STS-107 OVERVIEW

SPACE RESEARCH AND YOU

To Improve Life Here, To Extend Life to There, To Find Life Beyond.

That is NASA's vision. As part of our vision to improve life here on Earth, seven astronauts, including the first astronaut from Israel, will spend 16 days in space this winter aboard the Space Shuttle Columbia. The crew will work 24 hours a day, in two alternating shifts, to complete more than 80 experiments. These experiments include studies of astronaut health and safety; advanced technology development; and Earth and space sciences.

"We're doing a huge amount of science, " said Mission Specialist Laurel Clark. "Understanding us as humans, our physiology and why we lose bone mass, why we lose muscle mass…trying to help people like my grandmother, who's losing bone mass every day…trying to understand these processes and prevent pain and suffering in the world."

"This mission will help us to understand and protect our home planet, in particular with the studies that we're doing that look at the Earth's atmosphere and the ozone layer," said Rick Husband, the commander of STS-107.

"I think one of the legacies of NASA is that you always push forward," said 107 Payload Commander and Mission Specialist Michael Anderson. "That's why it was founded – to push human knowledge and experience forward. STS-107 is doing that on the science side – pushing human science knowledge forward."

To understand and protect our home planet
To explore the Universe and search for life
To inspire the next generation of explorers
…as only NASA can.

That is NASA's mission.

Related Web Sites:

http://spaceflight.nasa.gov/shuttle/
http://spaceresearch.nasa.gov/sts-107/
http://spd.nasa.gov/
http://www.spacehab.com/sts107/

Understanding How the Human Body Adapts to Space

During their 16 days in space, the seven astronauts aboard the Space Shuttle Columbia will focus much of their attention on what happens to the human body when it is deprived of gravity. Microgravity, or "zero-g" (for zero gravity), is what makes space so special for scientists. They can use microgravity to grow large, very pure protein crystals to help them understand the role proteins play in maintaining health and causing disease. Human cells grown in space produce cultures that scientists can use to help them understand the growth of tumors and how they might control that growth.

For space travelers though, spending time in microgravity can cause them to lose bone and muscle mass, as well as experience other effects that are not felt until their return to Earth, such as dizziness. Scientists are working to find ways to minimize those losses and long-term effects and the STS-107 mission will play an important part in that research.

As part of the European Space Agency (ESA) Advanced Respiratory Monitoring System, the crew will perform seven separate experiments aboard Columbia to look for any changes that may occur in their lungs, hearts or metabolism while in space. Additional ESA biological investigations will examine how bones form and maintain themselves without gravity; the function of the immune system; connective tissue growth and repair; and bacterial and yeast cell responses to the stresses of spaceflight.

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Developing New Products for Use on Earth

The commercial development of the space frontier is one of the greatest opportunities for economic growth. NASA is encouraging businesses to seize this opportunity through its Space Product Development Office, to ensure the continued economic growth of the United States and to bring the opportunities for new advances, technological understanding, products and jobs to the public. The STS-107 crew will be working with several such experiments during their mission.

The Astroculture Glove Box and Growth Chamber are two facilities that are being used to improve old products and create new ones. Astronauts will use these facilities to grow soybean plants that scientists can study to determine the impact of microgravity on the genetic traits of soybeans. This data can be used to improve future agriculture products by giving plants greater resistance to disease and drought. Other Astroculture experiments will look at the impacts of microgravity on plant oil development and the development of new cosmetics and food flavors.

Another commercial payload will perform cancer research in microgravity. Its objectives include the production and growth of protein crystals that can be used to develop drug therapy to prevent the spread of breast, lung, colon and brain cancers; developing a drug therapy to alleviate the pain associated with bone cancer; and the production and growth of microcapsules that will deliver drugs directly to tumors.

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STS-107: Providing 24/7 Space Science Research

Space shuttle mission STS-107 is the 28th flight of the Space Shuttle Columbia and the 113th shuttle mission to date. This mission will give more than 70 international scientists access to the microgravity environment of space, and a set of seven human researchers, for 16 uninterrupted days.

Astronaut Rick Husband (Colonel, USAF) will command STS-107 and will be joined on Columbia's flight deck by pilot William "Willie" McCool (Commander, USN). Columbia will be crewed by Flight Engineer (Mission Specialist 2) Kalpana Chawla (Ph.D.), Payload Commander (Mission Specialist 3) Michael Anderson (Lieutenant Colonel, USAF), Mission Specialist 1 David Brown (Captain, USN), Mission Specialist 4 Laurel Clark (Commander, USN) and Payload Specialist 1 Ilan Ramon (Colonel, Israeli Air Force), the first Israeli astronaut.

When Columbia is launched from Kennedy Space Center it will carry a SPACEHAB Research Double Module (RDM) in its payload bay. The RDM is a pressurized environment that is accessible to the crew (while in orbit) via a tunnel from the shuttle's middeck. Together, the RDM and the shuttle's middeck will contain the majority of the mission's experiments.

In the area of physical sciences, the crew will perform three studies that are isolated inside a large, rugged chamber. These experiments will examine the physics of combustion, soot production and fire quenching processes in microgravity. Another experiment will compress granular materials in the absence of gravity to further our understanding of construction techniques – this information can help engineers provide stronger foundations for structures in areas where earthquakes, floods and landslides are common.

A commercially-sponsored facility will be used to grow two kinds of protein crystals to study possible therapies against the factors that cause cancers to spread and bone cancer to cause intense pain to its sufferers. Two other experiments will grow different types of cell cultures – one used to combat prostate cancer, the other to improve crop yield. Another facility for forming protein crystals more purely and with fewer flaws than on Earth may lead to a drug designed for specific diseases with fewer side effects.

The Canadian Space Agency is also sponsoring three bone-growth experiments on STS-107, and is collaborating with the European Space Agency on two others. The German Space Agency will measure the development of the gravity-sensing organs of fish in the absence of gravity. Students from six schools in Australia, China, Israel, Japan, Liechtenstein and the United States will probe the effects of spaceflight on spiders, silkworms, inorganic crystals, fish, bees and ants, respectively.

There are also six experiments on a pallet in Columbia's payload bay – the Fast Reaction Experiments Enabling Science, Technology, Applications and Research (FREESTAR), which is mounted on a bridge-like structure spanning the width of the payload bay. These six investigations will look outward to the Sun, downward at Earth's atmosphere and inward into the physics of fluid phenomena, as well as test technology for space communications. One FREESTAR experiment is made up of 11 separate student experiments from schools across the U.S.

Space Shuttle Columbia

After a 17 month stay in California for modifications and refurbishment, Space Shuttle Columbia returns to Kennedy Space Center aboard the Shuttle Carrier Aircraft. After STS-109, Columbia's payload bay was outfitted with the new SPACEHAB Research Double Module preparing the orbiter for 16 days of research on mission STS-107.

Experiments

Biology
1. Biological Research in Canisters (BRIC): Development of Gravity Sensitive Plant Cells in Microgravity
2. Biotechnology Demonstration System (BDS-05)
3. European Space Agency BIOPACK: Bacterial Physiology and Virulence on Earth and in Microgravity
4. Fundamental Rodent Experiments Supporting Health (FRESH-02): Anatomical Studies of Central Vestibular Adaptation
5. Fundamental Rodent Experiments Supporting Health (FRESH-02): Arterial Remodeling and Functional Adaptations Induced by Microgravity
6. Fundamental Rodent Experiments Supporting Health (FRESH-02): Choroidal Regulation Involved in the Cerebral Fluid Response to Altered Gravity
7. Magnetic Field Apparatus (MFA/BIOTUBE): Application of Physical and Biological Techniques to Study the Gravisensing and Response System of Plants

Biomedical Research & Countermeasures
1. Calcium Kinetics During Spaceflight
2. Flight Induced Changes in Immune Defenses
3. Incidence of Latent Virus Shedding During Spaceflight
4. Microbial Physiology Flight Experiments: Effects of Microgravity on Microbial Physiology and Spaceflight Effects on Fungal Growth, Metabolism and Sensitivity to Anti-fungal Drugs
5. Protein Turnover During Spaceflight
6. Renal Stone Risk During Spaceflight
7. Sleep-Wake Actigraphy and Light Exposure During Spaceflight

Earth & Space Sciences
1. Mediterranean Israeli Dust Experiment (MEIDEX)
2. Shuttle Ionospheric Modification with Pulsed Localized Exhaust (SIMPLEX)
3. Shuttle Ozone Limb Sounding Experiment-2 (SOLSE-2)
4. Solar Constant Experiment (SOLCON-3)

Physical Sciences
1. Combustion Module –2 (CM-2)
2. Critical Viscosity of Xenon-2 (CVX-2)
3. Laminar Soot Processes-2 (LSP-2)
4. Mechanics of Granular Materials-3 (MGM-3)
5. Space Acceleration Measurement System Free Flyer (SAMS-FF) and Orbiter Acceleration Research Experiment (OARE)
6. Structures of Flame Balls at Low Lewis-number (SOFBALL)

Space Product Development
1. ASTROCULTURE
2. Commercial Instrumentation Technology Associates Inc. Biomedical Experiments Payload (CIBX-2)
3. Commercial Protein Crystal Growth – Protein Crystallization Facility (CPCG-H)
4. Water Mist Fire Suppression Experiment (MIST)
5. Zeolite Crystal Growth (ZCG)

Technology Development
1. Low Power Transceiver (LPT)
2. Ram Burn Observations (RAMBO)
3. Vapor Compression Distillation Flight Experiment (VCD FE)

CREWMEMBERS
Red Team & Blue Team

STS-107

Meet the Crew

Pictured from left to right is the STS-107 crew:

Mission Specialist 1: David Brown
Born April 16, 1956 in Arlington, Virginia. Received a bachelor of science in biology from the College of William and Mary in 1978 and a doctorate in medicine from Eastern Virginia Medical School in 1982.

Mission Commander: Rick Husband
Graduated from Amarillo High School, Amarillo, Texas, in 1975. Received a bachelor of science in mechanical engineering from Texas Tech University in 1980, and a master of science in mechanical engineering from California State University, Fresno, in 1990.

Mission Specialist 4: Laurel Clark
Born March 10, 1961 in Ames, Iowa. Received a bachelor of science in zoology from the University of Wisconsin-Madison in 1983 and a doctorate in medicine from the same school in 1987.

Mission Specialist 2: Kalpana Chawla
Born in Karnal, India. Received a bachelor of science in aeronautical engineering from Punjab Engineering College, India, in 1982, a master of science in aerospace engineering from the University of Texas in 1984 and a doctorate of philosophy in aerospace engineering from the University of Colorado in 1988.

Mission Specialist 3: Michael Anderson
Graduated from Cheney High School in Cheney, Washington, in 1977. Received a bachelor of science in physics/astronomy from the University of Washington in 1981 and a master of science in physics from Creighton University in 1990.

Pilot: William McCool
Graduated from Coronado High School, Lubbock, Texas, in 1979. Received a bachelor of science in applied science from the U.S. Naval Academy in 1983, a master of science in computer science from the University of Maryland in 1985 and a master of science in aeronautical engineering from the U.S. Naval Postgraduate School in 1992.

Payload Specialist: Ilan Ramon
Born June 20,1954 in Tel Aviv, Israel. In 1974, Ramon graduated as a fighter pilot from the Israel Air Force (IAF) Flight School. Received a bachelor of science in electronics and computer engineering from the University of Tel Aviv, Israel, in 1987.

Open All Nite

Red Team

Rick Husband
Commander

Kalpana Chawla
Flight Engineer,
Mission Specialist 2

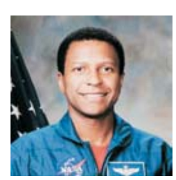
Laurel Clark
Mission Specialist 4

Ilan Ramon
Payload Specialist

Blue Team

William McCool
Pilot

David Brown
Mission Specialist 1



Michael Anderson
Payload Commander,
Mission Specialist 3

Human Body

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Other life sciences experiments are included in the ESA Biobox, which is a multi-user facility that hosts a variety of biological experiments, allowing scientists to observe the effects of microgravity on living systems. Two Biobox experiments involve the growth of bone-forming and bone-removing cells in microgravity in order to compare them to cells grown in normal gravity. This research could have a tremendous effect on our understanding and treatment of bone loss diseases on Earth, such as osteoporosis, while helping to ensure that long-duration astronauts remain strong and healthy. Another multi-user facility is the ESA Biopack, which will be used to conduct biological experiments under varying gravity conditions, including a study of human DNA.

The seven STS-107 crewmembers will also take part in experiments that involve measurements taken before and after their spaceflight. These experiments include studies of how calcium and muscle protein metabolism changes over time during a spaceflight, providing data that will aid in the development of countermeasures to prevent their losses during long-duration space missions. The astronauts will also take part in studies related to kidney stone formation and how being in space affects their ability to sleep.

Students from six countries also will study everything from spiders to fish in the microgravity environment aboard Columbia, and there are 11 additional student experiments in Columbia's payload bay from schools across the U.S. Students are given the opportunity to fly experiments in space in order to promote an interest in scientific careers.

To study ways to help human bodies on Earth, another facility will grow protein and virus crystals that are expected to lead to improved drug designs. A NASA experiment will assess the effects of gene therapy on the growth of prostate cancer cells using a NASA-engineered rotating bioreactor. The cells that are grown for this experiment will be used for research, clinical diagnosis and treatment on Earth.

By taking full advantage of this unique environment for 16 days, the crew of STS-107 will not only help researchers better protect future space travelers, but improve life on Earth as well.

SPACEHAB Research Double Module

Physical Accommodations

1. 9,000 lb. total payload capability
2. 6 Double Rack locations (1,400 lb. and 45 cubic ft. each)
3. 4 ISPR capability
4. Locker Capacity: Up to 62 hard mounted locker locations (Up to 60 lb. and 2 cubic ft. each)

Increased Data Management Facilties

1. High bandwidth Orbiter Ku-Band signal processing
2. Forward compatible with ISS interfaces
3. Backward compatible with Spacelab interfaces
4. LOS on-board data storage and playback

Increased Power Supply

1. 5.5 kW experiment manifest allocation
2. AC and DC to experiment locations
3. 3.0 kW high power rack accommodations
4. Remote commanding Status

Enhanced Environmental Control

1. Life science payload accommodations
2. Experiment air and water cooling
3. Four-person environmental load capability
4. Cabin temperature and humidity control

New Products

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Using a NASA-designed Combustion Module, the crew of Columbia also will complete three experiments related to fire and controlling fire. One of those experiments will provide a better understanding of soot formation. Controlling the amount of soot produced is critical to efficient, clean and safe combustion. Though soot is good for extracting heat in power plants, it's bad in jet engines because it reduces their durability. Soot is also a hazardous air pollutant.

Another combustion experiment will examine how a mist of water can inhibit the spread of flames. This data can be used to design improved, lighter-weight fire suppression systems on Earth, as well as spacecraft-based systems that don't require ozone-damaging chemicals such as Halons. The data can also be used to improve aircraft accident survivability by using a mist of water to contain flames, increasing escape times for passengers.

The third combustion experiment will improve our understanding of lean combustion, helping engineers design engines with better fuel efficiency and reduced emissions (less pollution). The data can also be used to protect spacecraft from fire by determining the limits of flammability in microgravity. Finally, it can provide a better understanding of pre-mixed gas explosions in confined spaces, such as those that occur in underground mines.

Another commercial experiment will use the microgravity environment aboard Columbia to grow larger, more uniform zeolite crystals. This has the potential of significant advances in gasoline refining technology, as well as improving products for the chemical industry.