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## Health & Wellness -- **What's Your Workout?** Space Buff: Lifting Weights in Weightlessness

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For an astronaut about to lift off, having the right stuff means going easy on the daily workout.

Chris Hadfield, 53 years old, will take off in December for the International Space Station and he has altered his Earthbound gym routine to prep for the six-month space adventure.

"The closer you get to launch, the less you do," says the astronaut, who was born in Sarnia, Ontario, and will be the first Canadian to command the station. "This is not a time for pickup basketball or church volleyball. I don't need to dislocate or break something."

The International Space Station, launched in 1998, is a \$100 billion, permanently staffed research laboratory orbiting some 250 miles above the Earth. The long time spent in weightlessness will take a toll on Cmdr. Hadfield's body over his six-month mission. Life in microgravity can lead to bone loss, as well as changes to the cardiovascular system and even in the shape of the eyes.

Over the 50 years of the space program, scientists have discovered that two hours a day of exercise could prevent some muscle and bone loss when normal gravity isn't giving astronauts a passive workout. But the challenge remains: How do you lift weights in weightlessness?

The Workout on Earth. . .

A competitive water skier, beach-volleyball player and a former downhill ski instructor, Cmdr. Hadfield has trained for the past three years at the Johnson Space Center facilities in Houston, the Canadian Space Agency in Montreal, and with the European, Japanese and Russian space agencies.

This is his first mission to the ISS and by far his longest stay in space, although he has been on two shuttle missions, including one that made him the first Canadian to do a spacewalk. He will be on the ISS for about three months before he takes over as commander.

"We have some people in the office who are real gym rats, some ultramarathoners, but I just work out two or three times a week," he says.

His routine includes running about four miles outdoors a few days a week. Inside the gym, he stretches to maintain flexibility and then does 30 minutes of cardio on the stationary bike, treadmill or the elliptical machine.

Next, he lifts weights. He starts with the large muscle groups by doing squats, torso raises, dead lifts and pull-downs. He then works smaller muscles with leg curls, calf raises, bench presses, and butterfly and wrist curls.

He likes to keep moving during the entire workout to keep his heart rate up, and watches sports or movies to keep his mind occupied while on the machines. He finishes with abs and more stretching.

He has personal trainers -- one from NASA, the other from the Canadian Space Agency -- who monitor him before launch, during his mission, and after his return so they can keep tabs on how his body works and how it changes in orbit. They also will help him return to his preflight condition when he gets back.

In Houston, he learns to exercise on special equipment identical to that used on the space station.

And in Space. . .

To model the resistance of free weights, NASA developed a machine -- the Advanced Resistive Exercise Device, or ARED -- that requires an astronaut to pull levers against the suction of a vacuum chamber.

Astronauts are strapped with elastic cords onto a treadmill or a stationary bicycle so they won't float away. The treadmill and cycle have stabilizing gyroscopes and are suspended on wires in the station so vibrations from Cmdr. Hadfield's workout don't cause the space station to rock and shake, potentially upsetting the science experiments on board.

The treadmill, called the Combined Operational Load Bearing External Resistance Treadmill, or Colbert -- named for the television personality, Stephen Colbert, following a write-in contest -- juts from a wall. There is no "up" in a weightless environment.

Staying fit in space isn't just necessary so he can walk when he lands back on Earth, Cmdr. Hadfield says. Astronauts have to keep fit to perform spacewalks, which amount to grueling, hourslong cardio workouts. The spacewalking suit leaves him bloody, with knuckles, fingernails and collarbone taking the worst punishment from scraping, he says.

Even turning a wrench to make repairs on the ISS is demanding without the help of gravity. "It's like trying to change a tire when you're on ice skates," the astronaut says, "After 6 1/2 hours, you're a wreck."

The Diet

There isn't a lot of fresh food on the space station -- only some occasional fresh fruit during resupply -- so astronauts eat canned and bagged items, such as Clif Bars, Power Bars, peanut butter and Cheez Whiz. Salt speeds up calcium loss and an astronaut's skeleton already suffers in a nonweight-bearing environment. So nutritionists seek other ways to make a space diet healthy and tasty.

The Sacrifice

Cmdr. Hadfield says he loves a cold beer on a warm day after working out, or an Islay malt whiskey -- neat -- when he sings with his astronaut band, Bandella. But he won't drink alcohol during his six months aboard the space station. "At any given moment, if we have a leak or fire, we have to jump in a space ship and fly home," he says. "There's no drunk-dialing for a taxi. We are it. So we live a fairly monastic life."

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Out of This World Athletic Gear

The space program has provided more than just Tang and Velcro. Many people use items every day that owe their origins to NASA.

GPS

When you track your run, ride or swim with a smartphone or wrist-mounted GPS, you are using satellite navigation technology developed by the U.S. military and launched by the space program.

Reflective Blankets

At marathon finish lines around the world, aluminum-coated plastic blankets are wrapped around athletes to prevent hypothermia when they stop running.

The light-weight, pliable heat shield traps and reflects body heat. It was first developed to coat the base of Apollo lunar landing vehicles.

Vibration Training

NASA has been studying vibration as a possible tool to combat muscle and bone loss associated with extended trips spent in weightlessness.

Gyms and personal trainers are using motorized vibration plates developed for astronauts to speed up workout results and to build muscle.

-- Sarah Rose

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