ISS to Gateway
Forging the Path to Space Exploration

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"Lead an innovative and sustainable program of exploration with commercial and international partners to enable human expansion across the solar system and to bring back to Earth new knowledge and opportunities.

Beginning with missions beyond low-Earth orbit, the United States will lead the return of humans to the Moon for long-term exploration and utilization, followed by human missions to Mars and other destinations."
The International Space Station
Animation of ISS Assembly
<table>
<thead>
<tr>
<th><strong>ISS Fun Facts</strong></th>
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<tbody>
<tr>
<td><strong>Continuously Occupied Since</strong></td>
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<tr>
<td><strong>Travel Speed</strong></td>
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<tr>
<td><strong>Orbits Earth</strong></td>
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<tr>
<td><strong>One Earth Day</strong></td>
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<tr>
<td><strong>Length</strong></td>
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<td><strong>Travel Time to ISS</strong></td>
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<td><strong>Solar Panels Size</strong></td>
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<td><strong>Size</strong></td>
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<td><strong>Space Walks</strong></td>
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<td><strong>Assembly</strong></td>
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<td><strong>Research</strong></td>
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Views from ISS

Posted to Twitter by @Astro_Alex, European Space Agency astronaut Alexander Gerst, this image shows our planet’s Moon as seen from the International Space Station.


The Aurora Borealis seen from the ISS
ISS Research
What Happens in Microgravity, doesn’t stay in Microgravity
ISS as a US National Lab

“In 2005, Congress designated the U.S. portion of the ISS as the nation’s newest national laboratory to maximize its use for improving quality of life on Earth, promoting collaboration among diverse users, and advancing science, technology, engineering, and mathematics (STEM) education. This unique laboratory environment is now available for use by non-NASA U.S. government agencies, academic institutions, and the private sector, providing these customers access to a permanent microgravity setting, a powerful vantage point in low Earth orbit, and the extreme and varied environments of space.”

ISS Research for you!

https://www.nasa.gov/mission_pages/station/research/nlab/research_opportunities

https://www.issnationallab.org/

https://nspires.nasaprs.com/

National Lab Research Opportunities
The ISS National Laboratory welcomes proposals for research and product development that might be suitable for the space station.

For more information, please see:
ISS National Lab Solicitations
ISS National Lab Research Proposal Submission and Evaluation Processes

NASA is seeking innovative partnerships for new capabilities. For more information, please see:
NASA Research Announcement: Research Opportunities for International Space Station Utilization, Solicitation: NNJ13ZBG01N (UPDATED: November 14, 2014)

ISS Research Client Service and IT Customer Service Helplines

ISS Research (Client Service) Helpline
The ISS Research Integration Office has both a phone and an email client service helpline that Payload Developers and others interested in doing research on ISS can contact to get assistance. The phone is staffed during regular business hours. After hours, please leave a message and a representative will return the call on the next business day. Or send us an email with your contact info, affiliation, detailed question(s), and how you are planning to use the info.
Phone: 202-244-6187
Email: jsc.iss-research.helpline@mail.nasa.gov

ISS IT PD Liaison/Customer Service
If you have questions regarding NASA/USC badging, security or remote computer access (e.g., to NASA internal websites, ISS Payload documentation, etc.), please email the ISS IT PD Liaison or call Customer Service. The phone is staffed live during regular business hours. After hours, please leave a message and a representative will return the call on the next business day.
Phone: 202-244-8999
Email: jsc.iss-it-pd- liaison@mail.nasa.gov
ISS Ongoing Operations

CREW OPERATIONS

Health monitoring aboard the ISS

STATION OPERATIONS

NASA astronaut Serena Auñón-Chancellor performs plumbing duties inside the ISS toilet, also known as the Waste and Hygiene Compartment, located in the U.S. Tranquility module.

ISS Research This Week – Astrobee

Terry Fong, Ph.D.  NASA Ames Research Center, Moffett Field, CA


https://youtu.be/XqyA0trJUql?t=10s
ISS Research This Week – Flow Dynamics

Japan Aerospace Exploration Agency (JAXA)


SLUG FLOW  CHURN FLOW  SEMI-ANNULAR  ANULAR
ISS Research This May – VEG04A

https://www.youtube.com/watch?v=c1Gxn_nfgWA

ISS Research October – PH02


Radish
Plans for the future

- Artemis (2010)
- LRO (2009)
- Orion Spacecraft 2019
- Power & Propulsion Element 2022
- Orion Crewed Exploration
- Gateway in Lunar Orbit 2026

ISS–Sustainable Low-Earth Capability 2000–
Small Commercial Landers 2019–
Mid-Size Robotic Landers 2022
Advanced Exploration Lander 2026

2018
2022
2026
NASA’S Open Architecture Develops Space

**ISS as a model**

- Cygnus (Orbital ATK)
- Dragon (SpaceX)
- Dream Chaser (SNC)
- Dragon Crew (SpaceX)
- Starliner (Boeing)

**INTERNATIONAL**

- Soyuz & Progress (Roscosmos)
- H-II Transfer Vehicle (JAXA)
- Orion/European Service Module (ESA)

**GATEWAY**

Multiple providers expected in lunar orbit and on the surface

**Lunar Surface**
GATEWAY

An exploration and science outpost in orbit around the Moon

Power and Propulsion Element:
- Power, communications, attitude control, and orbit control and transfer capabilities for the Gateway.

ESPRIT:
- Science airlock, additional propellant storage with refueling, and advanced lunar telecommunications capabilities.

Utilization Element:
- Small pressurized volume for additional habitation capability.

Habitation Modules:
- Pressurized volumes with environmental control and life support, fire detection and suppression, water storage and distribution.

Robotic Arm:
- Mechanical arm to berth and inspect vehicles, install science payloads.

Logistics and Utilization:
- Cargo delivery of consumables and equipment. Modules may double as additional utilization volume.

Airlock:
- Enables spacewalks, potential to accommodate docked elements.

Sample Return Vehicle:
- A robotic vehicle capable of delivering small samples or payloads from the lunar surface to the Gateway.

Orion:
- U.S. crew module with ESA service module that will take humans farther into deep space than ever before.

NASA-led architecture and integration:
- U.S., International, TBD: U.S. and/or International

Gateway Compared to the International Space Station:
- The International Space Station is a permanently crewed research platform that has 11 modules and is the size of a football field.
- The Gateway is a much smaller, more focused platform for extending initial human activities into the area around the Moon.

https://www.nasa.gov/topics/moon-to-mars/lunar-outpost
INTERNATIONAL INTEROPERABILITY STANDARDS

Draft Deep Space Interoperability System Standards
Posted for feedback on March 1, 2018

- Avionics
- Communications
- Environmental Control and Life Support Systems
- Power
- Rendezvous
- Robotics
- Thermal

www.InternationalDeepSpaceStandards.com
NextSTEP Habitation

NextSTEP Phase 1: 2015-2016
Cislunar habitation concepts that leverage commercialization plans for LEO

- Partners develop required deliverables, including concept descriptions with concept of operations, NextSTEP Phase 2 proposals, and statements of work.

NextSTEP Phase 2: 2016-2019
- Partners refine concepts and develop ground prototypes.
- NASA leads standards and common interfaces development.

- Partnerships and Acquisition approach, leveraging domestic and international capabilities.
- Development of deep space habitation capabilities.
- Deliverables: flight unit(s)

Phase 3: 2019+

NASA defines reference habitat architecture in preparation for Phase 3.

https://www.nasa.gov/nextstep/habitation
Habitation Development Partnerships

Five full-sized ground prototypes will be delivered for testing in 2019. In final negotiations with NanoRacks for sixth habitat prototype demonstrator.

Lockheed Martin
Denver, CO
- Refurbishes heritage hardware

Northrop Grumman
Dulles, VA
- Builds on proven cargo spacecraft development

Bigelow Aerospace
Las Vegas, NV
- Expandable

Boeing
Pasadena, TX
- Leverages existing technologies

Sierra Nevada
Louisville, CO
- Modular buildup

NanoRacks
Louisville, CO
- Converted Centaur upper stages

Government Evaluation Location:
KSC
JSC
Las Vegas
MSFC
JSC
MSFC
What’s Next? And What Can You Do?

• ISS National Lab Research is ramping up.
  • Check NSPIRES for Proposal Opportunities! (www.nspires.nasa.gov)

• Gateway is real. Congress approved FY19 NASA Appropriations.

• NextSTEP Phase 2 testing and closeout in 2019; Phase 3 build.

• Stay tuned for updates on your favorite NASA channel.
Plans for the future

**HUMAN EXPLORATION**

**NASA's Path to Mars**

**EARTH RELIANT**
- Mission: 6 to 12 months
- Return to Earth: Hours
- Learning fundamentals aboard the International Space Station
- U.S. companies provide access to low-Earth orbit

**PROVING GROUND**
- Mission: 1 to 12 months
- Return to Earth: Days
- Expanding capabilities by visiting an asteroid in a lunar distant retrograde orbit
- Traveling beyond low-Earth orbit with the Space Launch System rocket and Orion spacecraft

**MARS READY**
- Mission: 2 to 3 years
- Return to Earth: Months
- Exploring Mars, its moons and other deep space destinations