Rehabilitating An Astronaut

The return of Commander Chris Hadfield

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Photo from: Canadian Space Agency

If you've recently found yourself with an increased interest in outer space and the International Space Station (ISS), you're not alone. Millions of Canadian fans, as well as international ones, have surfaced showing a renewed support in space exploration. This is due in no small part to the efforts of Canadian astronaut—and internet sensation—Commander Chris Hadfield.

Commander Hadfield returned to earth in May after spending five months on the international space station—in space! He has achieved many honours, including being the first Canadian to walk in space, the first Canadian commander of the ISS, having an asteroid named after him (asteroid 14143 Hadfield), and having a bust of his likeness made out of butter (which was on display at the 2013 Canadian National Exhibition). Hadfield gained notoriety through his activity on Twitter and other social media by posting updates, videos, and photos from space; he even has the distinction of starring in the first music video ever shot in space (he played guitar and sang a version of David Bowie's "Space Oddity").

We know a lot about Hadfield's life on the ISS thanks to his internet activity, but what happened to him once he came back down to earth? Spending six months in microgravity takes an extreme toll on the human body. Our bodies have evolved to operate in earthly conditions; this involves gravity, of course. For instance, our hearts are used to pumping blood against the force of gravity, in space, however, where everything is weightless, the heart doesn't think it has to work as hard to send blood around the body so heart muscles begin to shrink. Since legs aren't needed to support the weight of the body, muscles in the legs will atrophy (thin and weaken).

Intensive rehabilitation post-mission is not a shock to these astronauts' systems, however, as they spent more than two hours a day exercising while in space. Exercising in space helps to slow the effects of the microgravity conditions but it's impossible to avoid them all together. An astronaut's daily exercise regime focuses on resistance training and might consist of using a treadmill, a stationary bike, and hydraulic weights to combat loss of muscle mass. Maintaining this discipline in space keeps astronauts prepared for the weeks of work they'll have to do once returning home.

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Astronauts lose half to one per cent of their bone density per month spent in space. These effects of weightlessness are reversible, however; it generally takes about two months of rehabilitation per month spent in space for bone mass to recover. While bone mass may recover in this time, studies have shown that bone density, strength, and structure do not recover in the same way. Part of the rehabilitation process includes taking vitamins and medications normally used by post-menopausal women. It can take several months to restore normal, pre-space strength, but a lot of astronauts will spend up to one year in rehabilitation after extended space missions, like the one Hadfield finished in the spring. Other physical effects of prolonged space travel include development of cataracts, and exposure to the increased radiation of space—the long-term effects of which have not yet been fully discovered.

Upon his return, Hadfield, like other astronauts, will have spent about 45 days undergoing medical tests and training. Post-space flight rehabilitation is left up to the Astronaut Strength Conditioning and Rehabilitation specialists (ASCRs)—they are also responsible for pre-flight and in-flight training—as well as each astronaut's personal flight surgeon. The ASCRs create the exercise programs used by the astronauts to help minimize bone and muscle loss while in space. In an interview with CBC's *The National*, Hadfield said upon his return "I'm learning to walk again. The re-adaptation process takes months."

While the physical effects of space travel are quite visible on astronauts, it is also important to consider the psychological effects of long duration space flight. Astronauts have reported, not surprisingly, feelings of isolation, deprivation, confinement, and simply feeling endangered by their situation. Astronauts also experience sensory deprivation, including a lost sense of time. In space, sunrise and sunset alternate every 45 minutes, making standard sleep cycles seem less natural. This combined with the long hours of working without refreshing breaks or change of environment can alter one's sense of how time is passing. There is also the added psychological effect of never being alone. Along with limited privacy aboard the space station, astronauts are also always being monitored by ground control. The NASA archives describe this as like being alone in public, saying "everybody is watching you but you can't see anybody. There are certain psychological nuances there because you fight yourself."

Since long duration space flights are still relatively new, the psychological and physiological effects are still being researched and new discoveries are being made with each mission. With each successful return of an astronaut, more and more is being learned about the effects of space travel. This unbridled pursuit of knowledge has led to innumerable discoveries about the human body and post-flight rehabilitation has allowed scientists to further investigate these discoveries. In addition to the myriad experiments conducted and shared by Commander Hadfield, the space program continues to unearth new findings back here on solid ground.