associated with surgical biopsy.

BREAST CANCER DETECTION - A solar cell sensor is positioned directly beneath x-ray film, and determines exactly when film has received sufficient radiation and has been exposed to optimum density. Associated electronic equipment then sends a signal to cut off the x-ray source. Reduction of mammography x-ray exposure reduces radiation hazard and doubles the number of patient exams per machine.

LASER ANGIOPLASTY - Laser angioplasty with a "cool" type of laser, called an excimer laser, does not damage blood vessel walls and offers precise non-surgical cleanings of clogged arteries with extraordinary precision and fewer complications than in balloon angioplasty.

ULTRASOUND SKIN DAMAGE ASSESSMENT - Advanced instrument using NASA ultrasound technology enables immediate assessment of burn damage depth improving patient treatment, and may save lives in serious burn cases.

HUMAN TISSUE STIMULATOR - Employing NASA satellite technology, the device is implanted in the body to help patient control chronic pain and involuntary motion disorders through electrical stimulation of targeted nerve centers or particular areas of the brain.

COOL SUIT - Custom-made suit derived from space suits circulates coolant through

tubes to lower patient's body/ temperature, producing dramatic improvement of symptoms of multiple sclerosis, cerebral palsy, spina bifida and other conditions.

PROGRAMMABLE PACEMAKER - Incorporating multiple NASA technology the system consists of the implant and a physician's computer console containing the programming and a data printer. Communicates through wireless telemetry signals

OCULAR SCREENING - NASA image processing techniques are used to detect problems in very young children. An electronic flash from a 35-millimeter camera sends light into the child's eyes, and a photorefractor analyzes the retinal reflexes, producing an image of each eye.

AUTOMATED URINALYSIS - NASA fluid dynamics studies helped development of system that automatically extracts and transfers sediment from urine sample to an analyzer microscope, replacing the manual centrifuge method.

MEDICAL GAS ANALYZER - Astronaut-monitoring technology used to develop system to monitor operating rooms for analysis of anesthetic gasses and measurement of oxygen, carbon dioxide, and nitrogen concentrations to assure proper breathing environment for surgery patients.

VOICE-CONTROLLED WHEELCHAIR - NASA teleoperator and robot technology used to develop chair and manipulator that respond to 35 one-word voice commands utilizing a minicomputer to help patient perform daily tasks, like picking up packages, opening doors, and turning on appliances.

Other spinoffs in this area include: Arteriosclerosis detection, ultrasound scanner, automatic insulin pump, portable x-ray device, invisible braces, dental arch wire, palate surgery technology, clean room apparel, implantable heart aid, MRI, bone analyzer, and cataract surgery tools.

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Industrial Productivity/Manufacturing Technology - NASA Spinoffs

MAGNETIC LIQUIDS - Based on the NASA-developed ferrofluid concept involving synthetic fluids that can be positioned and controlled by magnetic force, ferrofluidic seal was initially applied in a zero-leakage, nonwearing seal for the rotating shaft of a system used to make semiconductor chips, solving a persistent problem of contamination due to leaking seals.

WELDING SENSOR SYSTEM - Laser-based automated welder for industrial use incorporates a laser sensor system originally designed for Space Shuttle External Tank to track the seam where two pieces of metal are to be joined, measures gaps and minute misfits, and automatically corrects the welding torch distance and height.

MICROLASERS - Based on a concept for optical communications over interplanetary distances, microlasers were developed for the commercial market to transmit communication signals and to drill, cut, or melt materials.

MAGNETIC BEARING SYSTEM - Bearings developed from Space Shuttle

designs support moving machinery without physical contact, permitting motion without friction or wear, and are now used in electric power generation, petroleum refining, machine tool operation, and natural gas pipelines.

ENGINE LUBRICANT - A NASA-developed plasma-sprayed coating is used to coat valves in a new, ten-inch-long, four-cylinder rotary engine, eliminating the need for lubricating the rotorcam, which has no crankshaft, flywheel, distributor, or water pump.

INTERACTIVE COMPUTER TRAINING - Known as Interactive Multimedia Training (IMT), originally developed to train astronauts and space operations personnel, now utilized by the commercial sector to train new employees and upgrade worker skills, using a computer system that engages all the senses, including text, video, animation, voice, sounds, and music.

HIGH-PRESSURE WATERSTRIPPING - Technology developed for preparing Space Shuttle solid rocket boosters first evolved into the U.S. Air Force's Large Aircraft Robotic Paint Stripping (LARPS) system, and now used in the commercial airline industry, where the waterjet processing reduces coating removal time by 90 percent, using only water at ultra-high pressures up to 55,000 psi.

ADVANCED WELDING TORCH - Based on the Variable Polarity Plasma Arc welding technology, a handheld torch originally developed for joining light alloys used in NASA's External Tank, is now used by major appliance manufacturers for sheet metal welding.

Other spinoffs in this area include: Gasoline vapor recovery, self-locking fastener, machine tool software, laser wire stripper, lubricant coating process, wireless communications, engine coatings, and engine design.

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Public Safety - NASA Spinoffs

RADIATION HAZARD DETECTOR - NASA technology has made commercially available new, inexpensive, conveniently carried device for protection of people exposed to potentially dangerous levels of microwave radiation. Weighing only 4 ounces and about the size of a cigarette pack, it can be carried in a shirt pocket or clipped to a belt. Unit sounds an audible alarm when microwave radiation reaches preset level.

EMERGENCY RESPONSE ROBOT - Remotely-operated robot reduces human injury levels by performing hazardous tasks that would otherwise be handled by humans.

PERSONAL ALARM SYSTEM - Pen-sized ultrasonic transmitter used by prison guards, teachers, the elderly, and disabled to call for help is based on space telemedicine technology. Pen transmits a silent signal to receiver that will display the exact location of the emergency.

EMERGENCY RESCUE CUTTERS - Lightweight cutters for freeing accident

victims from wreckage developed using NASA pyrotechnic technology.

FIREMAN'S AIR TANKS - Lighter-weight firefighter's air tanks have been developed. New back-pack system weighs only 20 lbs. for 30 minute air supply, 11 lbs. less than conventional firefighting tanks. They are pressurized at 4,500 psia (twice current tanks). A warning device tells the fireman when he or she is running out of air.

PERSONAL STORM WARNING SYSTEM - Lightning detector gives 30-minute warning to golfers, boaters, homeowners, business owners, and private pilots.

SELF-RIGHTING LIFE RAFT - Developed for the Apollo program, fully inflates in 12 seconds and protects lives during extremely adverse weather conditions with self-righting and gravity compensation features.

Other spinoffs in this area include: Storm warning services (Doppler radar), firefighters' radios, lead poison detection, fire detector, flame detector, corrosion protection coating, protective clothing, and robotic hands.

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Transportation - NASA Spinoffs

STUDLESS WINTER TIRES - Viking Lander parachute shroud material is adapted and used to manufacture radial tires, increasing the tire material's chainlike molecular structure to five times the strength of steel should increase tread life by 10,000 miles.

BETTER BRAKES - New, high-temperature composite space materials provide better brake linings. Applications include trucks, industrial equipment and passenger cars.

TOLLBOOTH PURIFICATION - A laminar airflow technique used in NASA clean rooms for contamination-free assembly of space equipment is used at tollbooths on bridges and turnpikes to decrease the toll collector's inhalation of exhaust fumes.

WEIGHT SAVING TECHNOLOGY - NASA research on composite materials is used to achieve a 30-percent weight reduction in a twin-turbine helicopter, resulting in a substantial increase in aircraft performance.

IMPROVED AIRCRAFT ENGINE - Multiple NASA developed technological advancements resulted in a cleaner, quieter, more economical commercial aircraft engine known as the high bypass turbofan, featuring a 10-percent reduction in fuel consumption, lower noise levels, and emission reductions of oxides of nitrogen, carbon monoxide, and unburned hydrocarbons.

ADVANCED LUBRICANTS - An environmental-friendly lubricant designed to support the Space Shuttle Mobile Launcher Platform led to the development of three commercial lubricants for railroad track maintenance, for electric power company corrosion prevention, and as a hydraulic fluid with an oxidation life of 10,000 hours.

ENERGY STORAGE SYSTEM - The Flywheel Energy Storage system, derived

from two NASA-sponsored energy storage studies, is a chemical-free, mechanical battery that harnesses the energy of a rapidly spinning wheel and stores it as electricity with 50 times the capacity of a lead-acid battery, very useful for electric vehicles.

NEW WING DESIGN FOR CORPORATE JETS - NASA-developed computer programs resulted in an advanced, lighter, more aerodynamically-efficient new wing for Gulfstream business aircraft.

AIDS TO SCHOOL BUS DESIGN - Manufacturer uses three separate NASA-developed technologies originally developed for aviation and space use in their design and testing of a new school bus chassis. These technologies are a structural analysis computer program infrared stress measurement system, and a ride quality meter system.

Other spinoffs in this area include: Safer bridges, emission testing, airline wheelchairs, electric car, auto design, methane-powered vehicles, windshear prediction, and aircraft design analysis.

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