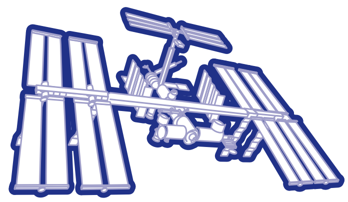
Educational Product

Educators	Grades K-8

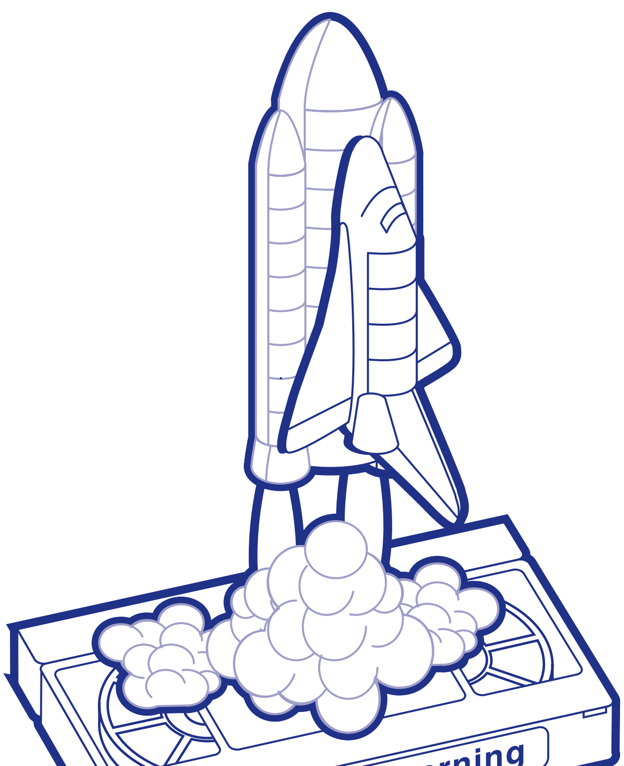
National Aeronautics and Space Administration

Liftoff to Learning



Geography From Space

A Videotape for Earth and Space Science, Life Science, and Science in Personal and Social Perspectives



Video Resource Guide

EV-1997-07-005-HQ

Video Synopsis

Title: Geography From Space

Length: 10:00 minutes

Subjects: Earth's continents as seen from the vantage point of orbit.

Description:
This program takes the viewer on a rapid video tour of Earth's surface as seen from outer space. After explaining how the altitude of the viewer affects the amount of Earth's surfaces that is seen at one time, the video moves into a travelogue on some of the interesting features of Earth's continents as seen from space. Because the inclination of the Space Shuttle's orbit to Earth's equator did not carry the crew over Antarctica or the Arctic, these regions are not visited in the program.

Science Standards:
Life Science
- Organisms and environments

Science in Personal and Social Perspectives
- Changes in environments
- Populations, resources, and environments
- Environmental quality

Earth and Space Science
- Structure of the earth system
- Earth in the solar system

Background

One of the earliest benefits of the space age came when astronauts and cosmonauts started returning to Earth with fascinating stories and pictures of the view of Earth they were privileged to see. Climbing higher over Earth than anyone had done before gave them a unique perspective of their home planet. Instead of being able to observe hundreds of square kilometers at a time, as airplane travelers do, space travelers were able to see thousands. Furthermore, as Earth rotated beneath their orbiting spacecraft, nearly every bit of Earth's surface came into view in just a matter of days.

Today, an invaluable collection of Earth photography and video is available for geographers and scientists to study. The collection spans more than 30 years. This provides opportunities to study Earth's resources, environmental interactions, and monitor short and long term biologic, cultural, and physical changes in Earth's surface.

Taking advantage of the Earth images collection, the crew of the STS-59 Space Shuttle mission (April 9-20, 1994), provide viewers of this video program with an astronaut's eye view of some of the interesting features of Earth's continents. The crew orbited at an altitude of 220 kilometers at an inclination to Earth's equator of 57 degrees. This meant the mission flew directly over nearly every portion of Earth's surface between 57 degrees north and 57 degrees south. The continent of Antarctica was not covered because it lies south of 57 degrees south latitude.

STS-59 Mission

The primary payload of STS-59 was the Space Radar Laboratory. Radar emissions from the laboratory were directed at Earth's surface and their reflections were then recorded. Scientific researchers, policy makers, and military operations require information about specific regions of Earth that may be difficult to obtain due to blocked views or remote locations. The ability to "see" and gather information about objects hidden from optical observation is the driving motivation behind radar imaging from space. One of the most useful features of radar imaging is its ability to make measurements over virtually any region at any time, regardless of weather or sunlight conditions. It is able to penetrate cloud cover and provide its own source of illumination. At some frequencies, radar waves can also penetrate through vegetation, some types of snow, and extremely dry sand.

The STS-59 mission lifted off from the Kennedy Space Center on the 62nd Space Shuttle flight carrying to space the Space Radar Laboratory-1 (SRL-1) payload as part of NASA's Mission to Planet Earth program. SRL consists of the Spaceborne Imaging Radar-C/X-Band Synthetic Aperature Radar (SIR-C/S-SAR) and a sensor to measure carbon monoxide distribution in the lower atmosphere. SIR-C/X-SAR (actually five separate radars) also contained the Data Processing Assembly to provide direct readout of ocean surface data. SIR-C/C-SAR was jointly developed by NASA, the German Space Agency (DARA), and the Italian Space Agency (ASI). NASA developed the SIR-C (L- and C-band radars). DARA and AST developed the X-band system and all three participated in the integration of these radars into a single instrument, the SIR-C/X-SAR. The Measurement of Air Pollution from Satellites (MAPS) instrument, developed by the NASA Langley Research Center, studied the presence of carbon dioxide in the troposphere. NASA will distribute the data and findings of these experiments to assist the international scientific community in essential research for protecting the environment.

Once the crew was in orbit, they powered up the SRL-1 payloads and conducted a checkout of the experiment systems. Ground controllers uplinked commands to begin radar observations during the 11-day flight. The crew worked in two shifts around the clock to conduct Earth photography and personal observation of weather and environmental conditions to compare to the SRL data after the flight. To aid in postflight data interpretation, the crew documented site conditions by maintaining a written log and taking nearly 14,000 photographs with several cameras and lenses. The crew also performed 412 attitude maneuvers, the most of any Shuttle mission to date, to reduce radar ambiguities particularly in the X-band frequency radar. The mission returned approximately 47 terabits (47 trillion bits) of data—the equivalent of 20,000 encyclopedia volumes.

The SRL examined over 400 sites on Earth—19 of which were designated as "supersites." These sites were high priority focal points for data collection. Each supersite represented different environments within the scientific disciplines of ecology, hydrology, oceanography, geology, and radar calibration. As such, these are areas where intensive field work has occurred before, during, and after the mission. The supersite locations for ecology included: Manaus, Brazil; Raco, MI.; Duke Forest, NC.; and Central Europe. The supersite locations for hydrology included: Chickasha, OK.; Otzal, Austria; Bebedouro, Brazil; and Montespertoli, Italy. The supersite locations for oceanography included: Gulf Stream, Mid-Atlantic; Northeast Atlantic Ocean; and Southern Ocean. The supersite locations for geology included the Galapagos Islands, Sahara Desert, Death Valley, Andes Mountains, and Hawaii. Oberpfaffenhofen, Germany; Kerang, Australia; and Flevoland, The Netherlands were the calibration sites.

Ecologists will use the radar images of the tropical rain and temperate forests to study land use, the volume, types, and extent of vegetation, and the effects of fires, floods, and clear cutting. Hydrologists will use the data to study wetlands and snow cover to estimate the soil moisture. “Hidden” water plays a major role in determining whether a region is wet or dry and influences the global distribution of energy. Oceanographers will use the data to study how the Earth’s climate is moderated by the ocean, particularly heat-transporting currents like the U.S. Gulf Stream. Geologists will use the data to map geological structures and rock formations over large areas. They can also use the data to continue studies of features that record past climate changes. On a previous shuttle flight, SIR-A demonstrated the ability to penetrate extremely dry sand and discovered ancient river channels in portions of the Sahara Desert.

Classroom Activities

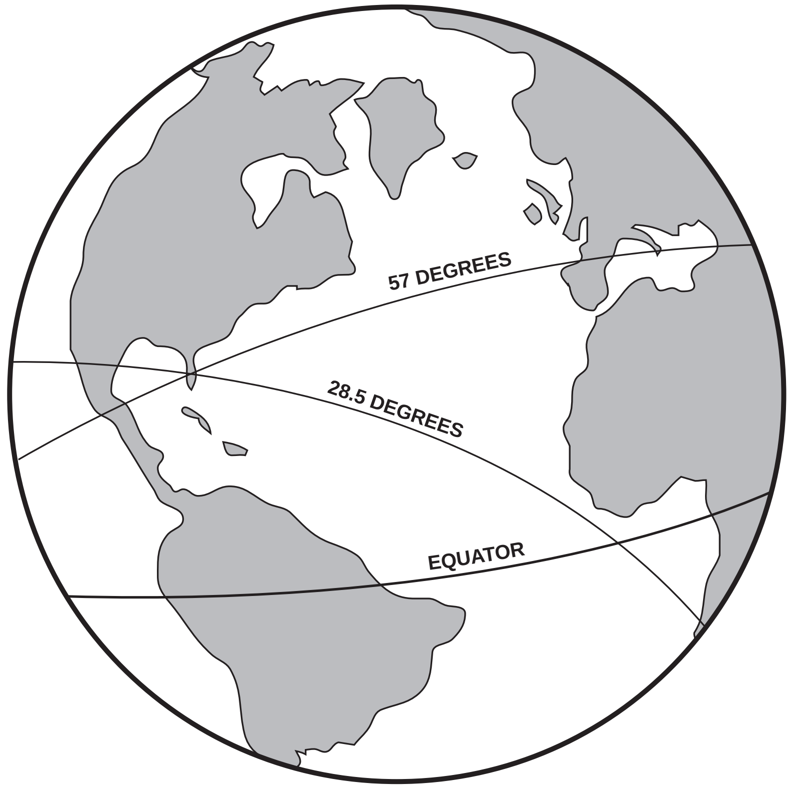
Space Geography On The Internet

Materials: Computer workstation connected to the Internet, image processing software (NIH Image, Photoshop, etc.), and world atlas.

Background: Since the beginning of the space program, NASA has collected hundreds of thousands of photographs of Earth as seen from space. Many of these pictures are accessible electronically through the Internet.   Because the pictures were collected over more than a 35-year period, they provide an excellent database for studies on global surface changes.

Procedure: Use the following Internet addresses to connect to the NASA photo libraries. Choose a particular subject for study (e.g. rivers) and identify a study site from the world atlas. Search the NASA photo libraries for pictures that cover your study area. Try to select areas that have been photographed several times over a period of years. Identify the major surface features seen in the picture. This job will be much easier if the study area is a place with which students are already familiar. Compare older pictures to newer ones to look for possible changes. Use image processing software, if you have it, to analyze each picture. Write an analysis of the pictures and the changes that have taken place.

Internet Addresses:
http://earth.jsc.nasa.gov
http://www.hq.nasa.gov/office/pao/Library/photo.html
http://www.jpl.nasa.gov/kidsat
http://images.jsc.nasa.gov
http:///edcwww.cr.usgs.gov/landdaac/sir-c/survey.html
http://earth.jsc.nasa.gov
http://earthrise.sdsc.edu
http://nix.nasa.gov
http://eol.jsc.nasa.gov
http://www.ed.gov/pubs/parents/Geography



Space Shuttle Orbits

Materials: World globe, large rubber bands, ruler, calculator.

Background: Space Shuttle missions are launched eastward. Their orbits are almost circular in shape with the center of the circle located approximately at the Center of Earth. The latitude of the Kennedy Space Center where Space Shuttles are launched is 28.5 degrees north. A Shuttle launched due east from there will travel in an orbit that is inclined to the equator at 28.5 degrees. To travel in an orbit with a greater inclination, the Shuttle has to be launched in a direction that is north of due east.

Procedure: Using the globe, locate the Kennedy Space Center in Florida. Place a rubber band around the globe so that the rubber band crosses through the launch site. Imagine that the rubber band is a disk. Move it so that the plane of the disk passes directly through Earth's center. Look at how the rubber band is inclined to Earth's equator. Place a second rubber band around the globe so that it runs through the launch site and is inclined at approximately 57 degrees to the equator. This is the highest Shuttle inclination flown. Imagine that the orbit of the Shuttle is 300 kilometers above Earth's surface. How high would the Shuttle be above the globe? To do this, students will have to figure out the scale of the globe and then determine how high the Shuttle would be if placed at its scale altitude. (Earth's diameter is approximately 12,740 kilometers.) Hold the globe near a student's eye at the scale distance of the Shuttle's orbit. Ask the student to estimate how much of the Earth is visible at one time. What would happen if the Shuttle's altitude were doubled? Why is it that the Arctic and Antarctic regions of Earth are not studied by Space Shuttle astronauts?

References

NASA On-line Resources for Educators provide current educational information and instructional resource materials to teachers, faculty, and students. A wide range of information is available, including science, mathematics, engineering, and technology education lesson plans, historical information related to the aeronautics and space program, current status reports on NASA projects, news releases, information on NASA educational programs, useful software and graphics files. Educators and students can also use NASA resources as learning tools to explore the Internet, access information about educational grants, interact with other schools, and participate in on-line interactive projects, communicating with NASA scientists, engineers, and other team members to experience the excitement of real NASA projects.

Access these resources through the NASA Education Home Page:
http://education.nasa.gov

Other web sites of interest:

http://www.jsc.nasa.gov

http://www.hq.nasa/gov/office/olmsa

STS-59 Crew Biographies

Sidney M. Gutierrez, Col., USAF, was the commander (CDR) of STS-59. He was selected to be an astronaut in 1984, and this was his second flight aboard the Space Shuttle. Gutierrez was born in Albuquerque, N.M. He received a bachelor's degree in aeronautical engineering from the Air Force Academy in 1973 and a master's degree in management from Webster College in 1977. Following graduation from the Air Force Academy, where he was a member of the National Championship USAFA Parachute Team and completed more than 550 jumps, Gutierrez completed pilot training at Laughlin Air Force Base, Del Rio, TX. He then served as an instructor pilot in T-38 aircraft at Laughlin from 1975-77, and in 1978, was assigned to the 7th Tactical Fighter Squadron, Holloman Air Force Base, Alamagordo, N.M., flying the F-15 Eagle aircraft. Gutierrez attended the Air Force Test Pilot School in 1981, and after graduating, served as the primary test pilot for airframe and propulsion testing on the F-16 aircraft. Gutierrez's first Shuttle flight was as pilot of STS-40, the first Spacelab Life Sciences flight, aboard *Columbia* in June 1991. Gutierrez has logged more than 480 hours in space and more than 4,000 hours of flying time in 30 different types of aircraft, sailplanes, rockets and balloons.

Kevin P. Chilton, Col., USAF, was the pilot (PLT) of STS-59. He was selected to be an astronaut in 1988, and STS-59 was his second spaceflight. Chilton was born in Los Angeles, CA. He received a bachelor's degree in engineering sciences from the Air Force Academy in 1976 and a master's degree in mechanical engineering from Columbia University in 1977. Chilton received his wings at Williams Air Force Base, Ariz., in 1978, and was assigned to the 15th Tactical Reconnaissance Squadron at Kadena Air Base, Japan, flying the RF4 Phantom II aircraft. In 1981, he was assigned to the 67th Tactical Fighter Squadron at Kadena Air Base flying the F-15 Eagle aircraft. Chilton attended the Air Force Squadron Officer School in 1982 and served as an F-15 weapons officer, instructor pilot and flight commander until 1984 at Holloman Air Force Base, N.M. He completed the Air Force Test Pilot School in 1984 and later served as weapons and systems test pilot in the F-15 and F-4. Chilton's first spaceflight was as pilot of *Endeavour*'s maiden flight on STS-49, a mission that repaired a stranded

INTELSAT communications satellite, in May 1992. Following STS-59, Chilton flew on STS-76 as the commander of the third Shuttle flight to the Russian Space Station Mir. He has logged more than 700 hours in space.

Linda M. Godwin, Ph.D., was the payload commander and mission specialist 3 (MS-3) of STS-59. She is a member of the astronaut class of 1985, and this was her second Shuttle flight. Her hometown is Jackson, MO. She received a bachelor of science degree in mathematics and physics from Southeast Missouri State in 1974 and in 1976 and 1980 earned master of science and doctorate degrees in physics from the University of Missouri, Columbia. While at the University of Missouri, she conducted research in low temperature condensed matter physics and authored and coauthored several scientific papers. She joined NASA in 1980 in the Mission Operations Directorate. Before being selected an astronaut, Godwin served in Mission Control as a flight controller and payloads officer on several Shuttle missions. Her first Shuttle mission was aboard *Atlantis* on the STS-37 mission in April 1991. The primary task of the crew during the flight was to deploy the Compton Gamma Ray Observatory and to evaluate translation techniques during two spacewalks. Following STS-59, Godwin flew on STS-76, the third mission to the Russian Space Station Mir. Godwin has logged more than 630 hours in space. She also is an instrument-rated private pilot and has logged approximately 500 hours in light aircraft.

Jay Apt, Ph.D., was mission specialist 1 (MS-1) and the commander of the blue shift on STS-59. He was chosen to be an astronaut in 1985, and STS-59 was his third Space Shuttle flight. Apt was born in Springfield, MA, but considers Pittsburgh, PA, his hometown. He graduated from Shady Side Academy in Pittsburgh in 1967; received a bachelor of arts degree in physics from Harvard College in 1971; and received a doctorate in physics from the Massachusetts Institute of Technology in 1976. He joined NASA in 1980 and worked in the Earth and Space Sciences Division at the Jet Propulsion Laboratory doing planetary research as part of the Pioneer Venus Orbiter Infrared team. In 1981, he became the manager of JPL's Table Mountain Observatory. He served as a flight controller and payloads officer in Mission Control from 1982 through 1985. Apt flew on the Shuttle first as a mission specialist on *Atlantis*, STS-37 in April 1991, to deploy the Compton Gamma Ray Observatory. During that mission, he conducted two spacewalks to release a stuck antenna on the Compton Gamma Ray Observatory and to evaluate translation techniques for possible use during future spacewalks and spacecraft assembly in orbit. His second flight, also as a mission specialist, was aboard *Endeavour* in September 1992. This mission was a cooperative effort between the U.S. and Japan to perform life sciences and materials processing experiments in the Spacelab pressurized module housed in the payload bay. He was the flight engineer and commanded the blue shift during the mission. In addition to STS-59, Apt has also flown on STS-79, the fourth Shuttle docking flight to the Russian Space Station Mir. In addition to his four Shuttle missions totaling 847 hours, Apt has logged more than 3,000 hours in 25 different types of aircraft.

Michael R. "Rich" Clifford, Lt. Col., USAF, was mission specialist 2 (MS-2) on STS-59. Selected as an astronaut in 1990, this was his second flight aboard the Space Shuttle. Clifford was born in San Bernardino, CA., but considers Ogden, UT, his hometown. He received his bachelor of science degree from the U.S. Military Academy, West Point, N. Y. in 1974 and earned a master of science degree in aerospace engineering in 1982 from the Georgia Institute of Technology. After graduation from the Naval Test Pilot School in 1986, he was designated an experimental test pilot. He was assigned to the Johnson Space Center in 1987 as a military officer and served as a Space Shuttle vehicle integration engineer. He was involved in design certification and integration of the Shuttle crew escape system. Clifford's first Shuttle mission aboard *Discovery*, STS-53, was a Department of Defense flight in December 1992. In addition to STS-59 Clifford has also flown on STS-76, the third Shuttle Mission to dock with the Russian Space Station Mir. Clifford has logged over 660 hours in space and more than 2,900 flying hours in a wide variety of fixed and rotary winged aircraft.

Thomas D. Jones, Ph.D., was mission specialist 4 (MS-4) on STS-59. He was selected to be a member of the astronaut corps in 1990, and this was his first flight aboard the Space Shuttle. Jones was born in Baltimore, MD. He received a bachelor of science degree in basic sciences from the U.S. Air Force Academy in Colorado Springs in 1977, and a doctorate in planetary science from the University of Arizona, Tucson, in 1988. He served on active duty as an Air Force officer for six years flying strategic bombers at Carswell AFB, Texas. While serving as a pilot and commander of a B-52D Stratofortress, he led a combat crew of six, accumulating more than 2,000 hours of jet experience. He resigned his commission in 1983 with the rank of captain. Prior to his selection as an astronaut, Jones was a program management engineer in the Office of Development and Engineering, Central Intelligence Agency (CIA), and a senior scientist with Science Applications International Corp. (SAIC), Washington, D.C. At SAIC, his tasks included advanced program planning for the Solar System Exploration Division at NASA Headquarters, concentrating on future robotic missions to Mars, asteroids, and the outer solar system. Following STS-59, Jones flew on STS-68 and STS-80. He has now logged over 960 hours in space.

NASA Liftoff to Learning
Geography From Space

EDUCATOR REPLY CARD
Video Resource Guide

To achieve America's goals in Educational Excellence, it is NASA's mission to develop supplementary instructional materials and curricula in science, mathematics, geography, and technology. NASA seeks to involve the educational community in the development and improvement of these materials. Your evaluation and suggestions are vital to continually improving NASA educational materials.

Please take a moment to respond to the statements and questions below. You can submit your response through the Internet or by mail. Send your reply to the following Internet address:

http://ehb2.gsfc.nasa.gov/edcats/educational_videotape

You will then be asked to enter your data at the appropriate prompt.

Otherwise, please return the reply card by mail. Thank you.

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   College/University - ______ Undergraduate ______ Graduate

   Number of Others:
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   ______ General Public ______ Civic Groups ______ Other

2. What is your home 5- or 9-digit zip code? __ __ __ __ __ — __ __ __ __

3. This is a valuable video and video resource guide.
   ❏ Strongly Agree ❏ Agree ❏ Neutral ❏ Disagree ❏ Strongly Disagree

4. I expect to apply what I learned in this video and video resource guide.
   ❏ Strongly Agree ❏ Agree ❏ Neutral ❏ Disagree ❏ Strongly Disagree

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5. What kind of recommendation would you make to someone who asks about this video and video resource guide?
   ❏ Excellent ❏ Good ❏ Average ❏ Poor ❏ Very Poor

6. How did you use this video and video resource guide?
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   ❏ Demonstration
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   ❏ Integration Into Existing Curricula
   ❏ Interdisciplinary Activity
   ❏ Lecture
   ❏ Science and Mathematics Standards Integration
   ❏ Team Activities
   ❏ Other: Please specify: ______________________________

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   ❏ NASA Educator Resource Center
   ❏ NASA Central Operation of Resources for Educators (CORE)
   ❏ Institution/School System
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