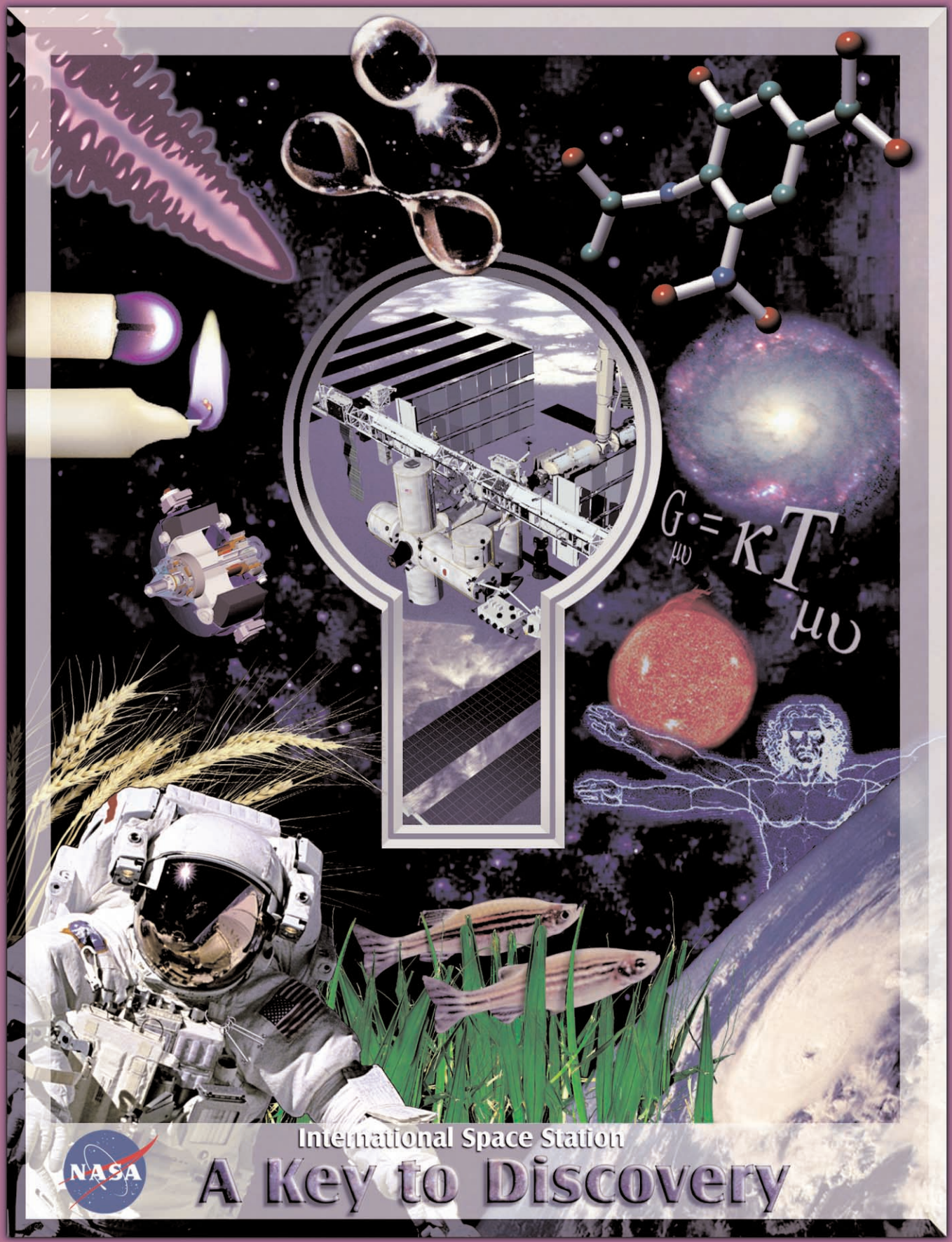
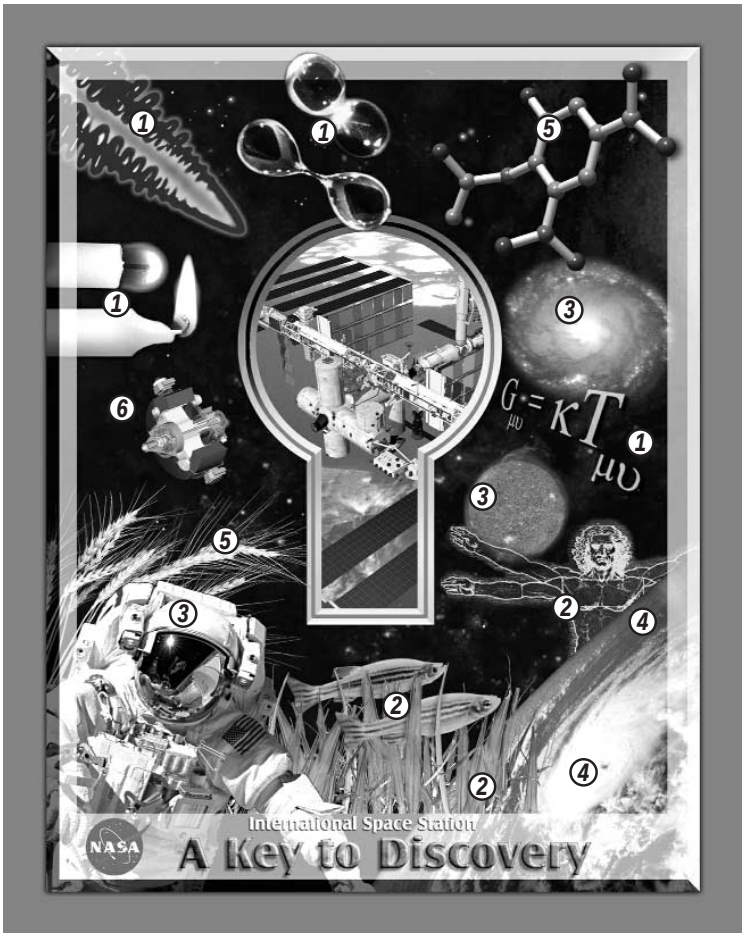

$G_{\mu\upsilon} = \kappa T_{\mu\upsilon}$
International Space Station
A Key to Discovery

International Space Station

Putting Space to Work the World Over



The International Space Station (ISS) will be an exciting laboratory for scientific and technological exploration. The keyhole depicted here and on the front symbolizes the potential to unlock the mysteries of the universe.

Areas of research and technology that will be performed on board the ISS include the following:

- ***Microgravity Research*** (1)
- ***Life Sciences*** (2)
- ***Space Science*** (3)
- ***Earth Science*** (4)
- ***Space Product Development*** (5)
- ***Engineering Research and Technology*** (6)

Scientific and industrial research on the ISS is expected to provide benefits to all humanity. Whether the research improves industrial processes, increases fundamental knowledge, directs us to better health, or enables us to take the next steps in the exploration and development of space, research on board the ISS should bring enduring benefits for life on Earth and in space. Collaboration among our international, industrial and academic partners will ensure that the benefits from ISS work are felt across the global spectrum of public and private interests.

Acknowledgements

This poster was developed in partnership with NASA Lyndon B. Johnson Space Center, Space Center Houston, and teachers from the following local area independent school districts: ClearCreek, Cypress Fairbanks, Pasadena and Pearland .

What is gravity?

Introduction: To understand the basic design and research environment of the International Space Station (ISS), it is necessary to understand *gravity*. The two most successful explanations of gravity are due to Isaac Newton, in the 17th century and Albert Einstein in the 20th. Newton's contribution is his Law of Gravity (1687), while Einstein's contribution is his General Theory of Relativity (1915). It turns out that Newton's Law is an approximation of Einstein's Theory, and a very useful one at that! Conceptually, they are very different, as the following discussion shows.

Newton: Newton's Law of Gravity is a mathematical expression that allows calculations of nearly all the phenomena we see in our everyday life. Newton discovered that the gravitational force between one body such as the Moon or an apple and another body (say, Earth) is proportional to the product of their masses divided by the distance between their centers squared. A further feature of Newton's Law of Gravity is that it depends only on instantaneous position in space and not on time. Connected to this, Newton saw absolute time as separate from absolute space. Newton's Law continues to be very successful in describing motion on and near Earth, and the orbits of spacecraft and even planets!

Einstein: When Einstein's Special Theory of Relativity was published in 1905, which deals with things moving very, very fast, he showed that time and the three dimensions of space were coupled. Then, when his General Theory of Relativity was published 10 years later, he predicted that near very massive bodies the four dimensions of *space-time* were curved. This was a big surprise for everybody, but in a few years (1919) his prediction was tested and found to be true! In the 84 years since Einstein proposed the bending of *space-time*, General Relativity has also passed other tests, and today physicists are still testing its finer points. At the same time, they are using it to explain things that astronomers see. For example, the motion of binary neutron stars is well explained by Einstein's theory, as are the motions of stars and gas near the centers of galaxies. The centers of most galaxies are thought to contain *black holes*, which are very heavy but compact masses predicted by General Relativity. Near a black hole, *space-time* is very curved and gravity is very strong. Anything that comes too close can't escape falling in! Don't worry though – we don't think there are any black holes near by!

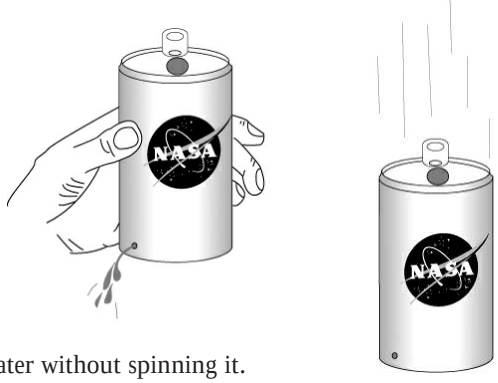
Future Discoveries? If Newton's Law of Gravity is an approximation of Einstein's General Theory of Relativity, is Einstein's theory an approximation? Who knows? The universe is full of mysteries waiting to be discovered! Perhaps you will discover something new! Not just in gravity, but in any of the research fields that will utilize the International Space Station. Study your math and science – chance favors the prepared mind!

References: Gravity's Fatal Attraction: *Black Holes in the Universe*, by Mitchell Begelman and Martin J. Rees, Scientific American Library, 1998. *Black Holes* by Jean-Pierre Luminet, Cambridge UP, 1992.
Relativity – the Special and the General Theory by Albert Einstein, Three Rivers Press, 1961. (There are many others – check the web or your local library or bookstore!)

Student Activity

Materials and Tools Needed:

Empty aluminum soft drink can
Sharp nail
Ladder (8 feet to 10 feet)
Water and paper towels
Television camera, videotape recorder and monitor (optional)



Procedure:

1. Take an empty aluminum can and punch a hole near the bottom.
2. Go outside and fill it with water. As you hold it, the water runs out.
3. Have someone stand up high, perhaps on a ladder and drop the can of water without spinning it.

Note: You may want to videotape this procedure and play it back in slow motion, observe the hole in the can.

Explanation:

When the can is stationary, water easily runs out of the small hole and falls to the ground.
Does the water run out when the can is falling? If it does, then there is force on the water.
If it does not, then there is no force.
Which is it? What does this tell us about gravity?

Microgravity Research

Microgravity Research contains five research areas to be studied on the International Space Station(ISS): Biotechnology, Combustion Science, Fluid Physics, Fundamental Physics, and Materials Science.

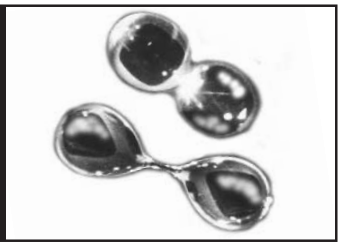
What is "Microgravity"?

When the ISS is in orbit, its various parts are falling almost freely around Earth. We say "almost freely" because there is a slight bit of atmospheric drag on the ISS, and because the various parts of the ISS are constrained from following their own orbits (which would all be slightly different). For example, parts of the ISS that are further away from Earth want to move more slowly around Earth than parts that are closer. However, the structural strength of the ISS holds all the parts together and they all take the same time to move around Earth. The small, steady forces acting on the ISS, due to the residual force differences, are only about one-millionth of the strength of gravity on the ground. Since *micro* means one-millionth, and since 1g is the gravity we feel on Earth's surface, the ISS has a *microgravity* or *micro-g* environment. There is no zero-g because there is always a small amount of force on the ISS.

Biotechnology

Biotechnology is the application of engineering and technology to life sciences research. It is a set of techniques and equipment for rearranging and manufacturing biological molecules, tissues, and living organisms, such as cells.

Water drops in microgravity can be manipulated by sound waves.



Fluid Physics

Of the four states of matter–solid, liquid, gas, and plasma–three are fluids. Fluids are very important for humans, from the circulation of blood, to atmospheric convection, to the dynamics of the sun. Gravity causes an important effect called "buoyancy," which effectively disappears in microgravity.

Fundamental Physics

Fundamental Physics research will employ the unique properties of microgravity to test some of the fundamental laws governing our physical world at levels of accuracy that are impossible on Earth. Fundamental physics investigates such topics as atoms, superfluids, and gravity itself.

The following is Einstein's equation, the fundamental equation of gravity.

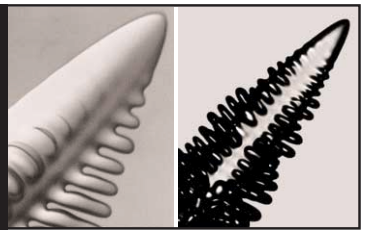
$$G_{\mu\upsilon} = \kappa T_{\mu\upsilon}$$

It is a mathematical representation of the statement, "Matter tells *space-time* how to curve and *space-time* tells matter how to move!" The symbol $G_{\mu\upsilon}$ represents the curvature of *space-time*, κ is a constant, and $T_{\mu\upsilon}$ represents the local density of mass, energy, and momentum. The subscripts μ and υ each take a value from the set (t, x, y, z), whose elements represent time and the three dimensions of space, respectively. Although a full understanding of Einstein's equation requires years of study, its presence here indicates the importance of mathematics to fundamental physics research.

Combustion Science

Combustion Science is concerned with all aspects of the process of burning. Combustion is a complex and usually rapid chemical reaction that releases energy in the form of heat and light. Combustion processes provide 85 percent of the world's energy needs.

Gravity-driven convection influences material formation. A dendrite, or tree-shaped, crystal in 1g (left) and microgravity (right).



Materials Science

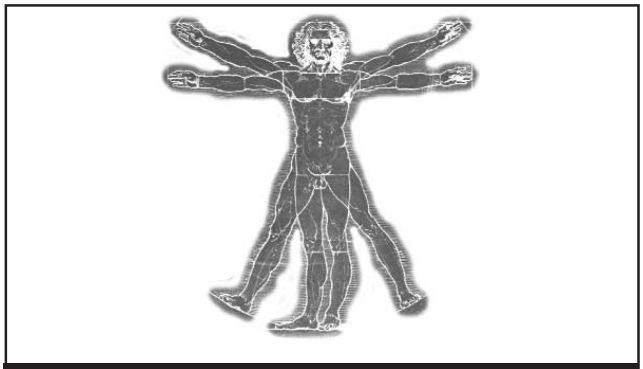
Materials Science investigates the structure, properties, and manufacture of materials. These materials include plastics, steels, and semi-conductors, all of which are essential in modern life. The structure and properties of these materials depend on their manufacture, which is very different in microgravity.

Web sites:

The International Space Station: *http://spaceflight.nasa.gov*
Microgravity Research Division - NASA Headquarters
http://microgravity.msad.hq.nasa.gov/
Microgravity Research Program Office -NASA MSFC *http://microgravity.msfc.nasa.gov/*
Microgravity Science Division - NASA GRC
http://www.grc.nasa.gov/

Life Sciences

Life Sciences research will focus on studies to increase human knowledge of natural processes using the space environment. Goals are to explore and inhabit the solar system, achieve routine space travel, and enrich life on Earth through people living and working in space. Three specific areas of life sciences research are: Advanced Human Support Technology for research in life support technology; Biomedical Research and Countermeasures for human research; and Fundamental Biology for basic biological research.



Scientists seek to increase human knowledge of nature's processes by utilizing the space environment.

Advanced Human Support Technology

Advanced Human Support Technology research includes advanced life support, space human factors engineering, and advanced environmental monitoring and control. This research focuses on investigations designed to: demonstrate and validate full self-sufficiency in air and food recycling technology for use in space vehicles or planetary bases; demonstrate and validate fully autonomous environmental monitoring and control systems; and validate and incorporate human factors engineering technology and protocols to ensure a high level of ground and flight crew skills during long-duration missions.

Biomedical Research and Countermeasures

Biomedical Research and Countermeasures research helps develop an understanding of the effects of spaceflight on humans and the underlying mechanisms of these effects. Its applied research activities enable the development of countermeasures to prevent the undesirable effects of space flight and support crew health. Biomedical research includes space physiology, environmental health, radiation health, behavior and performance research, and clinical research.

Fundamental Biology

Fundamental Biology research focuses on development of an understanding of the effects of gravity on biologically relevant molecules, organs and organelles, single organisms and the ecosystems. Studies include animals (including humans), plants, tissues, and cells.

Fundamental Biology provides opportunities to study fresh water and marine organisms in space.

Student Activity

Procedure:

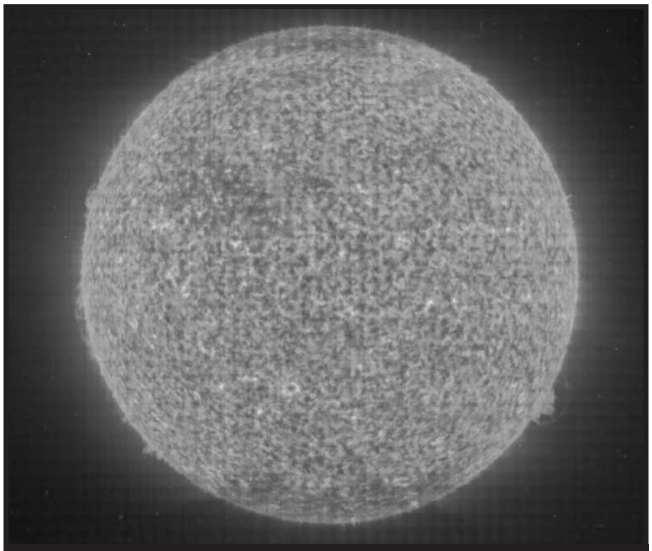
1. Divide students into teams. Each team will create a list of resources that they think are essential to their own survival on Earth.
2. Next, have the students relate their list to the natural cycles found within the environment.
3. Have the students identify renewable and nonrenewable resources found within their list.
4. Finally, have students design a self-sustaining habitation system in which the team could live for a one-year period of time.
5. Have each team present its concepts to the other teams.

Web sites:

Life and Microgravity Sciences and Applications
http://www.hq.nasa.gov/office/olmsa/lifesci/overview.htm
Human Research Facility *http://lslife.jsc.nasa.gov*
NASA-OLMSA Research Opportunities
http://peer1idi.usra.edu/
Life Sciences Data Archive *http://lsda.jsc.nasa.gov*
STELLAR Lessons *http://weboflife.arc.nasa.gov/stellar*
Human Physiology in Space
http://nsbri.tamu.edu/HumanPhysSpace/index.html

Space Science

Space Science research seeks to increase our understanding of the solar system and universe. Four major themes in Space Science are: Astronomical Search for Orgins, Structure and Evolution of the Universe, Solar System Exploration, and the Sun-Earth connection. Studying stars and planets helps tell us about our own star, the Sun and our own planet, Earth. It also helps us learn how stars, planets, and galaxies evolved and how the universe formed.



Scientists seeks to gain further insight into the structure and dynamics of the Sun.

With a vision toward the near and far reaches of space, scientists can gain further insight into the structure and dynamics of the Sun and near-Earth environment. By studying how the Sun affects Earth, from long-term climate alteration to temporary disruption of vital global communications, we enhance our forecasting skills. As we deepen our understanding of planetary and stellar systems, we gain a greater understanding of our place in the universe.

The International Space Station (ISS) as a multi-disciplinary laboratory, technology test bed, and observatory offers a unique vantage point from which research in space science can be conducted. The ISS offers researchers the resources required to increase our understanding of the solar system and the space environment and their effects on the health and future of the planet we inhabit.

Scientists seeks to understand galaxies and nebulae beyond our solar system.

The dynamic nature of the space environment demands that we respond quickly to observe, record, characterize, and assess the impact of cosmic events as they occur. The Alpha Magnetic Spectrometer (AMS), Advanced Cosmic-ray Composition Explorer for the Space Station (ACCESS), and Extremely-heavy Cosmic-ray Composition Observer (ECCO) experiments are being proposed for the ISS to study the composition or spectrum of cosmic rays, and other exotic particles in the universe. Data obtained from these investigations are expected to reveal much about the formation and evolution of the universe, as well as increase our understanding of the fundamental nature of energy and matter.

Web sites:

Office of Space Science
http://spacescience.nasa.gov
http://astrobiology.arc.nasa.gov
http:// nai.arc.nasa.gov
http://amazing-space.stsci.edu
http://science.nasa.gov

Space Environment
http://www.sel.noaa.gov
http://nssdc.gsfc.nasa.gov/spds/coshel_framed/sort_inst_frame.html

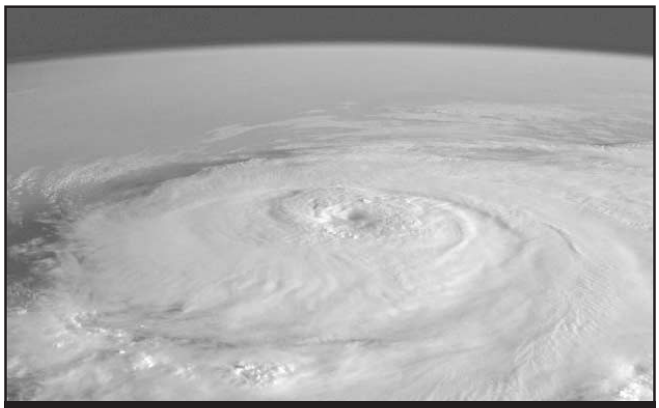
Cosmic Ray Missions
http://www701.gsfc.nasa.gov/access/access.htm
http://imagine.gsfc.nasa.gov/docs/sats_n_data/cosmic_missions.html
http://ultraman.berkeley.edu/ecco789.html
http://ams.cern.ch/

NASA Astronomy Picture of the Day Archive
http://antwrp.gsfc.nasa.gov:80/apod/archivepix.html

Earth Science

NASA's Earth Science Enterprise will explore Earth and its response to natural and human-induced changes to Earth's land, water, air and life. Specific areas of study include: atmospheric quality, regional and global climate, geologic activity, land use, land cover, and ocean and fresh water quality. The International Space Station (ISS) offers excellent and unique capabilities to researchers conducting studies in Earth Science. With an orbital tract covering more than 75 percent of Earth's surface, an area reflecting 95 percent of our planet's human population, this long-duration platform will contribute to our ability to assess a multitude of global trends.

NASA, its sister agencies, and international partners are striving to discover patterns in our climate that will allow us to better predict and respond to such environmental events as hurricanes, floods, and severe winters well in advance of their occurrence. With improved warning, nations, regions, and individuals can prepare for these events, saving countless lives and resources.



Hurricane Fran in the Atlantic

Tropical, subtropical and mid-latitude storms with organized cloud masses as large as 200 to 300 kilometers are easily seen and studied from the ISS. These storms originate in the eastern parts of the tropical Atlantic and Pacific oceans and are called hurricanes in the Atlantic, typhoons in the western Pacific, and cyclones in the Indian Ocean. Solar radiation warms the oceans at low latitudes. As a result, some atmospheric disturbances are able to transform the warm surface energy to large scale atmospheric motion. This occurs through the cyclical process of evaporation, condensation and precipitation. This same cyclical process is largely responsible for redistribution of the Sun's energy from tropical regions to polar regions.

Student Activity

Utilizing the Earth Science web sites, download images relating to surface temperature of the oceans during an El Niño event. Analyze the various temperature regions. Correlate this data with areas impacted by dramatic changes in weather patterns.

Teacher's Note:

Have the students create a concept map tracing the effects caused by climatic changes in ocean temperatures.

Volcanic eruption on the coast of Kamchatka, Russia's far east region.

Erupting volcanoes cause major impacts on society and the environment. The atmosphere, for example, is directly affected. Studies will seek to evaluate the effects of volcanic eruptions on local and worldwide climate and weather patterns.

Student Activity

Utilizing the Earth Science web sites, gather information relating to volcanoes. Evaluate the positive and negative effects of volcanic eruptions with particular focus on land, vegetation, climate, and humanity.

Teacher's Note:

Consider dividing the class in half such that 1/2 the class presents the negative effects of volcanoes and 1/2 presents the positive effects.

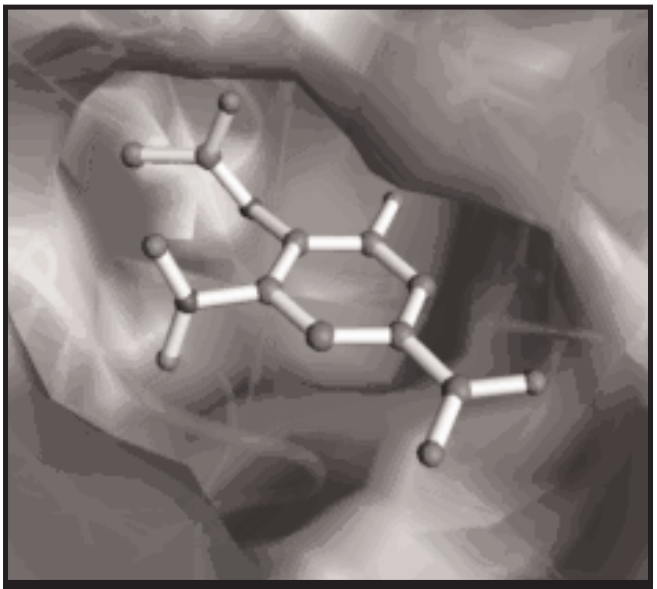
Web sites:

Earth Science *http://www.earth.nasa.gov*
Earth Science Branch *http://eol.jsc.nasa.gov/*
NASA Earth Science Education-On Line *http://sdcd.gsfc.nasa.gov/ESD/earth.html*
Space Imaging *http://www.spaceimage.com/*
NASA Image eXchange *http://nix.nasa.gov/*
Earth and Space Hotlist *http://space.rice.edu/~reiff/Bookmarks. html*

Space Product Development

The commercial development of the space frontier is one of the greatest opportunities facing America. It is the growth of business into space that will bring the benefits of space down to Earth and enrich the everyday lives of all Americans. NASA is encouraging businesses to seize this opportunity through the Space Product Development Program and its Commercial Space Centers, to help ensure the continued economic growth of the U.S., and to bring the opportunities for new advances, technological understanding, products and jobs to the public. This is being done by partnering with industry to help them discover the benefits that can come from commercial space and microgravity investigations.

By making use of the unique condition available on aircraft flying special trajectories, sounding rockets, the Space Shuttle or the International Space Station, businesses are able to get the information they need to deal with problems they face today, and to develop new ideas for future exploration and development.



Information from space-and Earth-grown crystals has helped in the design of a potential flu treatment.

Commercial research is helping to purify drinking water.

Commercial research through the Space Product Development Program has already resulted in products that are available to the public. The Ford Motor Company has used the program to help improve its cast automotive parts, resulting in more reliable products that cost less to produce. Research done by Water Technology Corporation/ WTC-Ecomaster has produced a new generation of water purification technology that is benefiting everyone from hikers to small municipal water treatment operations. Light Emitting Diodes (LED's), originally developed by Quantum Devices, Inc., for use in commercial microgravity plant research, are being used in a special type of cancer treatment called *photodynamic* therapy, where they provide a more reliable and efficient source of light. Other down-to-Earth benefits from commercial space and microgravity investigations are on the way as well. The International Space Station will help expand these efforts, benefiting everything from the growth and crystallization of proteins for use in drug design to the development of new plants.

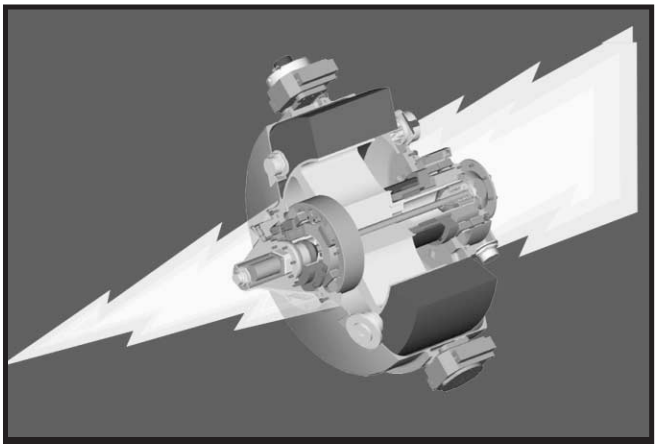
Web sites:

Office of Life and Microgravity Sciences and Application – Space Product Development
http://www.hq.nasa.gov/office/olmsa/spd

Space Product Development Program
http://commercial.nasa.gov

Engineering Research and Technology

As a technology test bed, the International Space Station (ISS) will enable researchers to develop and validate the technologies needed to enhance and facilitate the utilization and exploration of space. Many of the technologies being developed are expected to yield significant benefits for use on Earth, including improved commercial space communication systems for personal phone, computer and video use, more efficient use of energy, water recycling and improvements in air and water quality in private and commercial buildings.

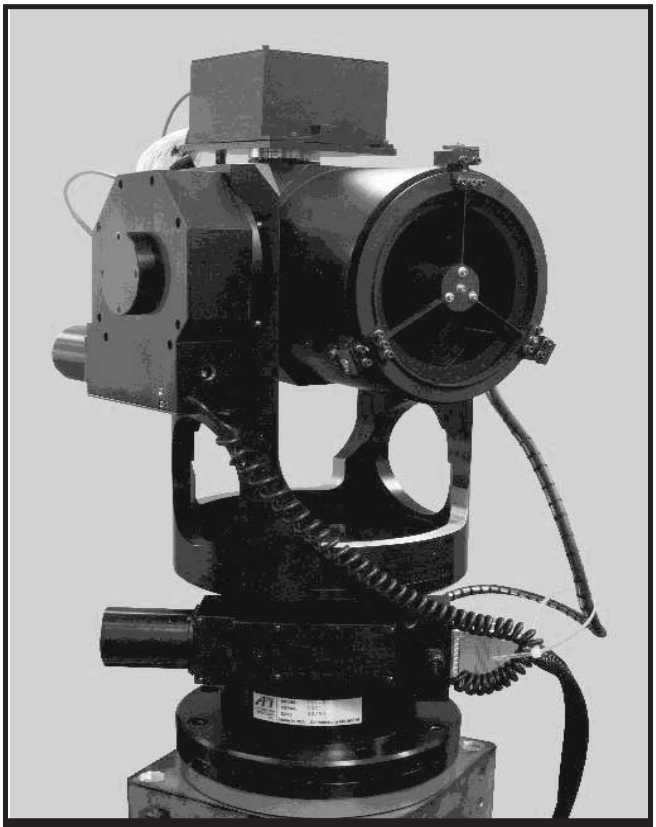


Flywheel energy storage technology supports advanced energy generation and possible battery replacement on the ISS.

Flywheel energy storage experiments are planned for the ISS to demonstrate the advanced energy storage technology and its benefits to the ISS as possible battery replacement. Studies have shown significant potential life cycle cost savings could be realized by taking advantage of the long-cycle life inherent in flywheel technology by eliminating the maintenance and logistics cost associated with battery change out.

Web sites:

International Space Station and Technology
http://spaceflight.nasa.gov/science
http://www.jsc.nasa.gov/expert



A laboratory-model optical communication tramsmitter, forerunner to the space-to-ground laser communication terminal, planned for the ISS.

National Aeronautics and Space Administration (NASA) space probes explore the solar system and beyond, relaying the information they gather to Earth. Historically, this information relay has been accomplished using radio waves sent from the spacecraft to large satellite dishes on Earth. However, as each new generation of space probe is capable of gathering more information than its predecessor, the need for information relay increases beyond the capability of radio waves. To meet this growing need, NASA is funding the Jet Propulsion Laboratory at the California Institute of Technology to develop optical communication. Optical communication technology uses laser beams and telescopes rather than radio waves and satellite dishes to communicate much more information. An important part of this development effort is the Optical Communication Demonstration, which will use a laser beam to transmit information from the ISS to a telescope on Earth.

NASA Resources for Educators

NASA's Central Operation of Resources for Educators (CORE) was established for the national and international distribution of NASA-produced educational materials in audiovisual format. Educators can obtain a catalogue and an order form by one of the following methods:

- NASA CORE
  Lorain County Joint Vocational School
  15181 State Route 58
  Oberlin, OH 44074-9799
- Phone (440) 775-1400
- Fax (440) 775-1460
- E-mail *nasaco@leeca.org*
- Home Page: http://core.nasa.gov

Educator Resource Center Network

To make additional information available to the education community, the NASA Education Division has created the NASA Educator Resource Center (ERC) network. ERCs contain a wealth of information for educators: publications, reference books, slide sets, audio cassettes, videotapes, telelecture programs, computer programs, lesson plans, and teacher guides with activities. Educators may preview, copy, or receive NASA materials at these sites. Because each NASA Field Center has its own areas of expertise, no two ERCs are exactly alike. Phone calls are welcome if you are unable to visit the ERC that serves your geographic area.

A list of the centers and the regions they serve includes:

AK, AZ, Northern CA, HI, ID, MT, NV, OR, UT, WA, WY
NASA Educator Resource Center
Mail Stop 253-2
NASA Ames Research Center
Moffett Field, CA 94035-1000
Phone: (650) 604-3574

CT, DE, DC, ME, MD, MA, NH, NJ, NY, PA, RI, VT
NASA Educator Resource Laboratory
Mail Code 130.3
NASA Goddard Space Flight Center
Greenbelt, MD 20771-0001
Phone: (301) 286-8570 MS

CO, KS, NE, NM, ND, OK, SD, TX
Space Center Houston
Educator Resource Center for
NASA Johnson Space Center
1601 NASA Road One
Houston, TX 77058
Phone: (281) 244-2129

FL, GA, PR, VI
NASA Educator Resource Center
Mail Code ERC
NASA Kennedy Space Center
Kennedy Space Center, FL 32899
Phone: (321) 867-4090

KY, NC, SC, VA, WV
Virginia Air & Space Center
Educator Resource Center for
NASA Langley Research Center
600 Settler's Landing Road
Hampton, VA 23669-4033
Phone: (757) 727-0900 x 757

IL, IN, MI, MN, OH, WI
NASA Educator Resource Center
Mail Stop 8-1
John H. Glenn Research Center at Lewis Field
21000 Brookpark Road
Cleveland, OH 44135
Phone: (216) 433-2017

AL, AR, IA, LA, MO,TN
U.S. Space and Rocket Center
NASA Educator Resource Center for
NASA Marshall Space Flight Center
One Tranquility Base
Huntsville, AL 35758
Phone: (205) 544-5812

MS
NASA Educator Resource Center
Building 1200
NASA John C. Stennis Space Center
Stennis Space Center, MS 39529-6000
Phone: (228) 688-3338

NASA JPL Educator Resource Center
Village at Indian Hill
1460 East Holt Avenue, Suite 20
NASA Jet Propulsion Laboratory
Pomona, CA 91767
Phone: (909) 397-4420

AZ and Southern CA
NASA Educator Resource Center for
NASA Dryden Flight Research Center
45108 N. 3rd Street East
Lancaster, CA 93535
Phone: (661) 948-7347

VA and MD's Eastern Shores
NASA Educator Resource Center
Visitor Center Building J-17
GSFC/Wallops Flight Facility
Wallops Island, VA 23337
Phone: (757) 824-2298

Regional Educator Resource Centers (RERCs) offer more educators access to NASA educational materials. NASA has formed partnerships with universities, museums, and other educational institutions to serve as RERCs in many states. A complete list of RERCs is available through CORE, or electronically via NASA Spacelink at *http://spacelink.nasa.gov/ercn/*

NASA's Education Home Page

NASA's Education Home Page serves as a cyber-gateway to information regarding educational programs and services offered by NASA for the American education community. This high-level directory of information provides specific details and points of contact for all of NASA's educational efforts, Field Center offices, and points of presence within each state.

Educators and students utilizing this site have access to a comprehensive overview of NASA's educational programs and services, featuring a searchable database that has cataloged each of NASA's educational programs.

In addition, the Education homepage features access to NASA Education News Releases, NASA's Education Calendar of Events, and schedules for NASA educational Internet and television broadcasts. The site highlights direct access to NASA's on-line resources specifically designed for the educational community, as well as access to home pages maintained by NASA's four areas of research and development (including Aero-Space Technology, Earth Science, Human Exploration and Development of Space, and Space Science Enterprises). Visit this resource at the following address: *http://education.nasa.gov*

NASA Spacelink

NASA Spacelink is one of NASA's electronic resources specifically developed for the educational community. Spacelink is a "virtual library" in which local files and hundreds of NASA World Wide Web links are arranged in a manner familiar to educators. Using the Spacelink search engine, educators can search this virtual library to find information regardless of its location within NASA. Special events, missions, and intriguing NASA web sites are featured in Spacelink's "Hot Topics" and "Cool Picks" areas. Spacelink may be accessed at:
http://spacelink.nasa.gov

NASA Spacelink is the official home to electronic versions of NASA's Educational Products. NASA educator guides, educational briefs, lithographs, and other materials are cross-referenced throughout Spacelink with related topics and events. A complete listing of NASA Educational Products can be found at the following address:
http://spacelink. nasa.gov/products

"Educator Focus" is comprised of a series of Spacelink articles, which offer helpful information related to better understanding and using NASA educational products and services. Visit "Educator Focus" at the following address: *http://spacelink.nasa.gov/focus*

Join the NASA Spacelink EXPRESS mailing list to receive announcements of new NASA materials and opportunities for educators. Our goal is to inform you as quickly as possible when new NASA educational publications become available on Spacelink:
http://spacelink.nasa.gov/express

NASA Television (NTV)

NASA Television (NTV) features Space Shuttle mission coverage, live special events, interactive educational live shows, electronic field trips, aviation and space news, and historical NASA footage. Programming has a 3-hour block—Video (News) File, NASA Gallery, and Education File—beginning at noon Eastern and repeated five more times throughout the day.

NTV Weekday Programming Schedules (Eastern Times)

Video File	NASA Gallery	Education File
12–1 p.m.	1–2 p.m.	2–3 p.m.
3–4 p.m.	4–5 p.m.	5–6 p.m.
6–7 p.m.	7–8 p.m.	8–9 p.m.
9–10 p.m.	10–11 p.m.	11–12 p.m.

Live feeds preempts regularly scheduled programming. Check the Internet for program listings at:

http://www.nasa.gov/ntv	NTV Home Page
http://www.nasa.gov/	*Select* "Today at NASA" and "What's New on NASA TV?"
http://spacelink.nasa.gov/NASA.News /	*Select NASA* "TV Schedules"

Tune in to NTV

Via satellite—GE-2 Satellite, Transponder 9C at 85 degrees West longitude, vertical polarization, with a frequency of 3880.0 megahertz (MHz) and audio of 6.8 MHz—or through collaborating distance learning networks and local cable providers: http://www.nasa.gov/ntv/ntvweb.html

For more information on NTV, contact: NASA TV
NASA Headquarters, Code P-2 Washington, DC 20546-0001
Phone: (202) 358-3572

How to Access Information on NASA's Education Program, Materials,and Services EP-1999-06-345-HQ
This brochure serves as a guide to accessing a variety of NASA materials and services for educators. Copies are available through the ERC network, or electronically via NASA Spacelink.

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