CAREERS AND SPIN-OFFS RESOURCE PAGES

CAREER: Cardiographic technician (301)
SPIN-OFF: *Artificial Heart* - The technology used in Space Shuttle fuel pumps led to the development of a miniaturized ventricular assist pump by NASA and renowned heart surgeon Dr. Michael DeBakey. The tiny pump – 2-inches long, 1-inch in diameter and weighing less than four ounces – is currently undergoing clinical trials in Europe where it has been successfully implanted into more than 20 people.

CAREER: Race car driver/Professional athlete (243)
SPIN-OFF: *Automotive Insulation* - Materials from the Space Shuttle thermal protection system are used on NASCAR racing cars to protect drivers from the extreme heat generated by the engines.

CAREER: CT technologist (321)
SPIN-OFF: *Balance Evaluation Systems* - Devices built to measure the equilibrium of Space Shuttle astronauts when they return from space are widely used by major medical centers to diagnose and treat patients suffering head injury, stroke, chronic dizziness and central nervous system disorders.

CAREER: Pathologist (285)
SPIN-OFF: *Bioreactor* - Developed for Space Shuttle medical research, this rotating cell culture apparatus simulates some aspects of the space environment, or microgravity, on the ground. Tissue samples grown in the bioreactor are being used to design therapeutic drugs and antibodies. Some scientists believe the bioreactor will routinely produce human tissue for research and transplantation.

CAREER: Phlebotomist (303)
SPIN-OFF: *Diagnostic Instrument* - NASA technology was used to create a compact laboratory instrument for hospitals and doctor offices that more quickly analyzes blood, accomplishing in 30 seconds what once took 20 minutes.

CAREER: CAD designer (139)
SPIN-OFF: *Gas Detector* - A gas leak detection system, originally developed to monitor the Shuttle's hydrogen propulsion system, is being used by the Ford Motor Company in the production of a natural gas-powered car.

CAREER: Firefighter (341)
SPIN-OFF: *Infrared Camera* - A sensitive infrared hand-held camera that observes the blazing plumes from the Shuttle also is capable of scanning for fires. During the brush fires that ravaged Malibu, CA in 1996, the camera was used to point out hot spots for firefighters.

CAREER: Nurse practitioner (292)
SPIN-OFF: *Infrared Thermometer* - Infrared sensors developed to remotely measure the temperature of distant stars and planets, led to the development of the hand-held optical sensor thermometer. Placed inside the ear canal, the thermometer provides an accurate reading in two seconds or less.

CAREER: Gemologist (592)
SPIN-OFF: *Jewelry Design* - Jewelers no longer have to worry about inhaling dangerous asbestos fibers from the blocks they use as soldering bases. Space Shuttle heat shield tiles offer jewelers a safer soldering base with temperature resistance far beyond the 1,400 degrees Fahrenheit generated by the jeweler's torch.

CAREER: Military/Combat specialty occupations (626)
SPIN-OFF: *Land Mine Removal Device* - The same rocket fuel that helps launch the Space Shuttle is now being used to save lives by destroying land mines. A flare device, using leftover fuel donated by NASA, is placed next to the uncovered land mine and is ignited from a safe distance using a battery-triggered electric match. The explosive burns away, disabling the mine and rendering it harmless.

CAREER: College faculty (224)
SPIN-OFF: *Lifesaving Light* - Special lighting technology developed for plant growth experiments on Space Shuttle missions is now used to treat brain tumors in children. Doctors at the Medical College of Wisconsin in Milwaukee use light emitting diodes in a treatment called photodynamic therapy, a form of chemotherapy, to kill cancerous tumors.

CAREER: Orthotist (636)
SPIN-OFF: *Prosthesis Material* - Responding to a request from the orthopedic appliance industry, NASA recommended that the foam insulation used to protect the Shuttle's external tank replace the heavy, fragile plaster used to produce master molds for prosthetics. The new material is light, virtually indestructible and easy to ship and store.

CAREER: Paramedic (309)
SPIN-OFF: *Rescue Tool* - Rescue squads have a new extrication tool to help remove accident victims from wrecked vehicles. The hand-held device requires no auxiliary power systems or cumbersome hoses and is 70 percent cheaper than previous rescue equipment. The cutter uses a miniature version of the explosive charges that separate devices on the Shuttle.

CAREER: Radiologic technician (321)
SPIN-OFF: *Digital signal-processing techniques* **-** Originally developed to create computer-enhanced pictures of the moon for the Apollo Program, digital signal-processing techniques are an indispensable part of Computer-Aided Tomography (CAT) scan and Magnetic Resonance Imaging (MRI) technologies used today in hospitals worldwide.

CAREER: Taxi driver (611)
SPIN-OFF: *Vehicle Tracking System* - Tracking information originally used onboard Space Shuttle missions now helps track vehicles on Earth. This commercial spin-off allows vehicles to transmit a signal back to a home base. Municipalities today use the software to track and reassign emergency and public works vehicles. It also is used by vehicle fleet operations, such as taxis, armored cars and vehicles carrying hazardous cargo.

CAREER: Photographer (260)
SPIN-OFF: *Video Stabilization Software* - Image-processing technology used to analyze Space Shuttle launch video and to study meteorological images also helps law enforcement agencies improve crime-solving video. The technology removes defects due to image jitter, image rotation and image zoom in video sequences. The technology also may be useful for medical imaging, scientific applications, and home video.

CAREER: Personal trainer (379)
SPIN-OFF: *SpiraFlex® Resistance Exercise Device* - The SpiraFlex system, presently aboard the International Space Station, is used by the crewmembers as a primary countermeasure against musculoskeletal degradation caused by microgravity. Using SpiraFlex technology, Schwinn Cycling & Fitness, Inc., launched an international fitness program for health clubs and select retail distributors, called RiPP™ (Resistance Performance Program).

CAREER: Machine operator (562)
SPIN-OFF: *ZipNut* - A fastening device that is pushed rather than turned, ZipNut was originally developed for Shuttle Flight STS-29 and then selected to be a key mechanical element for robotic assembly of the International Space Station. Installation time of Space Station trusses was improved greatly because the bolts could be pushed into place rather than having to be turned like conventional nut/bolt combinations. On Earth, the ZipNut can be used for a variety of applications, including firefighting, aerospace, gas fittings, and manufacturing. In 1999, 45 stainless steel 1-1/8 Heavy Hex ZipNuts were used by the Department of Energy Savannah River Project to speed up maintenance in a high radiation area during a nuclear outage. The ZipNuts were successful and reduced worker radiation.

CAREER: Marine biologist (147)
SPIN-OFF: *Personal Cabin Pressure Altitude Monitor and Warning System* is a hand-held personal safety device that warns pilots of potentially dangerous or deteriorating cabin pressure altitude conditions before hypoxia becomes a threat. Invented by a NASA Applied Research and Development Engineer to give Space Shuttle and International Space Station crew members an additional, independent notification of any depressurization events, the device benefits both pressurized and non-pressurized aircraft operations. Applications beyond aviation and aerospace include scuba diving, skydiving, mountain climbing, meteorology, altitude chambers, and underwater habitats.

CAREER: Poultry farmer (37)
SPIN-OFF: *AiroCide TiO2* - is an air-purifier that kills 93.3 percent of airborne pathogens that pass through it, including *Bacillus anthraci*, more commonly known as anthrax. It is a highly effective device used by the produce industry to aid in preserving the freshness of fruits, vegetables, and flowers. The products was first integrated into a pair of International Space Station plant-growth chambers known as ASTROCULTURE™ and ADVANCED ASTROCULTURE.™ Both chambers have housed commercial plant growth experiments in space.

CAREER: Nursing assistant / Home health aide (332)
SPIN-OFF: *Robotic Arms* - A series of autonomous robotic arms developed to recover crew or tools outside of the International Space Station have found application on Earth, in fields ranging from human-collaborative medical surgery to emergency response to chemical, biological, and nuclear materials. The Robotic Arm can reach around objects and clasp them with the use of gear-free cable drives to manipulate its joints. With a human-scale 3-foot-reach, the arms are so quick that they can grab a major-league fastball, yet so sensitive that they respond to the gentlest touch. The commercial manufacturer is also targeting markets such as physical therapy, rehabilitation, assisted-living aids, metrology, short-run manufacturing, and entertainment.

CAREER: Short order cook (352)
SPIN-OFF: *Fast Cooking* **-** Ovens designed for NASA's Space Station Freedom use new air impingement technology. Jets of hot air at the top and bottom of the oven are focused on the food, rather than heating the oven cavity as in a traditional thermal oven. By heating the food directly, foods cook faster and more consistently, retaining flavor and texture.

CAREER: Sewage treatment plant operator (586)
SPIN-OFF: *Waste water purification* **-** Originally developed for flight aboard the Space Station, NASA's waste water purification uses a direct osmosis process followed by a reverse osmosis treatment. Because the product extracts water from a waste product, it is being used in landfills.

CAREER: Hotel desk clerk (434)
SPIN-OFF: *360º Camera* - NASA technology used for guiding space robots in the space shuttle and space station programs, as well as research in cryogenic wind tunnels and for remote docking of spacecraft, employs panoramic cameras. Images are captured in their entirety in a 360-degree immersive digital representation, and the viewer can navigate to any desired direction within the image. Several car manufacturers already use this technology to provide customers a look at their latest line-up of automobiles, and the panoramic camera is also being used to show hotel accommodations and for non-invasive surgical procedures.

CAREER: Automotive service technicians (523)
SPIN-OFF: *Insulation barriers* made of aluminum foil laid over a core of propylene or mylar, which protected astronauts and their spacecraft's delicate instruments from radiation, are used to protect cars and trucks and to dampen engine and exhaust noise.

CAREER: Professional athlete (243)
SPIN-OFF: *Golf Clubs***:** A material designed for the space station aided in the development of Zeemet, a proprietary, high-damping shape memory alloy for the golf industry. The Nicklaus Golf Company created a new line of golf clubs using Zeemet inserts. Its super elastic and high damping attributes translate into more spin on the ball, greater control, and a solid feel.

CAREER: Ophthalmic medical assistant (328)
SPIN-OFF: *The Low Vision Enhancement System* (LVES) - is a video headset that offers people with low vision a view of their surroundings equivalent to the image on a five-foot television screen four feet from the viewer. For many people with low vision, it eases everyday activities such as reading, watching TV, and shopping. Researchers used NASA technology for computer processing of satellite images and head-mounted vision enhancement systems originally intended for the Space Station.

CAREER: Physical therapist (282)
SPIN-OFF: *Tomography Inspection System* finds imperfections in aerospace structures and components, such as castings, rocket motors and nozzles. The industrial version, or medical CAT scanner, searches the human body for tumors or other abnormalities.

CAREER: Nuclear reactor technicians/Power plant operator (582)
SPIN-OFF: *Cool suits*, which kept Apollo astronauts comfortable during moon walks, are today worn by race car drivers, nuclear reactor technicians, shipyard workers, people with multiple sclerosis and kids with a congenital disorder known as *hypohidrotic ectodermal displasia*.

CAREER: Hiking tour guide (638)
SPIN-OFF: *Freeze-dried food* solved the problem of what to feed an astronaut on the long-duration Apollo missions.

CAREER: Carpenter (470)
SPIN-OFF: *Cordless power tools and appliances* are one of the most successful commercial spin-offs of space-based technology.

CAREER: Athletic trainer (635)
SPIN-OFF: *A cardiovascular conditioner* developed for astronauts in space led to the development of a physical therapy and athletic development machine used by football teams, sports clinics and medical rehabilitation centers.

CAREER: Medical appliance technicians (646)
SPIN-OFF: *Chemical Process* - Kidney dialysis machines were developed as a result of a NASA developed chemical process that could remove toxic waste from used dialysis fluid.

CAREER: Designer (236)
SPIN-OFF: *Blow Molding* - A stress free "blow molding" process adapted from NASA space suit design is also used in shoe manufacturing. Athletic shoe design and manufacture also benefited from Apollo. Space suit technology is incorporated into a shoe's external shell.

CAREER: Order clerk/Sales representatives (438)
SPIN-OFF: *Vacuum metallizing techniques* led to an extensive line of commercial products, from insulated outer garments to packaging for foods, from wall coverings to window shades, from life rafts to candy wrappings and from reflective blankets to photographic reflectors.

CAREER: Biological scientist (147)
SPIN-OFF: *Water purification technology* used on the Apollo spacecraft is now employed in several spin-off applications to kill bacteria, viruses and algae in community water supply systems and cooling towers. Filters mounted on faucets can reduce lead in water supplies.

CAREER: Food service manager (43)
SPIN-OFF: *Food-preparation method* – NASA's food preparation method, designed to feed astronauts, is used by hospital food service systems. The method employs a cook/chill concept for serving food. It allows staff to prepare food well in advance, and to maintain heat, visual appeal, and nutritional value while reducing operating costs.

CAREER: Occupational health and safety inspector (315)
SPIN-OFF: *Retroreflector*. A hollow retroreflector, a mirror-like instrument that reflects light and other radiation back to the source, is used as a sensor to detect the presence of hazardous gases in oil fields, refineries, offshore platforms, chemical plants, waste storage sites and other locations where gases could be released into the environment.

CAREER: Machine tenders - metal (562)
SPIN-OFF: *A process for bonding dry lubricant to space metals* led to the development of surface enhancement coatings, or synergistic coatings, which are used in applications from pizza making to laser manufacture. Each coating is designed to protect a specific metal or group of metals to solve problems encountered under operating conditions, such as resistance to corrosion and wear.