

A full-page background image of an astronaut in a white spacesuit with an American flag patch on the sleeve, standing in a training facility. The astronaut is wearing a helmet with a clear visor and is surrounded by metal railings and yellow structural elements. The text 'PREPARE FOR LAUNCH' is overlaid in large, bold, black letters with a white outline.

PREPARE FOR LAUNCH

The Astronaut Training Process

Erik Seedhouse

 Springer

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Prepare for Launch

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 **Springer**

Published in association with
Praxis Publishing
Chichester, UK



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Milton
Ontario
Canada

SPRINGER-PRAXIS BOOKS IN SPACE EXPLORATION
SUBJECT ADVISORY EDITOR: John Mason, M.B.E., B.Sc., M.Sc., Ph.D.

ISBN 978-1-4419-1349-4 Springer Berlin Heidelberg New York

Springer is a part of Springer Science + Business Media (*springer.com*)

Library of Congress Control Number: 2009936077

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Cover design: Jim Wilkie
Project copy editor: Christine Cressy
Typesetting: BookEns, Royston, Herts., UK

Contents

Preface	xi
Acknowledgements	xvii
About the author	xxi
List of figures	xxiii
List of tables	xxvii
List of panels	xxix
List of abbreviations and acronyms	xxxix
Section I Astronaut Selection	1
1 A brief history of NASA astronaut selection	3
NASA	3
Selecting the Mercury astronauts	4
Female astronauts	7
From Gemini to Shuttle	8
Canadian Space Agency	12
European astronaut selection	12
Reference	13
2 Applying to become an astronaut	15
Basic qualifying criteria	17
Education	17
Health and fitness	17
Miscellaneous experience	19
Desirable qualities	20
Patience	20
Versatility	20
High achiever	22
Psychological disposition	22
Public relations	22

	The application process	23
3	Selection	25
	The trials and tribulations of being selected for the best job on and off the Earth	25
	NASA selection	26
	2008 selection process.	26
	ESA astronaut recruitment campaign	29
	The selection process	31
	Canadian Space Agency	34
	Saint-Hubert	34
	Halifax.	39
	The final cut	44
	 Section II Preparing for Life in Space	 47
4	Astronaut probationary training	49
	International Space Station training flow	49
	Basic Training	50
	Advanced Training.	50
	Increment-Specific Training	50
	European Space Agency	51
	Integrated training schedule	51
	Phases of astronaut training	51
	Advanced training	54
	NASA	59
	Overview of ascan training.	59
	Ascan training week by week	60
	Scuba-diving	75
5	Technical assignments	79
	Types of technical assignments	79
	Space Operations Mission Directorate	79
	International Space Station Payloads Office	80
	Extravehicular Activity Project Office	84
	CapCom	85
	Flight Crew Operations Directorate	86
	Office of the International Space Station Program Scientist	86
	Exploration Development Laboratory	88
	Russian Liaison	88
	Crew Support Astronaut	91
	Public speaking	91
6	Types of missions	93
	International Space Station missions.	93

Expedition 17: July 23rd to end of November, 2008	94
Lunar missions	104
Surface activities	104
Bio-Suit	105
Science on the Moon	107
In-situ resource utilization	110
Oxygen production.	111
Mars mission	112
Crew activities en route	112
Crewed initial surface operations	116
Crewed long-term surface operations	116
Departure preparations and departure	117
Analog and virtual environment training	118
Virtual Environment Generator training.	118
Analog	120
NASA Extreme Environments Mission Operations Project.	122
Mars500	123
References	125
7 Mission training	127
Increment-specific training	129
Crew qualification levels.	129
Emergency training and supplementary training	130
European Space Agency training	131
Core lessons.	132
Rendezvous and docking	133
Attached phase operations	134
Emergency operations	135
<i>Columbus</i> training	135
Expedition training.	137
Team assignment	138
Training flow for a generic ISS mission	138
Russia Part I	138
Canada	142
Russia Part II	147
United States Part I.	149
Russia Part III.	155
United States Part II	163
References	172
8 Astronaut selection and training in the future	173
Future crew selection criteria	173
Crew composition	175
Exceptional selection criteria	176
Genetic screening.	177

Precautionary surgery.	179
Cryopreservation	180
Future crew training.	181
Bioethics	181
Sex	181
Terminal illness	182
Hibernation	183
Advanced surface exploration training	186
Bioinspired engineering of exploration systems.	187
Artificial gravity indoctrination	194
References	196
 Section III Preparing for Launch	197
 9 The spacecraft and the launch team	199
Launch vehicles	199
Ares I	199
Ares V	201
Spacecraft.	203
Orion	203
Altair	206
Mission profile	206
Soyuz.	208
Launch teams.	209
Launch Director	211
Mission Control.	212
 10 Ten weeks and counting.	213
Practice makes perfect	213
Choreographing chaos	214
Marathon-integrated sim	215
Flight surgeon physical exam	216
Packing for space	217
Terminal Countdown Demonstration Test	219
Driving the M-113 escape tank	219
Emergency egress procedures	221
Terminal countdown demonstration test.	222
Quarantine	223
 11 The final count	225
Launch day	225
Suit-up.	226
Inside the Astrovan	229
White room	232

Closeout crew	233
Behind the scenes	233
Launch countdown	234
Launch commit criteria	236
Communication	237
Firing room	237
Pad activities during countdown	238
Vaya con Dios	238

Preface

“I have always wanted to be an astronaut. Every kid growing up during the space race wanted to be an astronaut. Unlike most kids, however, I never vacillated in my career choices. I have a vivid memory of sitting on the lounge floor, watching the first lunar landing on my parents’ black and white television set. Watching the images of the *Saturn V* on the launch pad and astronauts bounding across the lunar surface, I resolved to become an astronaut. Only 5 years old at the time, the initial appeal for me of becoming an astronaut was riding a rocket and walking on the Moon.

As I learned more about what was required to be selected as an astronaut, I focused increasingly on achieving my dream. In 1987, knowing many astronauts had a military background, I joined the 2nd Battalion of the Parachute Regiment. Forty-three recruits started the 27-week basic training to become a ‘Para’. Just three of us were successful. I was one of the three.

During my time in the Paras, I was trained by the Special Air Service (SAS) in jungle and desert warfare, made night jumps from Chinook helicopters, and jumped out of a Hercules C-130 more times than I can remember. I also endured annual 80-km marches with a 20-kg pack on my back and acquired advanced survival techniques in the jungles of Belize and the desert of northern Cyprus. During operational deployments, I gained extensive experience operating in the cohesive environment of a small team, while under considerable and prolonged stress. I enjoyed the training immensely, especially knowing it provided excellent experience for becoming an astronaut.

My first postgraduate degree was a Master’s in Medical Science at Sheffield University. Rather than choose one of the research options offered by the course, I decided to pay Dr. David Grundy a visit. David was Director of the Institute for Space Biomedicine. Together, we formulated a space life-sciences research proposal focusing on head-down-tilt, the outcome of which was an article published in the *Physiologist* in 1991. While at Sheffield, I began to focus more on sports, with the goal of becoming a professional athlete.

On completing my Master’s degree, I moved on to work in a Pulmonary Function

Laboratory and learned how to balance budgets and develop test protocols. Shortly after starting work at the laboratory in March, 1992, I applied to the Canadian Astronaut Program. Since I had not yet accumulated the myriad qualifications required for a competitive application, my objective was to indicate to the CSA my interest in becoming an astronaut, with the intention of being able to submit a more competitive application when the next selection was advertised.

Although I realized the next selection might be many years away, my focus never wavered. My next goal was to experience microgravity and, to that end, I volunteered to be a subject in a study conducted by a colleague of Dr. Grundy. In April, 1995, I participated as a subject in the European Space Agency's 22nd Parabolic Flight Campaign, which provided me with valuable experience in performing equipment set-up, calibration, and monitoring in support of physiological testing. The data collection for the study took place over a 5-day period, flying 30 parabolas daily over the Bay of Biscay, providing me with ample opportunity to experience microgravity.

My increasing involvement in competitive sports culminated in my achieving a key ambition: that of becoming a professional athlete. This goal was accomplished after winning the World Endurance Triathlon Championships in 1995. During my triathlon career, I repeatedly demonstrated my commitment to my corporate sponsors, an enduring resolve, and the mental and physical fortitude enabling me to win what many considered impossible races. Winning world championship races was achieved by adhering to a strict and rigorous training regime and with the motivation to achieve distinction, a trait I consider an asset to any aspiring astronaut. Furthermore, due to my success, I was in regular demand by the media for interviews and gained invaluable experience as a representative for my corporate sponsors.

Shortly after becoming a professional triathlete, I moved to Germany, courtesy of a \$50,000 ESA grant. While studying for my Ph.D. at the Institute for Space Medicine, I had the opportunity to acquire a working knowledge of ESA's program of operation. My work at the Institute also provided me with experience related to a variety of space program development practices and extended my ability to interact with external and international scientific counterparts. I pursued my Ph.D. studies simultaneously with my sports career – a combination requiring me to work 70 or more hours a week. Apart from being an ideal place to conduct research, the Institute also provided an outstanding opportunity to accumulate expertise in space program procedures and acquire a working knowledge of space medicine.

Upon retiring as a triathlete in 1999, I pursued my post-doctoral qualification at Simon Fraser University's (SFU) Environmental Physiology Unit (EPU). While there, I envisioned the Extreme Physiology Program (EPP) and initiated field research trips to Mount McKinley and Aconcagua. The EPP was envisaged as a multi-science/technology research and development program in which studies of human physiology in stressful environments would be conducted. These studies included lab experiments (simulated space, high altitude, and deep sea) and field studies (using wireless technologies), the first of which was a simulated 5-day stay onboard the International Space Station. Later (field) studies included ascents of Mt.

McKinley and Aconcagua to investigate the differences in physiological responses between athletes and non-athletes. As a Co-Director of the EPP, I directed, implemented, managed, and monitored research programs, and developed the priorities and objectives for research projects within the program.

In 2005, I was recruited by Bigelow Aerospace, Las Vegas, as an Astronaut Training Consultant. During my time at Bigelow Aerospace, I designed, wrote, and edited the *Spaceflight Participants Training Manual*, designed medical algorithms for spaceflight medical emergencies, and developed instructional materials. I also designed, wrote, and edited the *Chief Medical Officer's Manual* for spaceflight participant selection and designed and edited astronaut certification standards for spaceflight participants.

In 2007, I joined the Aerospace Group at the Defence and Research Development Canada (DRDC) in Toronto, to work as a program manager overseeing specialized research development projects.

Curiosity has always gotten the better of me. I enjoy scuba-diving, climbing mountains, writing books, racing Ironman triathlons, flying my Cessna, and writing and directing movies. My quirk is that I prefer technical manuals to television and I hate sitting still. I cannot resist new activities and enjoy squeezing as many projects into my life as possible. I consider the ability to display competence, self-reliance, and the ability to work effectively even under the most challenging conditions as traits required by an astronaut and I believe I possess those qualities. Having varied experiences and adapting well to their demands is a desirable characteristic for an astronaut and I consider my background supports this requirement.

My varied work experience has provided me with the opportunity to develop excellent communication skills, both written and verbal. I have contributed extensively to *Spaceflight* magazine, been interviewed on numerous occasions, published four books, and have worked as a motivational speaker. As an expedition leader, I utilized logistical skills to achieve successful outcomes in dynamic and challenging environments. I consider these and the other aforementioned skills to be key to my effective contribution to the CSA and I am confident in my ability to respond to the challenges of being a Canadian astronaut.

As a potential astronaut, I have demonstrated a willingness to accept physical hazards, a capacity to tolerate rigorous and severe environmental conditions, and the ability to react assertively under conditions of duress. These abilities have been demonstrated during parachute jumps, mountaineering, diving, triathlon, micro-gravity research, and as an instructor during high-altitude indoctrination training.

As an astronaut, I believe I will be an asset to the CSA. My varied scientific experience, combined with my athletic career and military training, have provided me with a unique background that has inculcated a calm, methodical, and cautioned approach to problem solving, whether in a laboratory or under conditions of prolonged physical and mental duress. I am easy to work with and integrate easily within a team and I believe I can provide the same support, encouragement, and honesty to fellow co-workers and astronauts.

Throughout my career, I have maintained an enduring, positive commitment to manned spaceflight, my life's one overriding passion. I have been reading about and

studying spaceflight since that day I watched the Moon landings. I want to join the Canadian Astronaut Team because it is the best occupation to fully utilize my professional skills and experience, and because it is a profession in which I could contribute the most to the CSA in its execution of Canada's space policy. I would be privileged to join the Canadian Astronaut Team, who have raised teamwork to a new level, made excellence a given, and challenged conventional thinking with courage and imagination. I am ready and eager to be a part of that team."

One of the first stages of the CSA's 2008 Astronaut Recruitment Campaign required applicants to write an essay explaining why they wanted to be an astronaut. The essay you have just read was the one I submitted. After a year of selection tests, including sea survival, fighting fires, robotics assessment, and a myriad other trials and evaluations, I made it to the final 30. Unfortunately, I didn't make it any further. For those applicants who had dedicated 20 years or more to the goal of becoming an astronaut, the blow was devastating to put it mildly. Unlike NASA, which routinely recruits astronauts, the CSA's campaign was only the third since 1983. For many of those deselected at the final stage who had waited 16 years since the CSA's 1992 campaign, it was the end of the road. The lucky few who worked in the US indicated they would apply for a Green Card with the intent of applying to NASA at the next campaign. Others returned to their jobs in academia, flying jets, or performing research. A small number found themselves recalibrating their life, trying to find another challenge. For example, one of the most highly qualified candidates confided to me he really didn't like his job (he is one of the world's leading emergency physicians and an Everest summiteer) and was considering climbing K2. Some reflected on the high price they had paid in the personal lives (many had burned through more than one marriage) by following a dream demanding sacrifices few can fathom. Then there were candidates such as myself who set their sights on achieving their goal by gaining employment (and hopefully a flight!) with one of the fledgling private space companies such as Virgin Galactic and SpaceX.

The road to becoming an astronaut is one demanding tremendous sense of direction, perspective, resolve, and extraordinary self-confidence. While many have entertained thoughts of becoming an astronaut, few ever embark upon the journey requiring them to accumulate the myriad qualifications essential for a competitive application. Those ultimately selected are already some of the most highly trained humans on the planet, yet the preparation for their new occupation hasn't even begun! Here, in this book, you will learn how these extraordinarily qualified and uniquely gifted people learn to be astronauts and how their unique training prepares them to do the most exciting, rewarding, and fulfilling job on and off the Earth.

Outline of the Chapters

There have been several books written by astronauts describing the challenges of training and preparing for spaceflight, but most of these have focused on time in orbit. Thanks to first-person accounts such as *Sky Walking* by Tom Jones, and

Riding Rockets by Mike Mullane, armchair spacefarers have the opportunity to gain an insight into the orbital adventures of astronauts. The objective of this book, however, is to describe the nuts and bolts of astronaut training, starting with the application process and finishing with the climactic ride into space.

Section I starts with the application and selection process. As a two-time applicant to become an astronaut with the Canadian Space Agency (CSA), the author reveals what it takes to assemble a competitive application and describes the stringent selection criteria used by space agencies to select future astronauts.

Section II begins with a generic chronology of an astronaut's probationary training at Johnson Space Center (JSC). From spending freezing nights in the Absaroka Mountains learning how to survive on rabbit stew, to pulling Gs in T-38s, the author describes the myriad training elements comprising an astronaut candidate's (ascan) first step towards becoming a fully fledged astronaut. Section II also provides an insight into the world of technical assignments, the seemingly never-ending wait for a flight, and an overview of the types of missions astronauts will be flying over the next two decades. Following a detailed account of the multitude of training elements comprising mission training, the author peers into the future by describing the advantages of hibernation and the challenges of bioethics training.

Before Section III delves into the high-intensity world of pre-launch preparation, the author provides an overview of NASA's new family of launch vehicles and spacecraft that will transport astronauts to the International Space Station (ISS), the Moon and, eventually, Mars. Following a "behind-the-scenes" glimpse of the launch team, the reader is guided through the final 10 weeks of mission training and preparation ultimately leading to launch day.

Acknowledgments

In writing this book, I have been fortunate to have had my wife, Doina, as my proof-reader. Once again, she has applied her considerable skills to make the text as smooth and coherent as possible. Any remaining shortcomings are my responsibility and mine alone.

I am also grateful to the five reviewers who made such positive comments concerning the content of this publication and to Clive Horwood and his team at Praxis for guiding this book through the publication process. The author also gratefully acknowledges Christine Cressy and BookEns, whose attention to detail and patience greatly facilitated the publication of this book. Thanks also to Jim Wilkie for creating the cover of this book.

Once again, no acknowledgment would be complete without special mention of our cats, Jasper and MiniMach, who provided endless welcome distraction and entertainment.

This book is dedicated primarily to my wife, without whom I would never have had the opportunity to pursue my dream.

It is also dedicated to those who helped me along the way, such as Professor David Grundy, Professor Paul Enck, and Parvez Kumar.

Finally, this book is dedicated to Heike, Rolf, Christian, Mark, and dozens of other supremely qualified individuals who, due to myopic political agendas or by not having the right passport, were denied an opportunity to demonstrate their talents as astronauts.

About the author

Erik Seedhouse is an aerospace scientist whose ambition has always been to work as an astronaut. After completing his first degree in Sports Science at Northumbria University, the author joined the legendary 2nd Battalion the Parachute Regiment, the world's most elite airborne regiment. During his time in the "Paras", Erik spent 6 months in Belize, where he was trained in the art of jungle warfare and conducted several border patrols along the Belize–Guatemala border. Later, he spent several months learning the intricacies of desert warfare on the Akamas Range in Cyprus. He made more than 30 jumps from a Hercules C130 aircraft, performed more than 200 abseils from a helicopter, and fired more light anti-tank weapons than he cares to remember!

Upon returning to the comparatively mundane world of academia, the author embarked upon a Master's degree in Medical Science at Sheffield University. He supported his Master's degree studies by winning prize money in 100 km ultradistance running races. Shortly after placing third in the World 100 km Championships in 1992 and setting the North American 100 km record, the author turned to ultradistance triathlon, winning the World Endurance Triathlon Championships in 1995 and 1996. For good measure, he also won the inaugural World Double Ironman Championships in 1995 and the infamous Decatriathlon, the world's longest triathlon, an event requiring competitors to swim 38 km, cycle 1,800 km, and run 422 km. Non-stop!

Returning to academia once again in 1996, Erik pursued his Ph.D. at the German Space Agency's Institute for Space Medicine. While conducting his Ph.D. studies, he still found time to win Ultraman Hawaii and the European Ultraman Championships as well as completing the Race Across America bike race. Due to his success as the world's leading ultradistance triathlete, Erik was featured in dozens of magazines and television interviews. In 1997, *GQ* magazine nominated him as the "Fittest Man in the World".

In 1999, Erik decided it was time to get a real job. He retired from being a professional triathlete and started his post-doctoral studies at Vancouver's Simon Fraser University's School of Kinesiology. While living in Vancouver, Erik gained his pilot's license, started climbing mountains, and took up sky-diving to relax in his



spare time. In 2005, the author worked as an astronaut training consultant for Bigelow Aerospace in Las Vegas and wrote *Tourists in Space*, a training manual for spaceflight participants. He is a Fellow of the British Interplanetary Society and a member of the Aerospace Medical Association. Recently, he was one of the final 30 candidates of the Canadian Space Agency's Astronaut Recruitment Campaign. Erik currently works as manned spaceflight consultant and author. He plans to travel into space with one of the private spaceflight companies. As well as being a triathlete, skydiver, pilot, and author, Erik is an avid scuba-diver and has logged more than 200 dives in more than 20 countries. His favorite movie is the director's cut of *Blade Runner*, his favorite science fiction authors are Allen Steele and Stanislaw Lem, and his favorite science fiction series is *Red Dwarf*. *Prepare for Launch* is his fifth book. When not writing, he spends as much time as possible in Kona on the Big Island of Hawaii and at his real home in Sandefjord, Norway. Erik lives with his wife and two cats on the Niagara Escarpment in Canada.

Figures

1.1	Ed White performs America's first spacewalk.	4
1.2	Pete Conrad.	6
1.3	Bob Crippen examines a spacesuit designed for the Manned Orbiting Laboratory program	10
1.4	The dawn of the Space Shuttle program.	11
2.1	NASA astronaut applicant selectivity.	16
2.2	Canadian Space Agency astronaut, Bob Thirsk	21
3.1	NASA's Class of 2009 Educator Astronauts.	29
3.2	The ESA's Astronaut Class of 2009	33
3.3	Canadian Space Agency astronaut applicants performing the Multi-Stage Fitness Test.	36
3.4	CSA astronaut applicants, Kenneth Welch and Bruce Woodley	37
3.5	CSA astronaut applicant, Chris Denny, "flies" the Canadarm2	38
3.6	CSA astronaut applicants being assessed during a hazardous material exercise.	40
3.7	A CSA astronaut applicant, Chris Denny, constructs a strongback	41
3.8	CSA astronaut applicants patch a fire main during an assessed team-building exercise	42
3.9	CSA astronaut applicants being evaluated inside Survival Systems' helo-dunker	43
3.10	CSA astronaut applicant, Joshua Kortryk, sits during a 3D anthropometric assessment.	44
3.11	David Saint-Jacques, Industry Minister Tony Clement, and Jeremy Hansen.	45
4.1	ISS training flow	49
4.2	The ESA's Astronaut Training Center, in Cologne, Germany.	52
4.3	Soyuz launcher.	53
4.4	<i>Jules Verne</i> Automated Transfer Vehicle approaches the International Space Station	54
4.5	European Physiology Module	55

4.6	The ESA's EVA pre-familiarization training takes place at the EAC, in Cologne	57
4.7	<i>Orion</i> mockup	60
4.8	NASA Educator Mission Specialist, Joseph M. Acaba, gives an all-clear sign.	61
4.9	One of NASA's Class of 2004 prepares for his helo-dunker indoctrination	62
4.10	Duncan Milne tests the built-in breathing device with his daughter . .	63
4.11	Simon Fraser University's hypobaric chamber	63
4.12	T-34 training aircraft	65
4.13	NASA's Class of 2004 ascans test their navigation skills in the wilderness of Maine	66
4.14	NASA Class of 2004 ascans "rescue" a classmate during survival training	67
4.15	Two T-38s fly over Edwards Air Force Base	68
4.16	Some of NASA's 2004 class of astronaut candidates and some JAXA astronauts tumble during one of a series of reduced gravity (zero-G) sessions	70
4.17	Artist's rendering of <i>Ares I</i> on the launch pad	71
4.18	Astronauts sit in the suit prep room in the Advanced Crew Escape System suits	74
4.19	The Maximum Absorbency Garment	74
4.20	NASA's astronaut candidates train in the Neutral Buoyancy Laboratory.	76
4.21	Astronauts test an <i>Orion</i> mockup.	77
5.1	Space Operations Mission Directorate organizational structure	80
5.2	Spacesuit engineer, Dustin Gohmert, simulates work in a mock crater in JSC's Lunar Yard	84
5.3	NASA's Mission Control Center, with CapCom on the right.	86
5.4	Low-fidelity mockup of NASA's <i>Orion</i> crew exploration vehicle	89
5.5	Panel display inside <i>Orion</i> mockup.	90
6.1	Sergei Volkov, Oleg Kononenko, and Greg Chamitoff take a break from training	94
6.2	The International Space Station and the ESA's Automated Transfer Vehicle.	97
6.3	Tropical Storm <i>Edouard</i> captured from the International Space Station.	98
6.4	Greg Chamitoff considers his strategy carefully as he prepares for his next move.	99
6.5	Flight Director, Chris Edelen, considers a move he hopes will stop Earth's losing streak.	99
6.6	Chamitoff works in the Kibo laboratory to move an experiment rack	100
6.7	The ESA's ATV begins its relative separation from the International Space Station	101

6.8	Astronauts conduct one of several extravehicular activities during Expedition 17	103
6.9	Future lunar attire: the Bio-Suit.	106
6.10	Artist's rendering of astronaut conducting seismic exploration on the Moon.	108
6.11	One iteration of NASA's lunar rover	109
6.12	Artist's rendering of a Mars crew extracting core samples	118
6.13	Virtual Environment Generator	119
6.14	Josef F. Schmid and Jose M. Hernandez participate in an underwater extravehicular activity session	122
6.15	Overhead view of the isolation chamber used in the ESA's Mars500 mission	124
7.1	Current configuration of the International Space Station	129
7.2	Robert Thirsk participates in a training session in an ISS mockup.	130
7.3	The European Space Agency's Automated Transfer Vehicle.	132
7.4	The European Space Agency's <i>Columbus</i> laboratory.	135
7.5	The <i>Columbus</i> laboratory mockup	136
7.6	Canadian astronaut, Robert Thirsk, sits inside the cramped interior of the Soyuz.	141
7.7	Canadian astronaut, Robert Thirsk, dons the Sokol spacesuit	143
7.8	Scott E. Parazynski works with cables linked to the Canadarm2	144
7.9	Dextre is a sophisticated dual-armed robot, part of Canada's contribution to the ISS.	145
7.10	Julie Payette practices using the Mobile Servicing System Operations Training Simulator.	146
7.11	Engineers pour plaster into the Soyuz seat liner to ensure a comfortable fit.	149
7.12	NASA's Neutral Buoyancy Laboratory	150
7.13	Divers assist astronauts during their simulated EVAs.	151
7.14	The Absaroka Mountains	154
7.15	Robert Thirsk practices firing a weapon in preparation for his upcoming mission	156
7.16	NASA's Extravehicular Mobility Unit	156
7.17	The Russian Orlan-M spacesuit	157
7.18	Canadian astronaut, Robert Thirsk, models the colorful Forel suit	159
7.19	Star City's centrifuge	162
7.20	Running on the International Space Station's treadmill	166
7.21	Medical algorithm used by crews on the International Space Station.	169
7.22	Testing different telemedicine architectures in the Gagarin Cosmonaut Training Center, Star City, Russia.	171
8.1	Plans to land astronauts on Mars will require new selection and training procedures	174
8.2	Future crew selection policies may echo those portrayed in the film <i>Gattaca</i>	177

8.3	Sir Ernest Shackleton	182
8.4	Astronauts hibernating on their way to Mars may sleep in hibernaculums	184
8.5	California Ground Squirrel (<i>Spermophilus beecheyi</i>)	184
8.6	A future Mars base	187
8.7	An inflatable habitat that may be used to construct a Mars base . . .	188
8.8	Haughton Crater on Devon Island, Canada	190
8.9	The gecko may hold the key to spacesuits capable of scaling walls . .	193
8.10	NASA's short-radius centrifuge	194
8.11	Configuration of mannequin and centrifuge in Wyle's lab in Houston	195
9.1	Exploded view of <i>Ares I</i>	200
9.2	J-2X engine	201
9.3	Exploded view of <i>Ares V</i>	202
9.4	Lunar surface access module/ <i>Altair</i>	203
9.5	<i>Orion</i>	204
9.6	Launch abort system	205
9.7	SpaceX's Dragon capsule	207
9.8	The Russian Soyuz capsule	208
10.1	Astronauts put NASA's M-113 escape tank through its paces	220
10.2	NASA's new emergency escape system	221
10.3	NASA's Astronaut Quarantine Facility	223
11.1	Kylie Clem and Gennady Padalka with astronauts, Michael Barratt and Tim Kopra	226
11.2	Astronauts suit up, assisted by a United Space Alliance suit technician	227
11.3	The crew exits the Operations and Checkout Building en route to the pad	230
11.4	NASA's Astrovan	231
11.5	Ares on the launch pad	231
11.6	The "white room"	232
11.7	Launch of <i>Ares I</i>	242

The colour section appears between pages 156 and 157.

Tables

1.1	Hazards of manned spaceflight.	3
2.1	Medical disqualification during 1992 CSA astronaut recruitment	19
3.1	NASA astronaut selection schedule	27
3.2	NASA medical examinations and parameters.	27
3.3	NASA's Class of 2009	30
3.4	The ESA's astronaut selection schedule	31
3.5	Total number of ESA applicants at the closure of the application period	31
3.6	ESA medical examinations and parameters	32
3.7	The six candidates selected after formal panel interview	34
3.8	Canadian Space Agency astronaut selection schedule	35
3.9	Breakdown of the top 40 astronaut candidates by region	35
3.10	The CSA's Class of 2009	46
4.1	The ESA's Neutral Buoyancy Facility characteristics	58
4.2	Major systems training.	72
5.1	Examples of payload policies and requirements	82
6.1	Typical ISS routine (September 25th, 2008)	95
6.2	EVA tasks during lunar missions	104
6.3	Scientific and human interest-driven activities	117
6.4	Mars500 experimental facility.	125
7.1	Mission training centers	127
7.2	The European Space Agency's ATV increment-specific training flow	131
7.3	Daily dive operations in the Neutral Buoyancy Laboratory	153
7.4	Categorization of light-loss criteria.	161
7.5	Run schedule for determination of G-sensitivity.	163
7.6	Classification of illnesses and injuries in spaceflight	167
7.7	NASA medical training for International Space Station crewmembers	168
8.1	Mars mission selection requirements.	174
8.2	Bioethical selection and training issues for long-duration missions . .	181

8.3	Effect of hibernation on life support requirements	183
9.1	Primary firing room positions	210
9.2	Key Mission Control positions	212
10.1	L-30 flight surgeon physical examination for long-duration crews . .	216
10.2	Robert Thirsk's music selection (ISS Expedition 20/21, 2009).	218
10.3	Robert Thirsk's official flight kit (ISS Expedition 20/21, 2009).	219
11.1	Launch countdown milestones	235

Panels

2.1	CSA general selection requirements	18
3.1	JAR-FCL 3 Class 2 medical.	32
3.2	Multi-stage fitness test	36
3.3	Challenges of manipulating the robotic arm	39
4.1	<i>Columbus</i> laboratory	56
4.2	High-altitude indoctrination training	64
4.3	Crew resource management	69
4.4	Zero-G.	70
4.5	<i>Orion</i> 's cockpit.	78
6.1	Bio-Suit	105
7.1	Keeping a space station tidy.	133
7.2	International Space Station Training Lead	138
7.3	Speaking Russian.	140
7.4	Canadarm2	143
7.5	Dextre	144
7.6	Tool bag overboard	152
7.7	Ballistic re-entry.	160
7.8	Science onboard the International Space Station	165
7.9	Telemedicine	170
8.1	Types of testing explained	178
8.2	Hibernation science	185
8.3	Behavioral effects of hibernation	186
8.4	The Yabby.	192
8.5	Gecko-Tech	193
9.1	Firing rooms	210
10.1	Simulation instructors' responsibilities	214
10.2	NASA's rollercoaster emergency escape system	222
11.1	Spacesuit	228
11.2	Crew rescue	233
11.3.	Range Safety Officer	239

Abbreviations

ACES	Advanced Crew Escape Suit
ACT	Advanced Concepts Team
AGSM	Anti-G Straining Manoeuvre
AI	Artificial Intelligence
ALTEA	Anomalous Long Term Effects in Astronauts
AMP	Acoustics Measurement Program
APC	Armored Personnel Carrier
AQF	Astronaut Quarantine Facility
ARC	Ames Research Center
AR&D	Automated Rendezvous and Docking
ATV	Automated Transfer Vehicle
BEES	Bioinspired Engineering of Exploration Systems
BLS	Basic Life Support
CapCom	Capsule Communicator
CBT	Computer Based Training
CEEG	Crew Escape Equipment Group
CEV	Crew Exploration Vehicle
CEVIS	Cycle Ergometer with Vibration Isolation System
CF	Canadian Forces
CHeCS	Crew Health Care Systems
CLL	Central Light Loss
CMO	Crew Medical Officer
CNM	Computer Network Modeling
CNS	Central Nervous System
COL	Crew Options List
CQRM	Crew Qualifications and Responsibility Matrix
CRM	Crew Resource Management
CSA	Canadian Space Agency
CSVS	Canadian Space Vision System
CT	Computer Tomography
CTN	Crew Training Notebook

DAM	Debris Avoidance Manoeuvre
DARPA	Defense Advanced Research Project
DCP	Display and Control Panel
DCS	Decompression Sickness
DMS	Data Management System
DoF	Degrees of Freedom
D-RATS	Desert Research and Technology Study
EAC	European Astronaut Center
ECG	Electrocardiograph
ECLSS	Environmental Control Life Support System
EDL	Entry, Descent and Landing
EDR	European Drawer Rack
EDS	Earth Departure Stage
EEG	Electroencephalograph
EES	Emergency Escape System
EET	Emergency Egress Training
EMU	Extravehicular Mobility Unit
ENT	Ear, Nose, Throat
EPDS	Electrical Power Distribution System
EPM	European Physiology Module
ESA	European Space Agency
EST	Ejection Seat Training
ETC	European Transport Carrier
EVA	Extravehicular Activity
EVCPS	Extravehicular Charged Particle Directional Spectrometer
FCB	Functional Cargo Block
FCER	Flight Crew Equipment Representative
FCL	Flight Crew Licensing
FCOD	Flight Crew Operations Directorate
FCR	Flight Control Room
FD	Flight Director
FEPA	Flight Equipment Processing Associate
FIT	Final Inspection Team
FOR	Frame of Resolution
FSL	Fluid Science Laboratory
FTS	Flight Termination System
GCR	Galactic Cosmic Radiation
GCTC	Gagarin Cosmonaut Training Center
G-LOC	Gravity-Induced Loss of Consciousness
GLS	Ground Launch Sequencer
GNC	Guidance Navigation and Control
GOR	Gradual Onset Rate
GRC	Glenn Research Center
HAI	High Altitude Indoctrination
HEAT	High-fidelity Environment Training

HMD	Head-Mounted Display
HMP	Haughton Mars Project
HOSC	Huntsville Operations Support Center
HPS	Human Patient Simulator
HRF	Human Research Facility
IBMP	Institute for Biomedical Problems
IGF	Insulin Growth Factor
ILOB	Icarus Lunar Observatory Base
IMS	Inventory Management System
INS	Inertial Navigation System
IOP	Intraocular Pressure
IR	Infrared
ISPR	International Standard Payload Rack
ISRU	In Situ Resource Utilization
ISS	International Space Station
IST	Increment-Specific Training
IVA	Intravehicular Activity
IVCPDS	Intravehicular Charged Particle Directional Spectrometer
JAA	Joint Aviation Authority
JAR	Joint Aviation Requirements
JGTF	Jake Garn Training Facility
JSC	Johnson Space Center
KSC	Kennedy Space Center
LAS	Launch Abort System
LCC	Launch Control Center
LD	Launch Director
LEE	Latching End Effector
LEO	Low Earth Orbit
LH2	Liquid Hydrogen
LLOX	Lunar Liquid Oxygen
LMA	Laryngeal Mask Airway
LMESSC	Lightweight Multi-Purpose Experiment Support Structure Carrier
LOV	Loss of Vision
LOX	Liquid Oxygen
LPS	Launch Processing System
LRC	Langley Research Center
LSAH	Longitudinal Study of Astronaut's Health
MAG	Maximum Absorbency Garment
MBS	Mobile Base System
MCAT	Medical College Admission Test
MCC	Mission Control Center
MCP	Mechanical Counter-Pressure
MDD	Multispatial Disorientation Device
MER	Mission Evaluation Room
MIT	Massachusetts Institute of Technology

MLC	Multimedia Learning Center
MMPI	Minnesota Multiphasic Personality Inventory
MMT	Mission Management Team
MOI	Mars Orbit Insertion
MOL	Manned Orbiting Laboratory
MRI	Magnetic Resonance Imaging
MRO	Mission Robotics Operator
MSFC	Marshall Space Flight Center
MSFT	Multi-Stage Fitness Test
MSS	Mobile Servicing System
MSSOTS	Mobile Servicing System Operations Training Simulator
NBL	Neutral Buoyancy Laboratory
NEEMO	NASA Extreme Environment Mission Operations Project
NSBRI	National Space Biomedical Research Institute
NTD	NASA Test Director
OBS	Operational Bioinstrumentation System
OETF	Operations Engineering Training Facility
OFK	Official Flight Kit
OID	Operational Intercommunications System
PBAN	Polybutadiene Acrylonitrile
PDGF	Power Data Grapple Fixture
PLL	Peripheral Light Loss
PLSS	Portable Life Support System
PPC	Private Psychological Conference
PPK	Personal Preference Kit
RDS	Russian Docking System
RHC	Rotational Hand Controller
ROR	Rapid Onset Rate
ROV	Remotely Operated Vehicle
RRT	Rapid Response Team
RSO	Range Safety Officer
RSS	Rotating Service Structure
RWS	Robotic Work Station
SAR	Synthetic Aperture Radar
SARJ	Solar Alpha Rotary Joint
SCA	Simulation Control Area
SCTF	Sonny Carter Training Facility
SETI	Search for Extraterrestrial Intelligence
SFU	Simon Fraser University
SM	Service Module
SOLO	Sodium Loading in Microgravity
SOMD	Space Operations Mission Directorate
SPE	Solar Particle Event
SRB	Solid Rocket Booster
SRC	Short-Radius Centrifuge