

## Astronaut Julie Payette prepares for her second mission to space

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**IT'S JUST AFTER SUNRISE ON MAY 27, 1999,** and Canadian astronaut Julie Payette and six crewmates ready for takeoff aboard the space shuttle Discovery. At 6:49 a.m., they begin an eight-and-a-half minute journey to space, hurtling toward their destination of the International Space Station. They quickly accelerate to 28,000 kilometres per hour – or 25 times the speed of sound – which hits the crew with triple the force of gravity. For Payette, who is 200 pounds outfitted in her spacesuit, this translates into a resounding 600-pound weight. Rocketing toward Earth's outer atmosphere, the shuttle devours a liquid oxygen and liquid hydrogen fuel – “basically,” says Payette, “a very, very well-controlled bomb.”

Forty hours later, the astronauts dock at the International Space Station. The space lab, which orbits 400 kilometres above Earth, is a multibillion-dollar engineering project involving 16 nations. Research is conducted in everything from medicine to materials science and fluid physics – laying the groundwork for human missions to Mars and beyond. Constructing the station is akin to attaching Lincoln Logs: each time a shuttle goes up, astronauts transport and assemble more modules and experiments. (Astronauts delivered

the first module in 1998. In 2010, and 50 missions later, the lab will reach completion.) On this trip, the crew delivers four tonnes of supplies and equipment to prepare for the first astronauts who will soon arrive to live aboard. Payette, 35, supervises an eight-hour spacewalk to repair and further assemble the station. She also operates the Canadarm and monitors the space station systems. Ten days later, after a six million-kilometre journey in orbit around Earth, the astronauts land at Kennedy Space Center in Florida. And Payette returns as the second Canadian woman to enter space (after Roberta Bondar in 1992) – and the first Canadian to set foot on the International Space Station.

This May, Payette, now 45, will journey to space for a second time. As the flight engineer aboard the space shuttle Endeavour, Payette – who earned a master's of applied science at U of T in 1990, and also received an honorary doctor of science in 2001 – will be busy. During the 15-day mission, she will be operating the robotic arms, including the Canadian robotic superstars Canadarm, Canadarm 2 and Dextre. Along with the commander and pilot, Payette will serve as part of the cockpit crew, responsible for taking the shuttle into space and back to Earth, for docking at the space station and for all manoeuvres and operations involving flying the spacecraft. The seven-member crew will deliver and install the last elements of the Japanese space agency's Kibo lab – which will attach to the outside of the station, allowing for experiments to remain exposed to space.

When Payette first entered the International Space Station in 1999, it was a much smaller entity. It had only two modules and there were not any astronauts living aboard. Now it's the size of a three-bedroom house and inhabited by a crew of three. (Astronauts have lived there, on a rotating basis, since November 2000.) How does she feel about returning to the station? Payette, a self-described matter-of-fact Cartesian, is not one to deliver answers exuding with sentiment. “I was very privileged to go on the station when it was at the very beginning of construction. I find I am extremely privileged to go and work on it again when it's nearing completion. That's the way I would describe it.” She also speaks about her first time in space in pragmatic terms: “You have very little time to think about what it represents in terms of inner self or emotion. On your first flight, usually you don't have that much time even to enjoy weightlessness or this absolutely

magnificent view of the Earth. The reason is that if you want this to be your profession, then you know that you're under evaluation. How you do on that first flight is going to determine whether or not you fly again. So this second flight, I think I'm going to have a bit more of this perspective to really enjoy the artifacts of being in space, which include weightlessness."

Payette has been enthralled by the artifacts of space since she was a young girl. After watching an Apollo mission at her primary school in Montreal, she decided she wanted to be an astronaut. She began making scrapbooks of space missions and taped posters of astronauts to her bedroom door. She describes watching her first space flight: "I'm nine years old, I'm sitting down on the floor of a gym and I'm watching an Apollo mission. I don't speak English. I'm a girl.... I had never been in an airplane, and most of my family had never been in an airplane or anywhere near an airplane. And I thought this was so cool. That's what I wanted to do. It didn't matter to me that I was the wrong nationality, the wrong gender and spoke the wrong language. It didn't cross my mind that this was a bit of a far-fetched goal because when you're nine years old, you don't think about these things."

It was not only her age, but her family that allowed her aspirations to take root. "You can always thwart someone's impetus to do something if you constantly bring them down," says Payette, the second of three children. "I was very lucky to be in a family that didn't just laugh at me. They smiled a little, but they said, 'OK, well you want to do that? Well, you better work, you better go to school, you better be good.'"

While selecting her academic and career tracks, Payette kept the idea of becoming an astronaut in the back of her mind, in case an opportunity should arise. After obtaining a bachelor of engineering degree from McGill University in Montreal, she completed a master's of applied science in electrical and computer engineering at U of T. Payette wrote her master's thesis on computer-based second-language instruction, an area of artificial intelligence. "Engineering is extremely useful for being an astronaut because it's extremely applied. What engineering teaches you in particular is to look at a problem, analyze that problem, look at what you've got available to solve that problem or to improve a system or to repair something or to design something new," she says. "That's exactly what we do in space. You need to be able to repair things and design new things, and you certainly have to have an inclination to look at a problem and try to solve it. Operational, we call it. So if you don't like that stuff, don't go into the astronaut business. It's all we do."

After graduating, Payette spent a year in Zurich, Switzerland, as a visiting scientist in IBM Research Laboratory's communications and computer science department. In 1992, at her next job – working in computer speech research at Bell-Northern Research in Montreal – she learned that the Canadian Space Agency was accepting applications for astronauts. 5,330 people applied. Payette was one of four selected. Four years later, Payette was chosen to attend NASA's astronaut candidate training.

**THE NASA JOHNSON SPACE CENTER** in Houston is a sprawling mega-complex staffed with 15,000 employees – engineers, astronauts, computer scientists – whose missions include putting humans in space. It is also the site of some of the world's most advanced high-tech hardware. One August morning, Payette gives a tour of Building 5 and its two high-fidelity space shuttle simulators – the only two in the world. Payette leads the way through the first, the fixed-base simulator – which is a mock-up of the space shuttle's mid-deck and cockpit. The electricity is shut down in the cockpit, and she hunts for a flashlight. The soft illumination in the shadowed room adds an appropriately reverential feel. It's like entering an astronomical version of the Vatican; another way to lift yourself to the heavens. A multitude of switches surround the commander and pilot's seats, like a hyper-magnified 747 cockpit. The windows offer simulated views of what astronauts see in space – including the Canadarm and Hubble Space Telescope. The flight software that runs in this cockpit is real, allowing any software glitches to be caught while safely on ground.



PHOTO BY JEFF WILSON

On the other side of Building 5 is the motion-based simulator, which looks like an industrial-sized gym locker on steel haunches. Of course, it's anything but rudimentary: operating on a hydraulic system, it pitches up and back down, mimicking the shuttle's takeoff and re-entry into the atmosphere. In a standard four-hour session, the astronauts practise several ascents and re-entries. The crew currently practising in the simulator will soon be journeying to repair the Hubble telescope.

Perhaps the most fascinating element of Building 5 is located behind the simulators: the offices of the Machiavellics, a group of intellectual schemers who focus on a highbrow sabotage, of sorts. Officially, they are called instructors in the Motion Based Instructor Station. They have earned their nickname because they contrive scenarios that fire astronauts some serious scientific curveballs. The Machiavellics introduce problems into simulations: they kill engines, cause computers to fail, stage electrical problems and make things crash. They are the monkey-wrench throwers and glitchcreators of NASA. Right now, they are igniting a pseudo-fire in the motion-based simulator, which the Hubble crew will have to hustle to extinguish. "Be nice to those guys, huh?" jokes Payette on her way out.

Like other aircraft pilots, astronauts spend a great deal of time training for worst-case scenarios and the unexpected. It's what Payette calls "what-iffing," so crew members can react swiftly in an unforgiving climate. In a mock-up of a Russian service module in Building Six later in the day, Payette sits on the floor and compares the International Space Station to a ship in a storm. "In the middle of the ocean, there is no Home Depot or hardware store. If you forgot a hammer or tape, or you didn't measure the size of the plywood you want to put in, you're doomed. If you're going to construct something in the middle of the ocean, you'll have to plan beforehand and once you go and execute it, you better have everything planned and working because there are not many options. We say 'ship in a storm' because the environment of space is one of the most hostile environments for a human being and equipment, period. There's no air, there's no pressure, it's scorching hot when you're exposed to the sun, and extremely cold when you're not in the sun, and it varies every 45 minutes, from -150 degrees Celsius to +150 degrees Celsius. So you can imagine what it does to people or to equipment if you're not properly covered or this is not well planned. There's also the fact that for human beings, clearly, there's an adaptation. There's weightlessness, there's radiation doses that are much higher outside the atmosphere of the Earth than they are here."

An astronaut's training is an incessant cycle of technical work, and developing and rehearsing procedures in simulators. But, of course, it also requires a large dose of intrepidity. The next day, Payette will spend several hours flying a T-38 Air Force training jet. A passionate pilot, Payette earned her captaincy on a CT-114 Tutor military jet in 1996, at the Canadian Forces Base in Moose Jaw, Saskatchewan. Like all astronauts, she has logged many hours on parabolic aircraft, which are modified commercial jets that simulate low-gravity levels through short free-falls. In 2004, Payette underwent a monthlong endurance training program at Canadian Forces Base Valcartier in Quebec, in which she and other astronauts lived and worked in sub-zero temperatures that replicated some of the environmental rigours faced on the International Space Station.

Tremendous versatility is also key: along with her piloting and engineering skills, Payette speaks six languages. Besides French and English, she can converse in Spanish, Italian, German and Russian. (She learned Russian to communicate with her counterparts from Russia who are involved with the station.) "People who have demonstrated that they can do more than one thing in their life have a better chance of being noticed during an astronaut selection, because they're looking for jacks-of-all-trades. In space, we're the only ones on board. We're the Maytag repairman, we're the cook, we're the photographer, we're the document keeper, we're the cleaner, we're the proxy scientist, the robotics operator, the spacewalker. We basically do everything. So it's not about being the top in one field, it's about being able to adapt to several," she says.

Payette's versatility was evident even as a student at Massey College. While studying engineering, she also played softball, squash and badminton and was co-chair of the Lionel Massey Fund, helping to organize cultural, social and musical events for students. (Payette is still involved with the University of Toronto: she is a member of the President's International Alumni Council, an advisory group composed of grads throughout the world who are leaders in their field.) Another interest that Payette pursued was music: she sang soprano with the prestigious Tafelmusik Chamber Choir in Toronto, performing baroque and classical pieces. Later, she joined the Montreal Symphony Orchestra Chamber Choir, and performed at Carnegie Hall with them. Payette is quick to underscore the group aspect: "I sing in a choir with these organizations. I'm not by myself. I'm not Sarah Brightman." The idea of teamwork is tremendously important to Payette, and she repeatedly tacks toward this viewpoint. When she speaks about her training or experiences in space, she often uses the collective "we" as opposed to "I" and her comments about the job's time commitments are militaristic: "You're not one anymore, you're part of a team, and you'll make the necessary adaptation and sacrifice."

During Payette's initial interview with the Canadian Space Agency, her choral experiences showcased her ability to collaborate. "They asked me how, in my previous life, was I a team player? And I said, well, I've been singing in choirs for 20 years. And therefore, clearly, I needed to sing the same tune, and was not supposed to sing out of key or out of tempo. And I'm really good with authority because I have a director in front there, and he or she sets the tempo and I follow it.... It's not my agenda, it's the group's agenda."

Is it more difficult, however, to be part of a group in which male astronauts outnumber females almost five to one? Payette says no, and believes astronauts are judged exclusively by their performance. In space exploration, she says, the distinction has to be ability because it is the key to a successful mission. "Competence, skills and *esprit de corps* are what set someone apart in the astronaut world. In contrast, nationality, gender, ethnic background, skin colour, mother tongue and other such characteristics actually become fairly transparent if you are considered competent at what you do." She adds, "Being a 'minority,' so to speak, has long ago ceased to be of concern and I do not perceive myself as an exception, even though females make up 17 per cent of the astronaut corps and there is only one French-Canadian astronaut working at NASA in Houston. In fact, I'd say it is actually a privilege to be considered 'different' from the norm, yet fully integrated in the group. I wouldn't trade places for anything."

Teamwork, of course, will also make further exploration in space possible. "I would say that there's a very good chance that we will see someone go to Mars in our lifetime. There are times when Mars is at one end of the sun and the Earth is at the other end, and we're talking 400 million kilometres. I mean, we're months away from home," says Payette. "I think we'll see that as an endeavour of multiple nations again, just because it's such an incredibly difficult one. And that is a huge step again, as a species to be able to leave your home planet and go to another one."

**BACK IN JUNE 1999**, before Payette and the Discovery crew left the International Space Station, they wrote a message in the station's notebook, acknowledging their "pride and happiness to have

contributed to the new space station." They also included a quote, attributed to Leonardo da Vinci, which Payette had supplied: "When once you have tasted flight, you will forever walk the Earth with your eyes turned skyward, for there you have been and there you will always long to return."

A decade after her first flight into space, Payette will once again be looking down at the Earth from the skies. Has da Vinci's quote proven true for Payette? "That's exactly it, it's an addiction. It's also true for flying airplanes," she says. "I probably have a gazillion million hours as a passenger and a pilot, and I never settle for anything else but the window seat. It's great. It's a privilege. Human beings have been wanting to fly for millenniums. And we've barely started to do it. It's extraordinary."

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