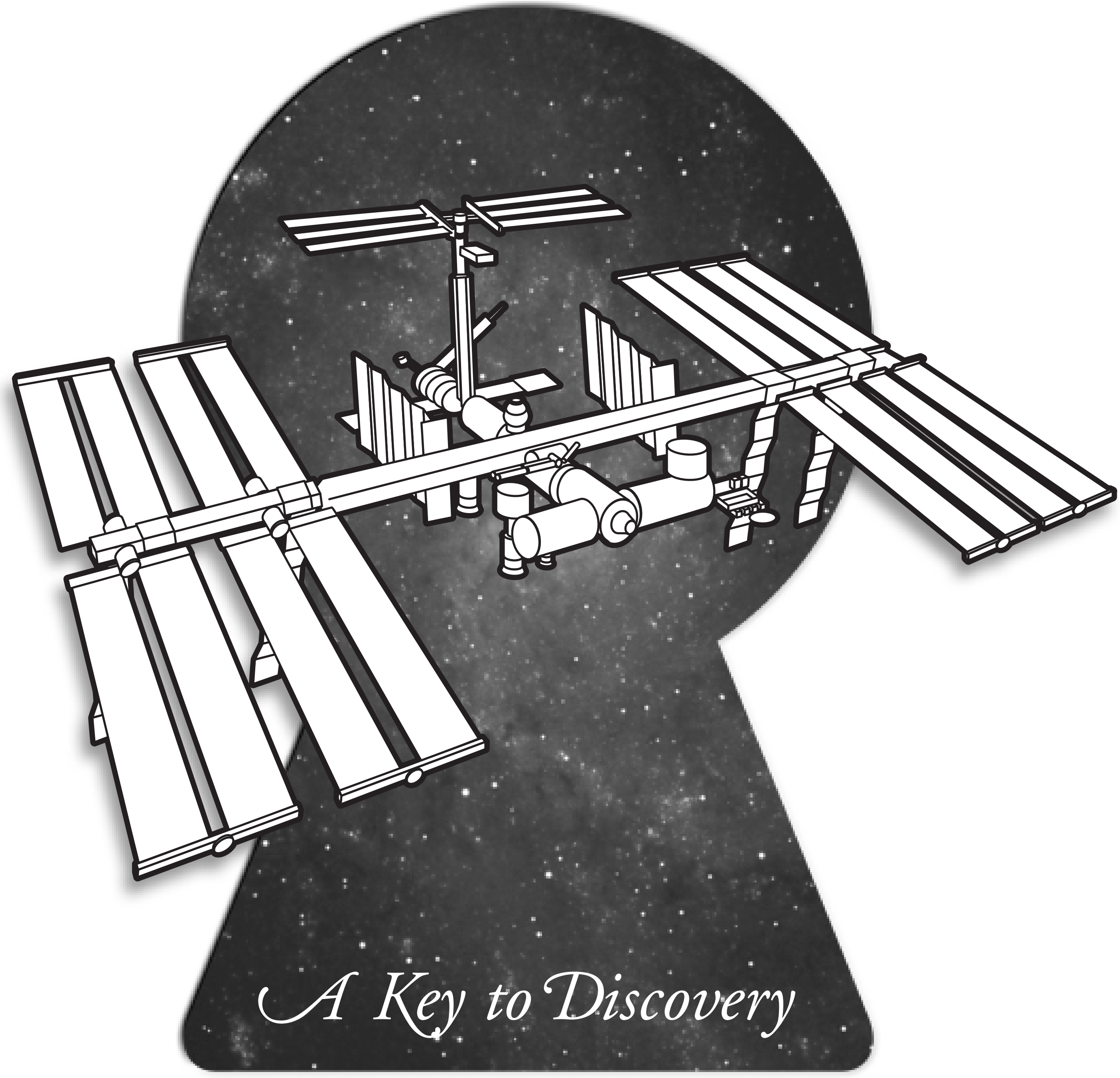


The International Space Station Fact Book

National Aeronautics and Space Administration

http://spaceflight.nasa.gov

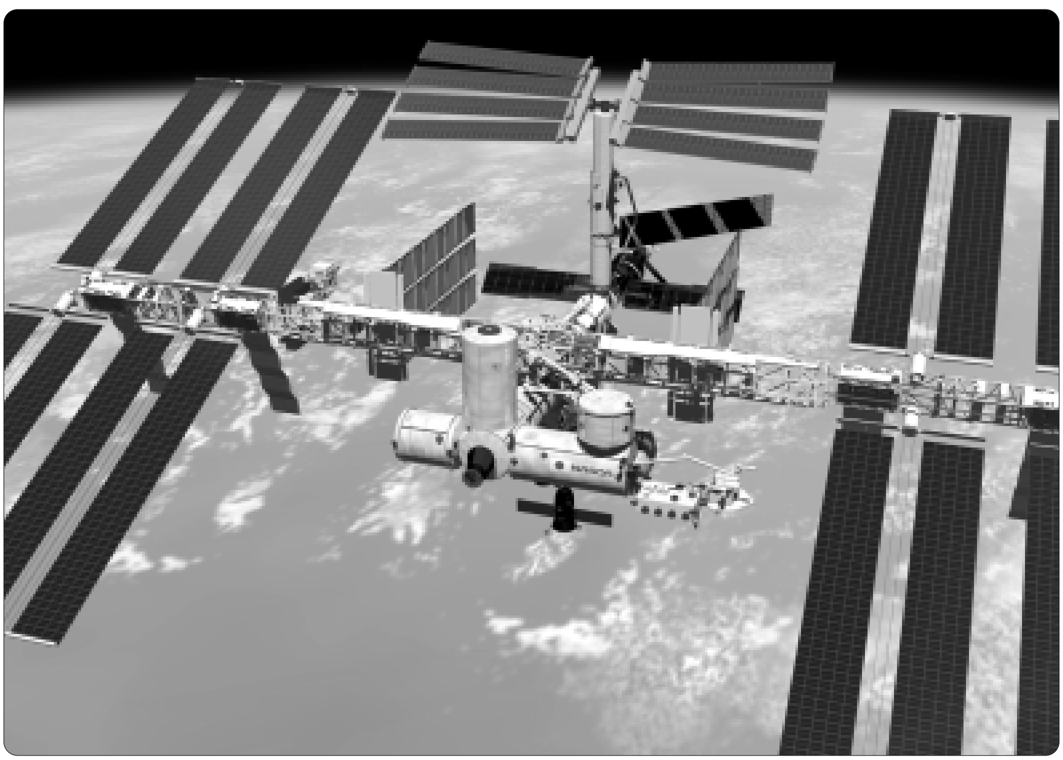
March 2001

The exciting thing is that we
don't *know what lies beyond*
the unopened door…and each
door will open to many more
doors…each answer leading
to many more questions…
that is discovery.

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

Why the ISS? It's about life on Earth . . . and beyond!

Exploration	The International Space Station (ISS) is an exciting gateway to new frontiers in human space exploration, meeting the deep-seated need of men and women throughout history to explore the unknown, to understand their world and the universe, and to apply that knowledge for the benefit of all here on Earth.
Leadership	The ISS sustains U.S. leadership in exploration and use of outer space that has inspired a generation of Americans and people thoughout the world.
Research	The ISS is a unique world-class laboratory providing an international platform for advances in science and technology.
Business	The ISS provides a stunning opportunity to enhance U.S. economic competitiveness and create new commercial enterprises.
Education	The ISS serves as a virtual classroom in space to the benefit of educators and students alike.



This artist's concept shows the International Space Station when its assembly sequence is completed. The 1 million pound station will have a pressurized volume equal to two jumbo jets and an acre of solar panels.

Facts and Figures—Based on December 2000 Configuration (Rev. F3)

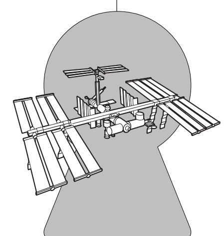
The Station:

■ Wingspan Width:	356 feet (108.5 meters)
■ Length:	290 feet (88.4 meters)
■ Mass (weight):	About 1 million pounds (453,592 kilograms)
■ Operating Altitude:	220 nautical miles average (407 kilometers)
■ Inclination:	51.6 degrees to the Equator
■ Atmosphere inside:	14.7 psi (101.36 kilopascals) same as Earth
■ Pressurized Volume:	43,000 cubic feet (1,218 m^3) in 6 laboratories
■ Crew Size:	3, increasing to 7

American Expenditure Statistics Compared to NASA Budget

American Consumer Expenditures*	**billions of dollars**
■ Tobacco products	66.0
■ Alcohol purchased for off-premise consumption	69.3
■ Clothing, accessories, and jewelry	397.2
■ New autos	97.3
■ Gasoline and oil	128.3
■ Airline	30.7
■ Recreation	534.9
FY 2001 NASA Budget (Total)	**14.3**
■ International Space Station	(2.1)
■ Space Shuttle	(3.1)
■ Science, Aeronautics, and Technology	(6.2)

* Source of information is the Department of Commerce Survey of Current Business, Personal Consumption Expenditures.



The International Space Station Fact Book

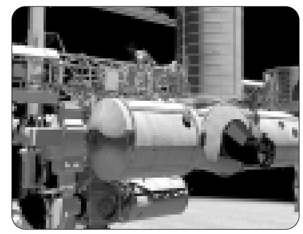
The ISS is an Earth-orbiting laboratory drawing upon the scientific and technological expertise of 16 cooperating nations: the United States, Canada, Japan, Russia, 11 member nations of the European Space Agency (ESA), and Brazil.

On the far left is the U.S. Lab, on the lower left is the X-38 crew return vehicle, and on the lower right is the U.S. Habitation module.

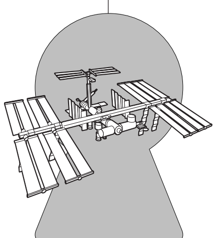
The pressurized living and working space aboard the completed ISS will be about the size of 3 average American homes (approximately 43,000 cubic feet). Its giant solar arrays will generate the electricity needed to power about 50 average American homes. An initial crew of three will begin living aboard the ISS in late 2000. Inside the ISS its weightless environment will be maintained at "shirt sleeve" temperatures with atmospheric pressures similar to what we have here on Earth.

Six main laboratories will house research facilities:

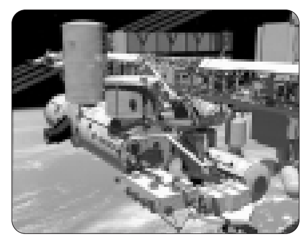
- Two U.S.—a laboratory module called "Destiny" and a Centrifuge Accommodations Module (CAM)
- One European Space Agency (ESA) laboratory named "Columbus"
- One Japanese Experiment Module named "Kibo"
- Two Russian Research Modules



The European Space Agency's (ESA) Columbus Orbital Facility (COF) laboratory



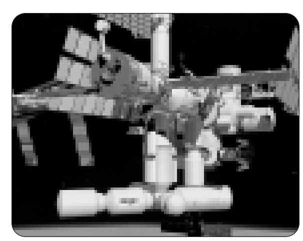
The central girder, called the truss, will connect the modules and four giant solar arrays making the ISS larger than a football field. The Canadian-built Remote Manipulator System, a 55-foot robot arm and a grappling mechanism called the Special Purpose Dexterous Manipulator (SPDM), will move along the truss on a mobile base transporter to perform assembly and maintenance work.



The Japanese Experiment Module (JEM) laboratory

External sites for mounting experiments intended for looking down at Earth and out into space or for direct exposure to space are provided at four locations on the truss structure along with 10 on the Japanese Kibo Module's back porch and 4 on the ESA Columbus Module exposed facility. These external payload sites vary as to the number of payloads that can be accommodated.

A three-person Russian Soyuz capsule will initially provide emergency crew return.



The Russian segment of the International Space Station

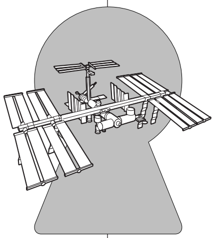
A variety of vehicles will be visiting the ISS to ferry crew and supplies from Earth. Crew exchanges will be accomplished with the Space Shuttle and Soyuz. Russian Progress spacecraft, Japanese H-II Transfer Vehicle, and Europe's Autonomous Transfer Vehicle (ATV) will provide resupply and reboost.

Progress To Date

The ISS, brought to life with a crew of three, is orbiting the Earth over 230 miles (SN) above us at a speed exceeding 17,000 mph (27,358 km/h)

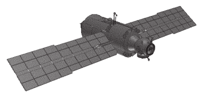
- The first crew (Expedition One) complete a very productive opening tour.
- Expedition Two crew is using the Human Research Facility and other equipment to begin 18 NASA experimental investigations.
- On-orbit elements now on orbit are the Zvezda Service Module, Russia's keystone contribution, and the U.S. laboratory, Destiny, the most complex and capable piece of the ISS.
- Key systems have been activated and confirmed to be operational including, life support, power, control, communications, structural, and Extra-Vehicular Activity (EVA) subsystems.
- Three quarters of all U.S. hardware is now either at KSC or deployed to orbit.
- Mission Control Center-Houston (MCC-H) has assumed responsibility from MCC-Moscow as the lead ISS Control Center.

ISS Elements Launched To Date

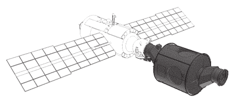


- November 1998, 1A/R, Russian Proton, Zarya Control Module
- December 1998, 2A, Space Shuttle Discovery: STS 88, Unity Connecting Module (Node-1)
- July 2000, 1R, Zvezda Service Module, First ISS Crew
- October 2000, 3A, Space Shuttle Discovery: STS 92, Integrated Truss Structure Z1, Presurrized Mating Adapter 3, Ku-band Communications System, Control Moment Gyros.
- November 2000, 4A, Space Shuttle Endeavour: STS-97, Integrated Truss Structure P6, Photovoltaic Module, Radiators
- February 7, 2001, 5A, Space Shuttle Atlantis: STS-98, Destiny Laboratory Module

Progress To Date . . .

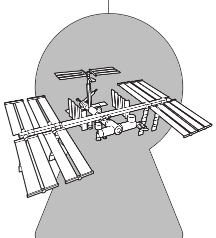


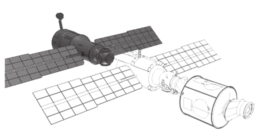
Russian Proton Rocket (1A/R)
Zarya Control Module (Functional Cargo Block)
November 1998



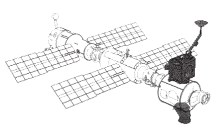
***Endeavour* (STS-88; 2A)**
Unity Node (1 Stowage Rack)
December 1998

Shuttle Crew: Cmdr Robert D. Cabana; Pilot Frederick W. "Rick" Sturckow; Mission Specialists James H. Newman, Nancy J. Currie, Ph.D., Jerry L. Ross, and Sergei Konstantinovich Krikalev (Russia).



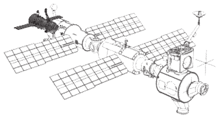


Russian Proton Rocket (1R)
Zvezda Service Module
July 2000



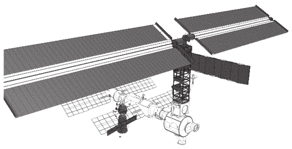
***Discovery* (STS-92; 3A)**
Truss Segments and Control Systems
October 2000

Shuttle Crew: Cmdr Brian Duffy; Pilot Pam Melroy; Mission Specialists Leroy Chiao, Michael Lopez-Alegria, Bill McArthur, Jeff Wisoff, and Koichi Wakata (Japan).



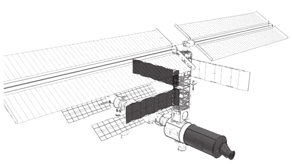
Expedition One/Soyuz (TM; 2R)
Test Flight and Assembly
October 2000

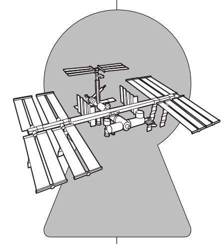
Crew: Soyuz Cmdr/ISS Pilot Yuri Gidzenko; ISS Cmdr Bill Shepherd; Sergei Krikalev.



***Endeavour* (STS-97; 4A)**
PV Arrays and Batteries
November 2000

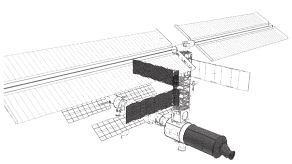
Shuttle Crew: Cmdr Brent Jett; Pilot Michael Bloomfield; Mission Specialists Joseph Tanner, Carlos Noriega, and Marc Garneau (Canada).





***Atlantis* (STS-98; 5A)**
U.S. Destiny Laboratory Module
January 2001

Shuttle Crew: Cmdr Kenneth Cockrell; Pilot Mark Polansky; Mission Specialists Bob Curbeam, Thomas Jones, and Marsha Ivins.

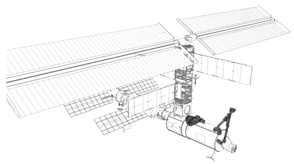


***Discovery* (STS-102/5A.1) Expedition Two**
Crew Exchange/Leonardo MPLM Laboratory Equipment
February 2001

Shuttle Crew: Cmdr James Weatherbee; Pilot James Kelly; Mission Specialists Andy Thomas and Paul Richards.

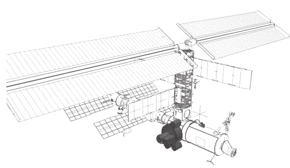
ISS Crew: ISS Cmdr Yury Usachev (Russia); James Voss; Susan Helms.

The Year Ahead . . .



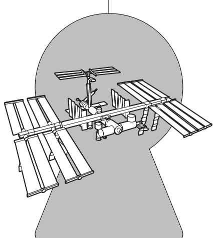
Endeavour **(STS-100; 6A)**
U.S. Lab Outfitting, UHF Antenna, Canada Arm
April 2001

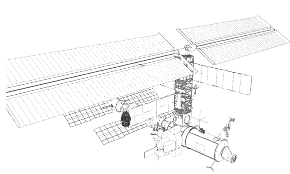
Shuttle Crew: Cmdr Kent V. Rominger; Pilot Jeffrey Ashby; Mission Specialists Chris Hadfield (Canada), John Phillips, Scott Parazynski, Umberto Guidoni (Italy), and Yuri Lonchakov (Russia).



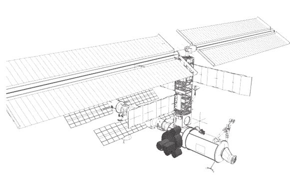
Atlantis **(STS-104; 7A)**
Joint Airlock, High Pressure Gas Assembly
May 2001

Shuttle Crew: Cmdr Steven Lindsey; Pilot Charles Hobaugh; Mission Specialists Michael Gernhardt, James Reilly, and Janey Kavandi.





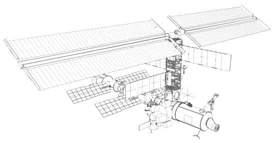
Soyuz (TM; 4R)
Russian Docking Ports, Strela Boom
TBD



Endeavour **(STS-105; 7A.1) Expedition 3**
Logistics and Resupply
July 2001

Shuttle Crew: Cmdr Scott Horowitz; Pilot Rick Sturckow; Mission Specialists Daniel Barry and Patrick Forrester.

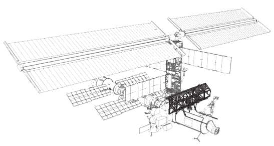
ISS Crew: Cmdr Frank Culbertson; Mikhail Turin (Russia); Valdimir Dezhurov (Russia)



***Endeavour* (STS-108; UF-1) Expedition 4**
Logistics and Utilization
November 2001

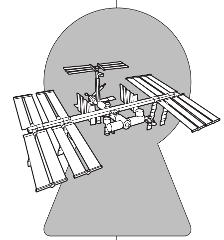
Shuttle Crew: Cmdr Dominic L. Gorie; Pilot Mark E. Kelly; Mission Specialist Linda M. Godwin and Daniel M. Tani.

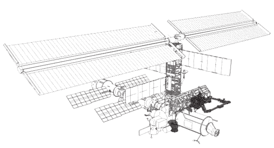
ISS Crew: Cmdr Carl E. Walz; Yuri Onufrienko (Russia); Daniel W. Bursch.



***Atlantis* (STS-110; 8A)**
Central Truss Segment and Mobile Transporter
January 2002

Shuttle Crew: TBD





***Discovery* (STS-111; UF-2)**
Multipurpose Logistics Module; Mobile Base System
February 2002

Shuttle Crew: TBD

Research on the International Space Station

The ISS represents a quantum leap in our capability to conduct research on orbit. It will serve as a laboratory for exploring basic questions in a variety of disciplines, and as a testbed and springboard for exploration. Research on the ISS will include commercial, scientific, and engineering research in the following areas:

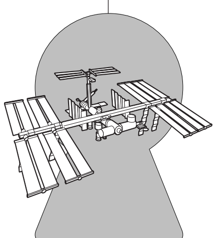
Early Research Disciplines:

Biomedical Research and Countermeasures: Researchers seek to understand and control the effects of the space environment on space travelers (e.g., muscle atrophy, bone loss, fluid shifts).

Long-term Benefits: Enhance the safety of space travel; develop methods to keep humans healthy in low-gravity environments; advance new fields of research in the treatment of diseases.

Fundamental Biology: Scientists study gravity's influence on the evolution, development, growth, and internal processes of plants and animals. Their results expand fundamental knowledge that will benefit medical, agricultural, and other industries.

Long-term Benefits: Advance understanding of cell, tissue, and animal behavior; use of plants as sources of food and oxygen for exploration; improved plants for agricultural and forestry.



Biotechnology: Current technology indicates that a weightless environment may enable researchers to grow three-dimensional tissues that have characteristics more similar to tissues in the body than has ever been previously available and to produce protein crystals for use in drug development.

Long-term Benefits: Culture realistic tissue for use in research (cancerous tumors, organ pieces); provide information to design a new class of drugs to target specific proteins and cure specific diseases.

Fluid Physics: The behavior of fluids is profoundly influenced by gravity. Researchers use gravity as an experimental variable to explain and model fluid behavior in systems on Earth and in space.

Long-term Benefits: Improved spacecraft systems designs for safety and efficiency; better understanding of soil behavior in Earthquake conditions; improved mathematical models for designing fluid handling systems for powerplants, refineries, and innumerable other industrial applications.

Later Research Disciplines:

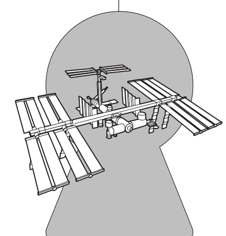
Advanced Human Support Technology: Researchers develop technologies, systems, and procedures to enable safe and efficient human exploration and development of space.

Long-term Benefits: Reduce the cost of space travel while enhancing safety; develop small, low-power monitoring and sensing technologies with applications in environmental monitoring in space and on Earth; develop advanced waste processing and agricultural technologies with applications in space and on Earth.

Materials Science: Researchers use low gravity to advance our understanding of the relationships among the structure, processing and properties of materials. In low gravity, differences in weight of liquids used to form materials do not interfere with the ability to mix these materials opening the door to a whole new world of composite materials.

Long-term Benefits: Advance understanding of processes for manufacturing semiconductors, collids, metals, ceramics, polymers, and other materials; determine fundamental physical properties of molten metal, semiconductors, and other materials with precision impossible on Earth.

Combustion Science: The reduction of gravity allows scientists to simplify the study of complex combustion (burning) processes. Since combustion is used to produce 85 percent of Earth's energy, even small improvements in efficiency and reduction of soot production (a major source of pollution on earth) will have large economic and environmental benefits.



Long-term Benefits: Enhance efficiency of combustion processes; enhance fire detection and safety on Earth and in space; improve control of combustion emissions and pollutants.

Fundamental Physics: Scientists use the low gravity and low temperature environment to slow down reactions allowing them to test fundamental theories of physics with degrees of accuracy that far exceed the capacity of Earthbound science.

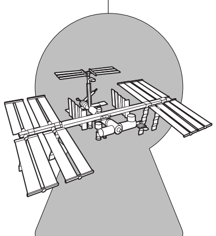
Long-term Benefits: Challenge and expand theories of how matter organizes as it changes state (important in understanding superconductivity); test fundamental theories in physics with precision beyond the capacity of Earth-bound science.

Earth Science and Space Science: Space Station will be a unique platform with multiple exterior attach points from which to observe the Earth and the universe.

Long-term Benefits: Space Scientists will use the location above the atmosphere to collect and search for cosmic rays, cosmic dust, anti-matter and "dark" matter. Earth scientists can obtain global profiles of aerosols, ozone, water vapor, and oxides in order to determine their role in climatological processes and take advantage of the longevity of ISS to observe global changes over many years.

For the latest information on the International Space Station, go to:

http://spaceflight.nasa.gov

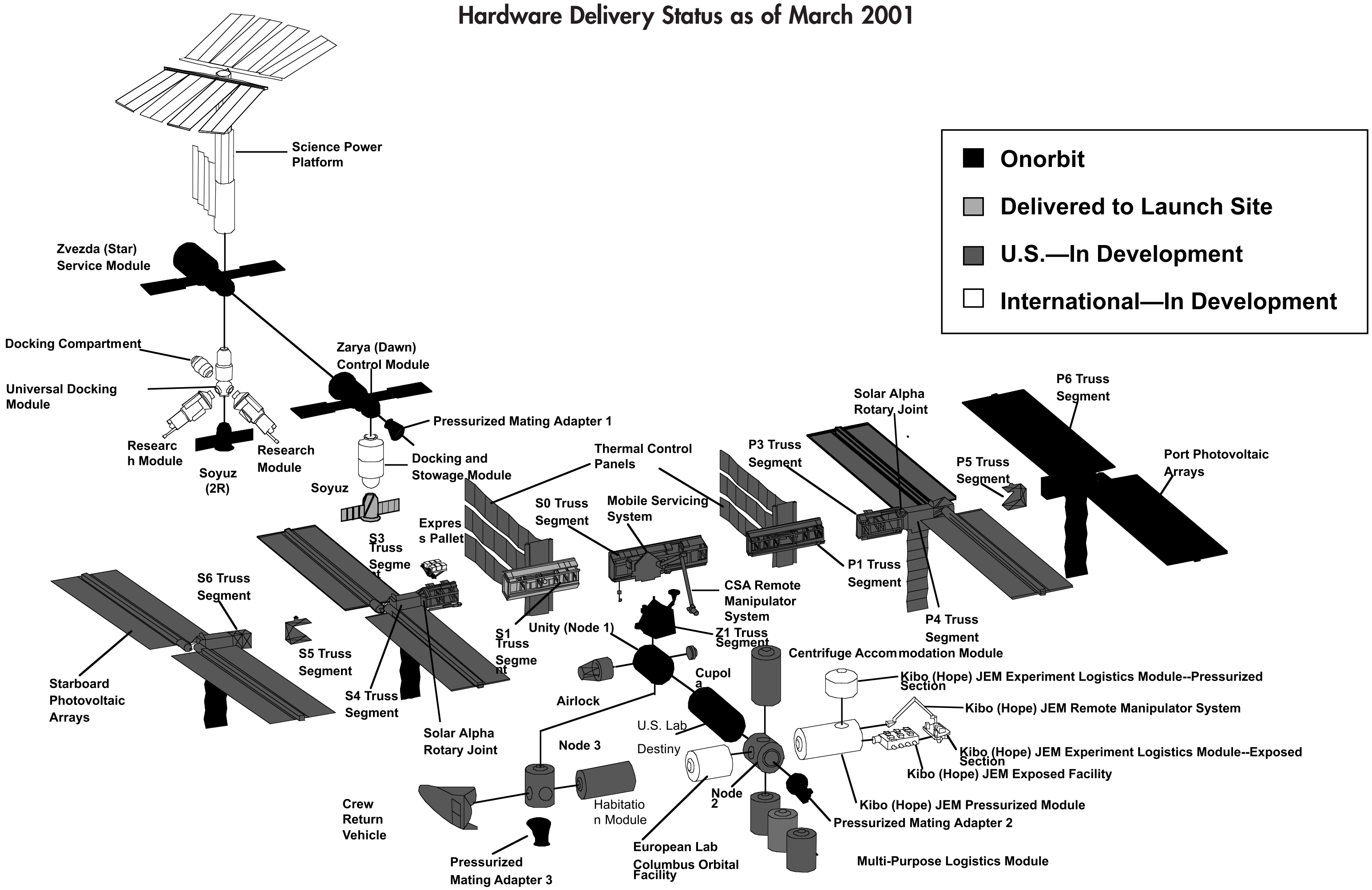


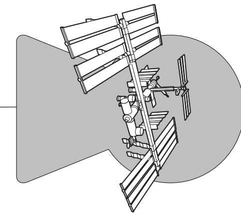
NASA's space flight Web site brings your the most up-to-the-minute information available on the International Space Station, including:

- Sighting information
- Realtime data
- Shuttle mission
- Assembly status
- The latest images
- Live video of life and work in orbit
- Live docking video
- Crew information and training
- News and interviews
- Time on orbit
- Scientific findings

International Space Station Assembly

Hardware Delivery Status as of March 2001





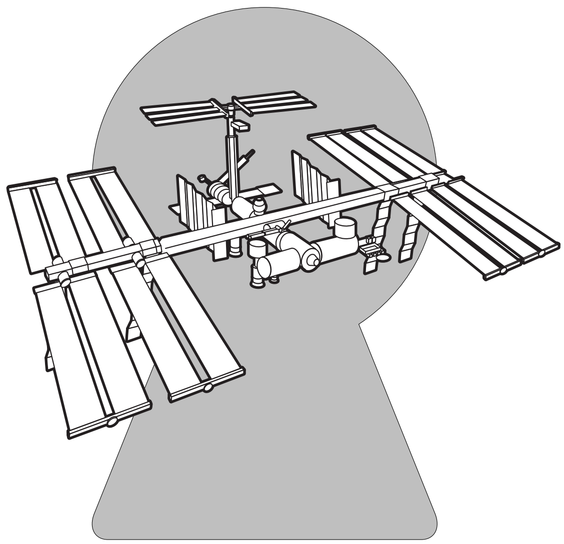
Assembly Sequence as of December 2000 (Rev. F3)

Calendar Year	1998	1999	2000	2001	2002	2003	2004	2005	2006
Launch Summary	2	1	5	7	7	7	5	10	4
Shuttle Launches*	**1**	**1**	**4**	**6**	**7**	**5**	**5**	**8**	**3**
Assembly	(1)	(1)	(4)	(5)	(5)	(4)	(4)	(6)	(2)
Utilization	(0)	(0)	(0)	(1)	(2)	(1)	(1)	(2)	(1)
Russian Assmebly Launches**	**1**	**0**	**1**	**1**	**0**	**2**	**0**	**2**	**1**

Major Milestones	
"Zarya" (FGB) *1st element launch*	11/98
"Unity" (Node1) *1st U.S. element launch*	12/98
"Zvezda" Service Module	7/00
Soyuz 3-Person Permanent	10/00
U.S. "Destiny" Lab launch	1/01
Canadian Robotic Arm launch	4/01
Utilization Flights	10/01, 2/02, 6/02, 10/03, 9/04, 2/05, 6/05, 4/06
Japanese Kibo launch	5/04
ESA Laboratory launch	10/04
Russian Research Modules	to be scheduled
U.S. Hab Module launch	9/05
7-Person Crew Capablity	1/06

* Shuttle launches of partner elements are included in U.S. assembly line (Japan's Kibo, ESA's COF, Canadian SSRMS, Russian SPP).

** Russian assembly launches excludes logistics, resupply, and crew exchange flights.



NASA