NASA Spin-Offs

Teacher Overview:
In this activity students will identify Spin-offs that are directly related to technology created by NASA programs.

Objectives:
To expose students to spin-offs from NASA technology through a word search.

Materials: none (Teacher Sheets)

Florida State Standards Met:
SC.A.1.3.1, SC.B.2.3.1, SC.C.2.3.2, SC.C.2.3.3, SC.C.2.3.6, SC.H.1.3.3, SC.H.1.3.6, SC.H.3.3.1, SC.H.3.3.3, SC.H.3.3.4, SC.H.3.3.6

Action:
1. Students will read What Can I Wear Today?
2. Students will complete NASA Spin-Offs Word Search.
3. Students will refer to More NASA Spin-Offs for information regarding the use of space spin-off technology.

What Can I Wear Today?

Courtesy of NASA's Human Exploration and Development of Space Enterprise Published by NASAexplores: May 31, 2001

You wouldn't wear the outer covering of an airplane to the swimming pool. You wouldn't wear moon boots to a track meet. Indirectly, though, these NASA creations have led to the development of quite a few items of clothing. NASA's Technology Transfer and Technology Spin-off programs encourage private enterprise to use and adapt space research for use in the public and commercial sectors.

The outer covering to an airplane? That technology, developed by NASA Langley Research Center, is riblets. These are small, barely visible grooves that were placed on the surface of an airplane to reduce surface friction and aerodynamic drag. Although the grooves are no deeper than a scratch, they make a surprising difference on the airflow near the plane's surface. Riblets are also featured on a line of competition swimsuits that in testing were found to bring competition results 10 to 15 percent faster than similar swimsuits.

Boots worn on the Moon needed to be specially cushioned because of the unusual lunar surface conditions. The material used has now turned up as a key element in a family of athletic shoes designed for improved shock absorption, energy return, and reduced foot fatigue. Tri-Lock® is the commercial incarnation of a three-dimensional space fabric. The design produces a system that retains shock-absorbing capabilities that stands up to the running, jumping, or pounding inflicted upon the shoe. The Earth-bound athletic shoes reduce impact forces that affect the muscular-skeletal system in the foot and lower leg, just like their Moon counterparts.

Sports enthusiasts will continue to offer thanks to NASA when they go out to play. Helmets used by bicyclists, football players, and other athletes are safer now because they have three times the shock-absorbing capacity of earlier helmets. Shock reduction is achieved by an interior padding of temper foam, first used in aircraft seats. Little league and professional players wear these helmets to protect the head, and other sports equipment such as baseball chest protectors and soccer shin guards have come about with the same technology. Temper foam absorbs sudden impacts without

shock or bounce. A 3-inch thick pad can absorb all the energy from a 10-foot fall by an adult, and can adjust to the shape of the wearer's head without putting undue pressure on any one point.

Aluminized Mylar (Mylar is the shiny material in foil balloons) was originally developed for NASA Goddard Space Flight Research Center to make satellites more reflective and for space suit insulation. It has been adapted to create jackets and ski parkas. The reflective capabilities are used to retain body heat and provide a barrier from cold and hot temperatures.

Space suits feature heat-absorbing gel packs that slip into insulated pockets of the astronauts' garments. Gel packets, which last about an hour and are easily replaced, are invaluable during space walks. Runners, joggers, and any other athlete on Earth whose performance may be affected by hot weather can wear cooling headbands, wristbands, and running shorts with gelpack pockets. Gel packs can have nonathletic uses as well. Two possibilities are hot and cold compresses for sore muscles and temperature control for sports spectators.

When in space, an astronaut's vision is crucial. NASA Lewis Research Center developed a film of diamond-like carbon (DLC) that is applied to the lenses of glasses. It provides scratch protection and also reduces surface friction so that the lenses shed water more easily to reduce spotting. A thin film of DLC in deposited on the lens by using an ion generator to create a stream of ions from a hydrocarbon gas source. The carbon ions meld directly on the target substrate and "grow" into a thin DLC film. The coating offers 10 times the scratch resistance of conventional glass lenses. As anyone who owns glasses knows, keeping glasses scratch free means they'll last longer and be more economical. In space, helmet lenses and observation windows obtain the same benefits.

Glasses aren't the only way to safeguard your eyes. Goggles do the job when eyes need to be protected from the elements. Goggles can now remain fog-free because of a NASA process, developed at Johnson Space Center. This process coats the lens with a combination of liquid detergent, deionized water, and fire-resistant oil. The same process is used in deep-sea diving masks, fire protection helmets, and some specific types of eyewear.

More Spin-offs

Z E D G L C E S S V D O S S R N M A R A E T D G A B M
G X G U H J R M L A I M Y H E O A R E R C N O A G I P
T L D G B E A I O C A T N R T I G E S T I E O S H L H
Q X F O A J W H O U L T E Y R T N M C I V M F D I R C
H Q P R U I T X T U Y E R Z O A E A U F E U D E Q O R
G A X V T N F T R M S R G V R C T C E I D R E T Q T X
S L Y Y O S O C E M I F I J E I I D T C L T I E T C P
X Q Z A M U S U W E S E S F F F C E O A A S R C A A W
W O X R O L N F O T M J T D L I R R O L V N D T D E L
P I J P T A O X P A A O I P E R E A L H O I E O H R A
I R I J I T I S S L C X C Q C U S R L E M C Z R P O I
E F C B V I T Y S L H T C A T P O F R A E I E R F I R
N N V C E O A Z E I I A O T O R N N E R R T E S N B E
X E K I I N Z N L Z N J A X R E A I R T E S R H G U T
V T Q D N B I Q D I E V T C A T N N X X N O F U I E A
N V Y U S A L N R N S O I V J A C L U E I N H Y S C M
N X H P U R I I O G S R N K N W E O A M M G E W E Q S
B X P X L R B V C T U I G Q G V I A Y K D A H Z D F I
E K S G A I A U T J H Z S J C P M P D G N I F D Y W S
K X S I T E T S T I U S L O O C A H M L A D U I R L E
Q L Y K I R S S K Q N A Z V K B G V N X L B S L L Q H
N L I G O S O G W N M L U U P U I M Z I M S N H E J T
B A L A N C E E V A L U A T I O N S Y S T E M S W C S
K S X K B E D L I F E S A V I N G L I G H T Q W E T O
F K G V E H I C L E T R A C K I N G S Y S T E M J G R
E P D V P A V I N F R A R E D T H E R M O M E T E R P
Y H P A R G O M O T D E D I A R E T U P M O C Z C Q U

Spin-Offs Word List

Artificial Heart
Automotive Insulation
Balance Evaluation Systems
Bioreactor
Computer-Aided Tomography
Cool Suits
Cordless Power Tools
Diagnostic Instrument
Dialysis Machines
Freeze-dried Food
Gas Detector
Infrared Camera
Infrared Thermometer
Insulation Barriers
Jewelry Design
Land Mine Removal Device
Lifesaving Light
Magnetic Resonance Imaging
Prosthesis Material
Rescue Tool
Retroreflector
Synergistic Coatings
Vacuum Metallizing
Vehicle Tracking System
Video Stabilization Software
Water Purification

More NASA Spin-offs

Invisible dental braces — developed from technology used to track heat-seeking missiles

Material used in competition swimsuits — developed from outer coverings on airplanes to reduce surface friction

Tri-Lock® athletic shoes — developed from boots worn on the Moon that were specially cushioned for Moon surfaces

Bicycle helmets — developed from the temper foam used in aircraft seats that are shock absorbent

Mylar foil balloons — developed to make satellites in space more reflective

Cooling headbands for athletes — gel packs that were developed to insulate astronaut's space suits

Scratch resistant sunglasses — developed to keep space helmet lenses and observation windows scratch free

Fog-free goggles — developed to protect the astronaut's eyes from the elements in space

More NASA SPIN-OFFS

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 European clinical trials where it has been successfully implanted into more than 20 people.

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.

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.

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.

CAT Scanners and MRI technology - Computer-Aided Tomography and Magnetic Resonance Imaging used in hospitals worldwide came from technology developed to computer-enhance pictures of the moon for the Apollo program. (A medical CAT scanner searches the human body for tumors or other abnormalities; the industrial version, or advanced computed tomography inspection system, finds imperfections in aerospace structures and components, such as castings, rocket motors, and nozzles.)

Cool suits - These 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.

Cordless power tools - These appliances are one of the most successful commercial spin-offs of spacebased technology.

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.

Dialysis machines - Kidney dialysis machines were developed as a result of a NASA developed chemical process that could remove toxic waste from used dialysis fluid.

Freeze-dried food - This food solved the problem of what to feed an astronaut on the long-duration Apollo missions.

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 gaspowered car.

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.

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.

Insulation barriers - 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 dampen engine and exhaust noise.

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 760 degrees Celsius (1,400 degrees Fahrenheit) generated by the jeweler's torch.

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.

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.

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.

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.

Retroreflector - A hollow 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.

Synergistic coatings - A process for bonding dry lubricant to space metals led to the development of surface enhancement coatings that are used in applications from pizza making to laser manufacturing. Each coating is designed to protect a specific metal group or group of metals to solve problems encountered under operating conditions, such as resistance to corrosion and wear.

Vacuum metallizing - These 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.

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.

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 videos.

Water purification technology - 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.