



# *Mass vs. Weight* Careers In Space

## Objective

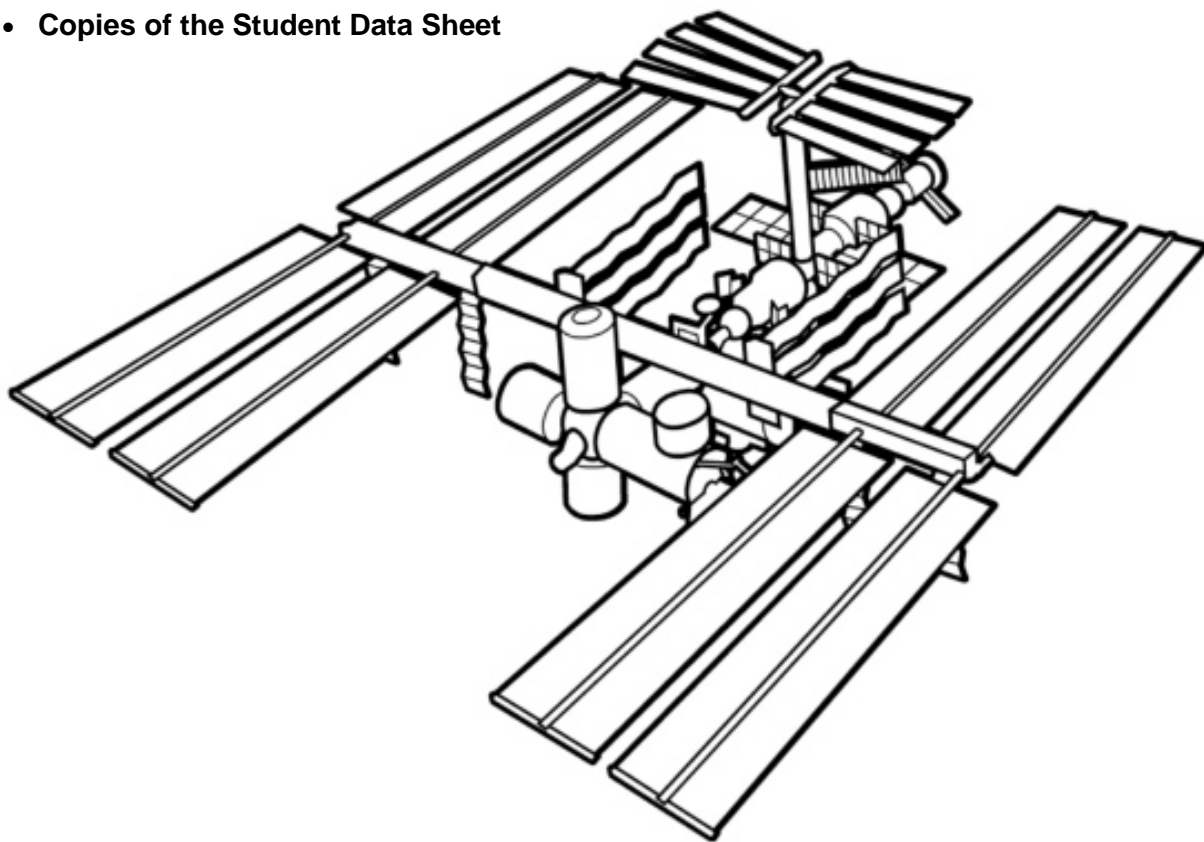
To explore careers, with a focus on the skills and interests needed to become an astronaut on the International Space Station (ISS).

## Description

Students will be introduced to the three astronauts on the International Space Station (ISS) who are featured in the *Mass vs. Weight* video clips. Students will explore the astronauts' backgrounds, experiences, interests, and careers. This information will guide them to better understand the importance of these factors in why these astronauts chose a career in space flight. Students will discuss their own backgrounds, experiences and interests as they explore careers that interest them.

## Materials

- *Mass vs. Weight* "Closing" video clip
- Copies of the astronaut biographies
- Copies of the Student Data Sheet



MASS VS WEIGHT

## Background

The International Space Station is the largest orbiting laboratory ever built. It is an international, technological, and political achievement. The international partners include the space agencies of the United States, Canada, Russia, Brazil, Japan, and the European Space Agency representing eleven European countries. Combined, these space agencies represent sixteen nations.

The first components of the ISS were launched and assembled in orbit in 1998. By the year 2000, crews began living continuously on board. Since then, over seventy-five astronauts and cosmonauts have served as crew members onboard the ISS. These crew members came from ten different nations.

## Procedure

1. View the *Mass vs. Weight* "Introduction" video clip with the students to observe a sample of how the featured astronauts live and work in space.
2. Have students read the biographies of ISS Expedition 20 astronauts, Nicole Stott, Robert Thirsk, and Koichi Wakata. Direct them to focus on each astronaut's unique skills and interests. Discuss what they learned from their reading.
3. Complete the Student Data Sheet based on the Expedition 20 astronauts' biographies.
4. Discuss the students' answers.

## Assessment

The correct answers for the chart on the Student Data Sheet can be found in the astronaut biographies. The answers for questions 2, 3 and 4 should not be considered correct or incorrect, but the students should be able to discuss and defend their answers. The detail and information in the discussions of their answers will demonstrate how well they understand the importance of proper preparation, experiences and education needed for any successful career.

## Extensions

1. Have the students research a career that interests them to determine the education requirements, experiences and skills needed to be successful in that career.
2. Have students refer to the Astronaut Selection site at the following address: <http://www.nasajobs.nasa.gov/astronauts/default.htm>  
This site explains the application process, FAQ, and how to become an astronaut.

## Standards

### National Science Education Standards

#### Science as Inquiry

- Abilities necessary to do scientific inquiry

#### Science in Personal and Social Perspectives

- Science and technology in society

#### History and Nature of Science

- Science as a human endeavor

### National Geography Standards

#### The World in Spatial Terms

- How to use mental maps to organize information about people, places, and environments in a spatial context
- How to analyze the spatial organization of people, places, and environments on Earth's surface

#### Places and Regions

- How culture and experience influence people's perceptions of places and regions

## Station (ISS) Expedition 20 Crew Members Featured in *Mass vs. Weight* On-orbit Demonstrations

Astronaut biographies can be found at: <http://www.jsc.nasa.gov/Bios/>



**Nicole Passonno Stott**  
NASA Astronaut

**PERSONAL DATA:** Born in Albany, New York. Her hometown is Clearwater, Florida. She enjoys flying, snow skiing, SCUBA diving, woodworking, painting, and gardening.

**EDUCATION:** Clearwater High School, Clearwater, Florida, 1980. B.S., Aeronautical Engineering, Embry-Riddle Aeronautical University, 1987.

M.S., Engineering Management, University of Central Florida, 1992.

**SPECIAL HONORS:** Aircraft Operations Division, Newt Myers Team Spirit Award, KSC Public Affairs Certificate of Appreciation for Service; NASA Exceptional Achievement Medal; NASA Certificates of Commendation; NASA Performance Awards; NASA On-the-Spot Award; Lockheed Certificate of Appreciation.

**EXPERIENCE:** Ms. Stott began her career in 1987 as a structural design engineer with Pratt and Whitney Government Engines in West Palm Beach, Florida. She spent a year with the Advanced Engines Group performing structural analyses of advanced jet engine component designs.

Nicole Stott is an instrument rated private pilot.

**NASA EXPERIENCE:** In 1988, Ms. Stott joined NASA at the Kennedy Space Center (KSC), Florida as an Operations Engineer in the Orbiter Processing Facility (OPF). After 6 months, she was detailed to the Director of Shuttle Processing as part of a two-person team tasked with assessing the overall efficiency of Shuttle processing flows, and implementing tools for measuring the effectiveness of improvements. She was the NASA KSC Lead for a joint Ames/KSC software project to develop intelligent scheduling tools. The Ground Processing Scheduling System (GPSS) was developed as the technology demonstrator for this project. GPSS was a success at KSC, and also a commercial success that is part of the PeopleSoft suite of software products. During her time at KSC, Ms. Stott also held a variety of positions within NASA Shuttle Processing, including Vehicle Operations Engineer; NASA Convoy Commander; Shuttle Flow Director for Endeavour; and Orbiter Project Engineer for Columbia. During her last two years at KSC, she was a member of the Space Station Hardware Integration Office and relocated to Huntington Beach, CA where she served as the NASA Project Lead for the ISS truss elements under construction at the Boeing Space Station facility. In 1998, she joined the Johnson Space Center (JSC) team in Houston, TX as a member of the NASA Aircraft Operations Division, where she served as a Flight Simulation Engineer (FSE) on the Shuttle Training Aircraft (STA).

Selected as a mission specialist by NASA in July 2000, Nicole reported for astronaut candidate training in August 2000. Following the completion of two years of training and evaluation, she was assigned technical duties in the Astronaut Office Station Operations Branch, where she performed crew evaluations of station payloads. She also worked as a support astronaut for the Expedition 10 crew and as an ISS CAPCOM. In April 2006 she was a crew member on the NEEMO 9 mission (NASA Extreme Environment Mission Operations) where she lived and worked with a 6 person crew on the longest duration NEEMO mission to date for 18 days on the Aquarius undersea research habitat. The NEEMO9 mission served as

an analog for future lunar operations -- the crew tested advanced space suit design concepts, robotic devices for surface-based exploration, construction and communication techniques, and advanced tele-medicine hardware and techniques.

In preparation for a long duration space flight, Nicole completed a Russian language immersion class in Moscow, Russia, and ISS system training in Russia, Japan, Germany, and Canada at each of the international partner training sites and served as a backup crewmember to Expedition 18 and a prime crewmember for Expeditions 20 and 21. She is currently assigned to STS-133 and training in preparation for a targeted launch in September 2010. The STS-133 mission is planned as the final Space Shuttle flight and will deliver the Permanent Multi-purpose Logistics Module (PMM) and an Express Logistics Carrier (ELC4).

**SPACE FLIGHT EXPERIENCE:** Nicole completed her first long duration space flight as a Flight Engineer on the ISS Expeditions 20 and 21 crews. She launched to the International Space Station on the Space Shuttle Discovery with the crew of STS-128 on August 28, 2009. Nicole performed one spacewalk along with her STS-128 crewmate Danny Olivas with a total duration of 6 hours and 39 minutes. During her tour of duty on ISS she had the opportunity to participate in many interesting activities -- along with two of her ISS crewmates she executed the first track and capture of the Japanese cargo vehicle HTV, she worked as part of a 6-person crew to install the new treadmill and maintain the ISS systems, and conducted a wide variety of science and research activities. She returned on the Space Shuttle Atlantis with the crew of STS-129 on November 29, 2009, having logged 91 days in space.



**Robert (Bob) Brent Thirsk (P. Eng., MDCM, MBA)**  
Astronaut, Canadian Space Agency

**PERSONAL DATA:** Born August 17, 1953, New Westminster, British Columbia.

**EDUCATION:** Attended primary and secondary schools in British Columbia, Alberta, and Manitoba. Received a Bachelor of Science degree in Mechanical Engineering from the University of Calgary in 1976, a Master of Science in Mechanical Engineering from the Massachusetts Institute of Technology (MIT) in 1978, a Doctorate of Medicine from McGill University in 1982, and a Master of Business Administration from the MIT Sloan School of Management in 1998.

**EXPERIENCE:** Dr. Thirsk was in the family medicine residency program at the Queen Elizabeth Hospital in Montréal when he was selected in December 1983 for the Canadian Astronaut Program. He began astronaut training in February 1984 and served as backup payload specialist to Marc Garneau for the October 1984 space shuttle mission STS-41G.

Dr. Thirsk has been involved in various Canadian Space Agency projects including parabolic flight campaigns and mission planning. He served as crew commander for two space mission simulations: the seven-day CAPSULES mission in 1994, at Defence Research and Development Canada in Toronto, and the 11-day NEEMO 7 undersea mission in 2004 at the National Undersea Research Center in Key Largo, Florida. He led an international research team investigating the effect of weightlessness on the heart and blood vessels. He works with educational specialists in Canada to develop space-related curriculum for grade school students. Initiatives such as Canolab, Space for Species, and Tomatosphere have allowed thousands of young Canadians to experience the thrill of scientific discovery.

**NASA EXPERIENCE:** In 1998, Dr. Thirsk was assigned by the Canadian Space Agency to NASA's Johnson Space Center in Houston to pursue mission specialist training. This training program involved advanced instruction on both shuttle and space station systems, EVA (spacewalking), robotic operations, and Russian language. Within the NASA Astronaut Office,



Dr. Thirsk served as a CAPCOM (spacecraft communicator) for the International Space Station (ISS) program. CAPCOMS participate in actual and simulated space missions as a communication link between the ground team at Mission Control and the astronauts in orbit. CAPCOMS speak directly with the space station crew, and assist with technical planning for the mission and last-minute troubleshooting.

In 2004, Dr. Thirsk trained at the Yuri Gagarin Cosmonaut Training Centre near Moscow and became certified as a Flight Engineer for the Soyuz spacecraft. He served as backup Flight Engineer to European Space Agency (ESA) astronaut Roberto Vittori for the Soyuz 10S taxi mission to the ISS in April 2005. During the 10-day mission, Dr. Thirsk worked as Crew Interface Coordinator (i.e. European CAPCOM) at the Columbus Control Centre in Germany. A veteran of two space flights, STS-78 in 1966, and Expedition 20-21 in 2009, Dr. Thirsk has logged over 202 days in space.

**SPACE FLIGHT EXPERIENCE:** STS-78 (June 20-July 7, 1996). Dr. Thirsk flew as a payload specialist aboard Columbia on STS-78, the Life and Microgravity Spacelab (LMS) mission. During the flight, he and his six crewmates performed 43 international experiments devoted to the study of life and materials sciences. The life science experiments investigated changes in plants, animals, and humans under space flight conditions. The materials science experiments examined protein crystallization, fluid physics and high-temperature solidification of multi-phase materials in a weightless environment. Mission duration was 16 days, 21 hours, 47 minutes and 35 seconds.

Expedition 20/21 (May 27-December 1, 2009) represented a milestone for the Canadian Space Program since it was the first time a Canadian took part in a long duration mission. Dr. Thirsk served as a Flight Engineer in a 6-month tour of duty aboard the International Space Station during which time he assumed responsibilities for the maintenance and repair of the ISS, while conducting experiments on behalf of Canadian and international researchers.



**Koichi Wakata (Ph.D.)**

Astronaut, Japan Aerospace Exploration Agency (JAXA)

**PERSONAL DATA:** Born in 1963, in Saitama, Japan. Married and has one child. Enjoys flying, baseball, and snow skiing.

**EDUCATION:** Graduated from Urawa High School, Saitama, in 1982; received a Bachelor of Science degree in Aeronautical Engineering in 1987, a Master of Science degree in Applied Mechanics in 1989, and a Doctorate in Aerospace Engineering in 2004, all from Kyushu University.

**SPECIAL HONORS:** Minister of State for Science and Technology Commendation (1996). Special awards from Saitama Prefecture and Omiya City (1996). National Space Development Agency of Japan Outstanding Service Award (1996). Diplome pilote-cosmonaute de l'URSS V.M. Komarov (1997, 2001). NASA Exceptional Service Medal (2001). Japan Society for Biological Sciences in Space Distinguished Service Award (2001). Foreign Minister's Certificate of Commendation (2004).

**NASA/JAXA EXPERIENCE:** Dr. Wakata reported to the Johnson Space Center in August 1992. He completed one year of training and was qualified for assignment as a Mission Specialist on the Space Shuttle. Dr. Wakata's technical assignments have included: payload science support for the Astronaut Office Mission Development Branch (April 1993 to February 1995), Space Shuttle flight software verification testing in the Shuttle Avionics Integration Laboratory (SAIL) (April to October 1994), Space Shuttle and Space Station Robotics for the Astronaut Office Robotics Branch (March 1996 to July 2006), and Extravehicular Activities (EVA) development for the Astronaut Office EVA Branch (May 2001 to April 2006).

During the STS-85 mission (August 7-19, 1997), Dr. Wakata was the NASDA Assistant Payload Operations Director for the Manipulator Flight Demonstration, a robotic arm experiment for the Japanese Experiment Module of the International Space Station (ISS). He operated the robotic arm system on NASDA's Engineering Test Satellite VII in the tele-operation robotics experiments in 1999. Since December 2000, he has been a NASA robotics instructor astronaut.

Dr. Wakata commenced training for a long-duration expedition on the ISS in October 2001. In July 2006, he served as the commander of the 10th NASA Extreme Environment Mission Operations (NEEMO) mission, a seven-day undersea expedition at the National Oceanic & Atmospheric Administration's Aquarius habitat located off the coast of Florida. In August 2006, he started flight engineer training for the Russian Soyuz spacecraft. In February 2007, Dr. Wakata was assigned as a flight engineer to ISS Expedition 18.

**SPACE FLIGHT EXPERIENCE:** STS-72, Endeavour (January 11-20, 1996): Dr. Wakata flew as the first Japanese Mission Specialist on this 9-day mission during which the six-member crew retrieved the Space Flyer Unit (launched from Japan ten months earlier), deployed and retrieved the OAST-Flyer, and conducted two spacewalks to demonstrate and evaluate techniques to be used in the assembly of the International Space Station. The STS-72 mission was completed in 142 orbits, traveling 3.7 million miles in 8 days, 22 hours, and 40 seconds.

STS-92, Discovery (October 11-24, 2000): Dr. Wakata became the first Japanese astronaut to work on the ISS assembly on this 13-day mission during which the seven-member crew attached the Z1 Truss and Pressurized Mating Adapter 3 to the ISS using Discovery's robotic arm and performed four space walks to configure these elements. This expansion of the ISS opened the door for future assembly missions and prepared the station for its first resident crew. The STS-92 mission was accomplished in 202 orbits, traveling 5.3 million miles in 12 days, 21 hours, 40 minutes, and 25 seconds.

STS-119, ISS Expeditions 18, 19, and 20, and STS-127: On March 15, 2009, Dr. Wakata flew aboard Discovery on the STS-119 mission during which the seven-member crew installed the final starboard truss segment S6 to the ISS and performed three space walks. During 4-1/2 months aboard the ISS, he served as a Flight Engineer and the JAXA Science Officer on the crews of Expeditions 18, 19 and 20. His duties included a variety of experiments and maintenance tasks. In addition, Dr. Wakata operated all of the current human space robotics systems - Canadarm on the Shuttle, Canadarm2, Dextre, and Kibo's robotic arm on the ISS. Dr. Wakata became the first Japanese astronaut to serve as a resident ISS crew member as well as to fly aboard Soyuz TMA spacecraft during the Soyuz TMA-14 relocation on the ISS. Expedition 20 marked the first ISS expedition to expand the crew size from 3 to 6 members with representative crew members from all the ISS partner agencies. With the arrival of STS-127, the crew expanded from 6 to 13, the largest ever to live and work aboard the ISS. The seven-member crew of STS-127 completed the final assembly of the Japanese Kibo modules of the ISS and performed five space walks. Dr. Wakata returned to Earth aboard Endeavour with the crew of STS-127 on July 31, 2009. During STS-119, Expeditions 18, 19, and 20, and STS-127, Dr. Wakata stayed in space for 137 days, 15 hours, and 5 minutes.

A veteran of three space flights, Dr. Wakata has logged a total of 159 days, 10 hours, 46 minutes and 5 seconds in space.

Name: \_\_\_\_\_

## **Careers in Space Student Data Sheet**

1. The International Space Station (ISS) is being built with international cooperation among sixteen countries. The three astronauts featured in the video are citizens of different countries. Read the biographies of Nicole Stott, Robert Thirsk, and Koichi Wakata, and complete the chart about their backgrounds, education, experience, and careers.

	<b>Citizenship</b>	<b>Degree (s)</b>	<b>Jobs/Duties (list only 3)</b>	<b>Importance of Background to Astronaut Career</b>
<b>Nicole Stott</b>				
<b>Robert Thirsk</b>				
<b>Koichi Wakata</b>				

2. What other experiences, expertise and skills do you think are needed to work on the International Space Station? Explain why you think they are important.

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3. What career are you interested in pursuing, and do you think this career would be important on the International Space Station?

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4. Astronaut is not the only career at NASA. On a separate sheet of paper, list other careers you feel are important at NASA and explain the reasons why you think they are important.

**More information and research about careers at NASA can be found at:**  
<http://www.nasa.gov/audience/forstudents/9-12/career>