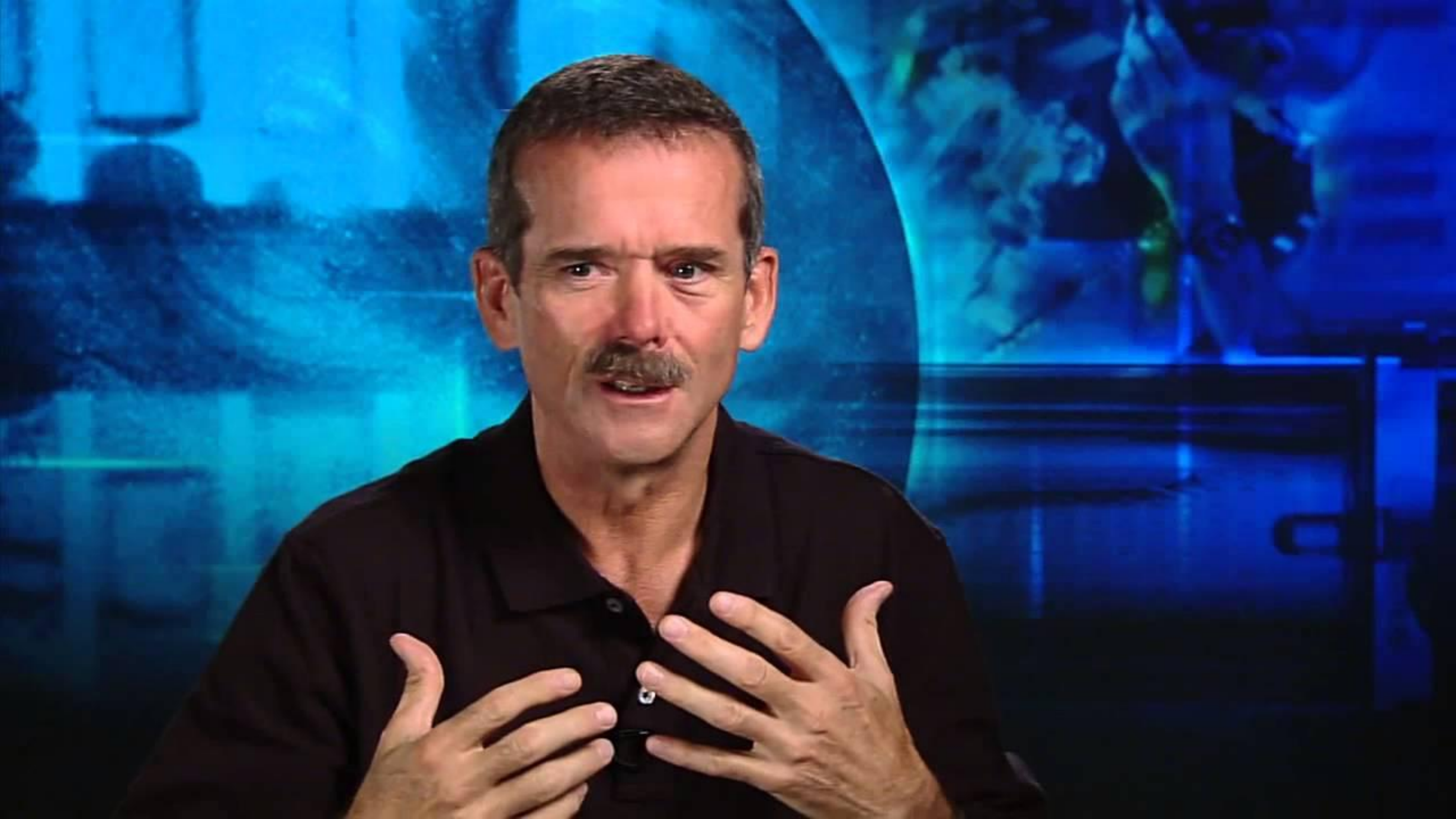

1
00:00:08,090 --> 00:00:14,110
Why did you want to be an astronaut?

2
00:00:14,110 --> 00:00:21,340
In the late ’60s I was seven, eight, nine
years old, and what was going on in the news

3
00:00:21,340 --> 00:00:26,850
at that time that really excited a seven,
eight, nine year old boy was the Space Race.

4
00:00:26,850 --> 00:00:32,440
The “2001: A Space Odyssey,” that science
fiction movie came out, and in reality people

5
00:00:32,440 --> 00:00:37,510
were flying Gemini and people were starting
to fly Apollo and starting to go to the moon,

6
00:00:37,510 --> 00:00:41,989
and the whole purpose of it, which was clear
to everybody, was to put a human being on

7
00:00:41,989 --> 00:00:43,579
the moon by the end of decade.

8
00:00:43,579 --> 00:00:47,490
Within the ’60s, and so as a kid growing
up, it didn’t matter where you were, whether

9
00:00:47,490 --> 00:00:53,570
you were in Malaysia or Canada or here in
Houston, this is a pretty exciting thing,

10
00:00:53,570 --> 00:00:55,110
and it really captured my imagination.

11
00:00:55,110 --> 00:01:00,930
I had a National Geographic big picture of

the moon above my bed on the wall and I was

12
00:01:00,930 --> 00:01:02,480
watching the exploits.

13
00:01:02,480 --> 00:01:09,100
On July 20, 1969, like so many other people,
I sat and looked at a bad, grainy little television

14
00:01:09,100 --> 00:01:13,869
and watched those first steps on the moon
and then went outside with my family, but

15
00:01:13,869 --> 00:01:20,630
really alone, looked up at the moon and thought,
that's what I want to do when I grow up;

16
00:01:20,630 --> 00:01:25,360
I'm going to grow up to be something, why
don't I grow up to be that, that is an interesting

17
00:01:25,360 --> 00:01:29,590
thing, that's a new challenge for humanity.

18
00:01:29,590 --> 00:01:33,369
But then when I look around I'm thinking,
I'm a nine year old kid and I'm a Canadian,

19
00:01:33,369 --> 00:01:34,369
what are my odds?

20
00:01:34,369 --> 00:01:35,369
Not very good.

21
00:01:35,369 --> 00:01:39,040
But I thought, well, up until yesterday people
couldn't even go and walk on the moon and

22
00:01:39,040 --> 00:01:42,799

now they can, so maybe I can, too.

23
00:01:42,799 --> 00:01:48,150
I started getting ready that night, what do
I need to do next?

24
00:01:48,150 --> 00:01:54,630
And I need to learn to fly and to scuba dive
and to stay in shape and other languages and

25
00:01:54,630 --> 00:01:56,750
study in university and all of those things.

26
00:01:56,750 --> 00:02:01,899
To become an engineer, a fighter pilot, a
test pilot and all of that, which was fun

27
00:02:01,899 --> 00:02:07,619
and fascinating, but also all to help maybe
in the lifelong dream of having a chance to

28
00:02:07,619 --> 00:02:11,450
be an astronaut and to follow in the footsteps
of Buzz and Neil.

29
00:02:11,450 --> 00:02:15,630
Amazingly enough it worked.

30
00:02:15,630 --> 00:02:18,099
Tell me a little of that story.

31
00:02:18,099 --> 00:02:21,680
Tell me about where you grew up.

32
00:02:21,680 --> 00:02:27,969
I was born in Sarnia, Ontario; a small town,
it’s where oil was pretty much discovered

33
00:02:27,969 --> 00:02:29,310

in North America.

34
00:02:29,310 --> 00:02:36,069
It’s an industrial town right on the Great Lakes, beautiful little spot, and my father

35
00:02:36,069 --> 00:02:40,910
got hired by an airline when I was about seven or eight and then we moved to a farm closer

36
00:02:40,910 --> 00:02:44,200
to Toronto because he was flying for Air Canada based out of Toronto.

37
00:02:44,200 --> 00:02:49,200
I spent my childhood basically in two towns, Sarnia for the first half of it, starting

38
00:02:49,200 --> 00:02:53,810
kindergarten and grade school there, and then Milton, Ontario, near Toronto, living on a

39
00:02:53,810 --> 00:02:58,870
farm for the rest of middle school and for high school.

40
00:02:58,870 --> 00:03:03,150
My parents still live on a farm near Milton, Ontario.

41
00:03:03,150 --> 00:03:09,400
How did that place and those people help make you the person that you are?

42
00:03:09,400 --> 00:03:14,680
I’ve raised three kids, my wife and I have three kids.

43
00:03:14,680 --> 00:03:21,420
I’ve observed through direct contact the

adults they are now is partially the product

44
00:03:21,420 --> 00:03:23,950
of where they came from and what we did.

45
00:03:23,950 --> 00:03:26,670
With them growing up, but partially how they
were wired at birth.

46
00:03:26,670 --> 00:03:32,120
There are fundamental differences, and I'm
sure I'm no different than my kids.

47
00:03:32,120 --> 00:03:37,890
I am born with whatever I was born with, what
height I'm going to be and what color my

48
00:03:37,890 --> 00:03:42,969
eyes are and how my particular synapses all
fire, but I'm also very much the product

49
00:03:42,969 --> 00:03:50,200
of the environment; my value system, the educational
system that I went through, the people that

50
00:03:50,200 --> 00:03:54,439
I met, the people that inspired me or the
people that oppressed me.

51
00:03:54,439 --> 00:03:59,040
I'm very much a product of all of that.

52
00:03:59,040 --> 00:04:04,639
So any successes I've had, partially it's
due to genetics, partially it's due to the

53
00:04:04,639 --> 00:04:08,629
people that have trained me and taught me
and shaped me over the years, and I have lots

54
00:04:08,629 --> 00:04:14,959
of people that I could directly thank for
helping get me to where I am today.

55
00:04:14,959 --> 00:04:19,459
For teaching me something critical or maybe
teaching me something in general that helped

56
00:04:19,459 --> 00:04:22,780
me perceive things the way that I do.

57
00:04:22,780 --> 00:04:29,389
I think, if you want to grow up to be an astronaut,
growing up as a kid in southern Ontario is

58
00:04:29,389 --> 00:04:31,370
a pretty good place to come from.

59
00:04:31,370 --> 00:04:36,139
Pick up the story from there for me and give
me a thumbnail sketch of big steps in your

60
00:04:36,139 --> 00:04:42,650
education and your career that have led you
to be here at this point.

61
00:04:42,650 --> 00:04:50,420
I went to a little tiny rural school called
Percy W. Merry.

62
00:04:50,420 --> 00:04:55,560
I was doing well in school; I was in grade
three or four and skipped one of those grades.

63
00:04:55,560 --> 00:04:59,570
Fortunately the Ontario educational system
in the province of Ontario in Canada, had

64
00:04:59,570 --> 00:05:04,361

decided that they should have, what at the
time they called “enrichment,” sort of

65
00:05:04,361 --> 00:05:08,130
like trying to pick out the kids that were
doing real well, how to challenge them, and

66
00:05:08,130 --> 00:05:13,340
how to maybe put them in a different educational
environment so that they could really learn

67
00:05:13,340 --> 00:05:14,340
and be challenged.

68
00:05:14,340 --> 00:05:18,449
I got into that program and for three years
I was in an enrichment program, really teaching

69
00:05:18,449 --> 00:05:24,680
us to think more critically, more analytically,
think on a different scale then just getting

70
00:05:24,680 --> 00:05:28,770
these exercises done in time for this test.

71
00:05:28,770 --> 00:05:33,599
I went to two different high schools, and
there was two different tracks, one the high

72
00:05:33,599 --> 00:05:36,319
school track to go to the university and one
not.

73
00:05:36,319 --> 00:05:39,699
At the time you went to an extra year of high
school if you’re going to university, nice

74
00:05:39,699 --> 00:05:44,900
preparation for the course that I decided
to follow.

75
00:05:44,900 --> 00:05:52,660
I was a ski instructor; there's a great
opportunity for outdoor activities in Canada

76
00:05:52,660 --> 00:05:58,610
and to be able to have the combination of
the natural environment, the physical challenges

77
00:05:58,610 --> 00:06:00,419
of downhill skiing and racing.

78
00:06:00,419 --> 00:06:06,070
Being a ski instructor, for me I learned a
lot about managing speed and managing energy.

79
00:06:06,070 --> 00:06:10,759
I learned to fly as a teenager; there's
a program in Canada called Air Cadets, it's

80
00:06:10,759 --> 00:06:14,691
sort of like the Civil Air Patrol in the United
States but it's a little closer to the Canadian

81
00:06:14,691 --> 00:06:20,539
air force, and they teach young Canadians,
whether it's Sea Cadets, Army Cadets or

82
00:06:20,539 --> 00:06:24,289
Air Cadets, they teach them a bunch of technical
things, they teach them self-discipline, they

83
00:06:24,289 --> 00:06:28,169
give them levels of responsibility that they
might not get otherwise as teenagers, and

84
00:06:28,169 --> 00:06:32,160
in my case, I spent one summer learning to
be a glider pilot and getting my glider pilot's

85
00:06:32,160 --> 00:06:33,160
license.

86
00:06:33,160 --> 00:06:37,150
Right at the age of 16 I became a powered
pilot.

87
00:06:37,150 --> 00:06:41,180
A significant percentage of commercial pilots
in Canada, something like half of them, went

88
00:06:41,180 --> 00:06:46,879
through Air Cadets, so it's a great program
set up by the country that allows young Canadians

89
00:06:46,879 --> 00:06:51,130
to pursue an area of specialized interest
that then makes them useful to the country

90
00:06:51,130 --> 00:06:52,300
later on.

91
00:06:52,300 --> 00:06:57,710
Then I went to our military academies, which
in our case was called Royal Roads Military

92
00:06:57,710 --> 00:07:06,000
College and then the Royal Military College
of Canada, RMC, studying engineering.

93
00:07:06,000 --> 00:07:09,310
If you're going to get into the air force
or any phase of the military you have two

94
00:07:09,310 --> 00:07:12,750
different ways, you can come in directly or
you can come through the military college

95
00:07:12,750 --> 00:07:18,389

system and I chose, I figured, well, the odds
of being an astronaut are pretty lousy and

96
00:07:18,389 --> 00:07:23,400
I need something else as a real career, and
so I decided I want to study engineering and

97
00:07:23,400 --> 00:07:27,060
then maybe I'll be able to be a pilot, and
then maybe I'll be able to be a pilot as

98
00:07:27,060 --> 00:07:29,250
my profession for my whole life.

99
00:07:29,250 --> 00:07:34,480
Maybe I'll get to be an astronaut, and fortunately,
all of those things worked out, but I would

100
00:07:34,480 --> 00:07:39,419
have been happy at each one of those stages
as I worked my way through.

101
00:07:39,419 --> 00:07:43,310
When I came out of military college I was
lucky enough to be able to do a, master's

102
00:07:43,310 --> 00:07:45,190
work, graduate level work.

103
00:07:45,190 --> 00:07:49,880
Then go on to fly and be able to fly Canada's
new fighter at the time which is our version

104
00:07:49,880 --> 00:07:52,919
of the F-18, we called it the CF-18.

105
00:07:52,919 --> 00:07:56,849
I flew those for NORAD [North American Aerospace
Defense Command], then I did exchange to the

106
00:07:56,849 --> 00:08:01,750
U.S. Air Force Test Pilot School, and then
flew as an exchange pilot, a Canadian flying

107
00:08:01,750 --> 00:08:05,600
F-18s with the U.S. Navy in Patuxent River.

108
00:08:05,600 --> 00:08:12,580
So that long, convoluted flow from an advanced
education program as a ten year old kid or

109
00:08:12,580 --> 00:08:18,530
eleven year old kid in the enrichment program
in elementary/middle school in Canada, all

110
00:08:18,530 --> 00:08:22,349
the way through to getting selected as an
astronaut.

111
00:08:22,349 --> 00:08:28,969
I see myself very much a product of all of
those structures and capabilities that Canada

112
00:08:28,969 --> 00:08:30,580
provided me.

113
00:08:30,580 --> 00:08:36,479
To fly as an astronaut is to assume some risks
that most people don’t have in their lives;

114
00:08:36,479 --> 00:08:44,890
question is, what is it you feel that we get
or learn as a result of flying people in space

115
00:08:44,890 --> 00:08:50,980
that makes it worth taking the risk?

116
00:08:50,980 --> 00:08:54,350
Almost everything worthwhile carries with

it some sort of risk, whether it’s starting

117
00:08:54,350 --> 00:09:02,750
a new business, whether it’s leaving home,
whether it’s getting married, or whether

118
00:09:02,750 --> 00:09:04,410
it’s flying in space.

119
00:09:04,410 --> 00:09:09,390
You are taking a risk: you are going from
one known set of circumstances into a new

120
00:09:09,390 --> 00:09:14,600
set of circumstances, and everybody takes
some of those risks during their life.

121
00:09:14,600 --> 00:09:21,900
It’s a natural progression of maturity,
of the desire to do something with yourself,

122
00:09:21,900 --> 00:09:28,540
the desire to have a measure of success and
increased capability and increased comfort

123
00:09:28,540 --> 00:09:30,460
in your life.

124
00:09:30,460 --> 00:09:36,140
Also maybe the desire to be able to look back
at your life and say, I did something worthwhile

125
00:09:36,140 --> 00:09:38,910
in the time that I was alive.

126
00:09:38,910 --> 00:09:43,000
That manifests itself all different ways in
human behavior.

127

00:09:43,000 --> 00:09:47,670
People try and answer those questions to themselves
doing all different sorts of things.

128
00:09:47,670 --> 00:09:52,600
I made the choice early on what I thought
was important was technical; I think it's

129
00:09:52,600 --> 00:09:58,530
important to push back the level of what we
can do technically, and I chose aerospace,

130
00:09:58,530 --> 00:10:05,370
and as a fighter pilot, I helped defend North
America by using the latest of aerospace technology,

131
00:10:05,370 --> 00:10:06,590
but that wasn't where I wanted to end up.

132
00:10:06,590 --> 00:10:13,580
I wanted to then get into aircraft design
and testing and try and make airplanes safer,

133
00:10:13,580 --> 00:10:15,660
make airplanes more capable.

134
00:10:15,660 --> 00:10:23,580
We burnt a hydrogen-fueled engine on the wingtip
of an F-18 trying to understand how to build

135
00:10:23,580 --> 00:10:28,960
a vehicle that could get you across the Pacific
in an hour.

136
00:10:28,960 --> 00:10:32,640
Doing high angle of attack testing of F-18s,
trying to make airplanes that could fly where

137
00:10:32,640 --> 00:10:37,650
airplanes could never fly before, that was

really interesting to me, and it was risky.

138
00:10:37,650 --> 00:10:41,460
I lost a good friend a year for ten years
as a fighter pilot and a test pilot.

139
00:10:41,460 --> 00:10:44,380
I knew that it was risky.

140
00:10:44,380 --> 00:10:49,230
My wife knew that we go to funerals on a fairly
regular basis of people that are just doing

141
00:10:49,230 --> 00:10:55,910
their job, but you can't make that omelet
without breaking some eggs.

142
00:10:55,910 --> 00:10:56,910
You cannot do it.

143
00:10:56,910 --> 00:10:58,520
You have to be able to take some risks.

144
00:10:58,520 --> 00:11:00,640
Some things are worth taking a risk for.

145
00:11:00,640 --> 00:11:05,300
Even if you decide, OK, I'm going to spend
my whole life sitting at my kitchen table

146
00:11:05,300 --> 00:11:10,630
and going in between there and my bed and
hiding from risks, your house, eventually

147
00:11:10,630 --> 00:11:15,280
the ceiling falls down; there's an earthquake,
a hurricane, a lightning storm, a tornado

148
00:11:15,280 --> 00:11:16,360

or whatever.

149
00:11:16,360 --> 00:11:21,190
There’s no guarantees, you may as well try
and do something worthwhile in the meanwhile

150
00:11:21,190 --> 00:11:23,150
and minimize the risks where you can.

151
00:11:23,150 --> 00:11:28,570
For me, spaceflight is just a natural extension
of all of that.

152
00:11:28,570 --> 00:11:34,260
For the first time in history, if we muster
all of our best of capabilities, we can just

153
00:11:34,260 --> 00:11:40,610
now safely start to leave the Earth, to go
away from our planet, and to be part of that,

154
00:11:40,610 --> 00:11:46,950
to be able to be one of the early explorers
that is opening the capability of leaving

155
00:11:46,950 --> 00:11:53,380
Earth, is fundamentally interesting to me
but I also judge it as a very worthwhile thing.

156
00:11:53,380 --> 00:11:57,480
It’s an important thing in this stage of
human development, like the first sailboats

157
00:11:57,480 --> 00:12:02,680
that left land or the first vehicles that
could drive safely and conveniently on the

158
00:12:02,680 --> 00:12:04,790
surface, or the first airplanes.

159
00:12:04,790 --> 00:12:09,340
We're at that level and I've wanted to
be a part of it my whole life.

160
00:12:09,340 --> 00:12:14,920
I've devoted 20 years as an astronaut, and
now there's risk involved.

161
00:12:14,920 --> 00:12:22,070
I'm going to fly a Russian spaceship as
the left-seater, sort of like the co-pilot

162
00:12:22,070 --> 00:12:28,200
and then live on a space station for six months
and we might die in the effort but I might

163
00:12:28,200 --> 00:12:30,410
die driving home from work tonight.

164
00:12:30,410 --> 00:12:34,790
I'm going to manage things as best I can
so that I live a long and healthy life, but

165
00:12:34,790 --> 00:12:39,050
a long, healthy and worthwhile life.

166
00:12:39,050 --> 00:12:45,660
You're about to launch to the International
Space Station for Expeditions 34 and 35.

167
00:12:45,660 --> 00:12:49,360
Chris, tell me what are the goals of this
flight and what are your jobs going to be

168
00:12:49,360 --> 00:12:51,850
on this mission?

169
00:12:51,850 --> 00:12:57,300
The space station is there for a purpose and

that is to do science that can’t be done

170
00:12:57,300 --> 00:12:58,300
on the surface of the Earth.

171
00:12:58,300 --> 00:13:03,820
That is the core purpose of the space station,
and so our job, as the people on board, is

172
00:13:03,820 --> 00:13:05,990
to make sure that that science gets done.

173
00:13:05,990 --> 00:13:07,910
Everything else is sort of downstream of that.

174
00:13:07,910 --> 00:13:14,360
Yes, we need to fix things as they break;
sometimes we have to go outside on spacewalks;

175
00:13:14,360 --> 00:13:19,290
sometimes we have to use the robot arm and
grab a new delivery truck that’s full of

176
00:13:19,290 --> 00:13:23,130
equipment, but the core of it is to run those
hundred and ten experiments that are running

177
00:13:23,130 --> 00:13:28,740
on board, and that’s our main job, to be
the lab technicians as well as the plumbers

178
00:13:28,740 --> 00:13:32,860
and the delivery men and all the rest of it,
but really the lab technicians that keep the

179
00:13:32,860 --> 00:13:37,310
International Space Station as the big international
laboratory that it is.

180

00:13:37,310 --> 00:13:41,820
Now you didn’t do any of that the last time
you visited the International Space Station.

181
00:13:41,820 --> 00:13:45,640
What are you looking forward to about the
station, on this trip?

182
00:13:45,640 --> 00:13:50,050
On my first spaceflight I went to the Russian
space station, Mir and built a piece of it

183
00:13:50,050 --> 00:13:51,820
using space shuttle Atlantis.

184
00:13:51,820 --> 00:13:56,260
The second spaceflight went to the international,
the early, small International Space Station,

185
00:13:56,260 --> 00:14:00,500
and built a piece of it using space shuttle
Endeavour.

186
00:14:00,500 --> 00:14:07,430
And both times I thought, wow, wish I could
stay; what a desirable thing to do in life,

187
00:14:07,430 --> 00:14:10,890
be able to leave Earth and not just go build
something and come back but to leave Earth

188
00:14:10,890 --> 00:14:16,620
for a while, change your zip code for a while
and really become a resident.

189
00:14:16,620 --> 00:14:22,790
Both places I just felt so jealous of the
experience as we undocked and left.

190
00:14:22,790 --> 00:14:29,770

And this time after a lot of lucky coincidences
and a lot of hard work, now I get to be one

191
00:14:29,770 --> 00:14:36,940
of those crew members that stays for an extended
period away from the planet, and it's been

192
00:14:36,940 --> 00:14:41,110
a long road getting there, it's been a huge
amount of qualifications necessary to get

193
00:14:41,110 --> 00:14:45,510
there, a lot of luck to get there, but for
me, it's really a culmination of all the

194
00:14:45,510 --> 00:14:48,740
things that I've done for the last 20 years
as an astronaut.

195
00:14:48,740 --> 00:14:56,780
I'm really looking forward to not just visiting
space but moving to Earth orbit and having

196
00:14:56,780 --> 00:15:03,950
all of the internal changes, the understanding
and the revelation that comes with that.

197
00:15:03,950 --> 00:15:05,940
I'm really looking forward to it.

198
00:15:05,940 --> 00:15:09,550
During your time there you're going to have
a number of crewmates, some who are there

199
00:15:09,550 --> 00:15:13,240
before you, some who will arrive later, two
of them that you're going to be with the

200
00:15:13,240 --> 00:15:17,400
whole time, and one of them, Tom Marshburn,

you’re already “flown” with, although

201
00:15:17,400 --> 00:15:20,030
it was underwater on a NEEMO [NASA Extreme Environment Mission Operations] mission.

202
00:15:20,030 --> 00:15:25,170
Has the experience of that mission, working with that crewmate, helped you guys prepare

203
00:15:25,170 --> 00:15:26,950
for this flight?

204
00:15:26,950 --> 00:15:31,970
I count myself hugely lucky to be flying with a group of people, the group of humans that

205
00:15:31,970 --> 00:15:33,250
I’m flying in space with.

206
00:15:33,250 --> 00:15:38,430
I’ve known all of them for a long time; Pavel Vinogradov and I trained together for

207
00:15:38,430 --> 00:15:40,470
a Mir flight back in the early ’90s.

208
00:15:40,470 --> 00:15:46,360
He came over to my house, I gave him his first Jet Ski ride back in about 1994, so we’ve

209
00:15:46,360 --> 00:15:48,790
been training together for a long time.

210
00:15:48,790 --> 00:15:54,180
Tom and I have climbed mountains together as part of [National] Outdoor Leadership School,

211
00:15:54,180 --> 00:15:58,100

as you say, we've lived at the bottom of
the ocean together, and through all of that

212
00:15:58,100 --> 00:16:01,250
what's important is shared experience.

213
00:16:01,250 --> 00:16:04,360
If you're going to take a small group of
people and ask them to do something that is

214
00:16:04,360 --> 00:16:10,810
really complicated or has really high stakes
and potential for really complex things to

215
00:16:10,810 --> 00:16:18,050
happen, then it is great to have had a shared
experience in advance, and as deep and representative

216
00:16:18,050 --> 00:16:19,440
an experience as possible.

217
00:16:19,440 --> 00:16:23,420
When something hard happens, if you can look
at each other and remember back when we saw

218
00:16:23,420 --> 00:16:27,680
this before, or remember when we were out
Jet Skiing together, or remember when we were

219
00:16:27,680 --> 00:16:35,370
living on the bottom of the ocean, that really
gives you a foundation to build upon, to rely

220
00:16:35,370 --> 00:16:40,710
on and a shared confidence in your ability
to deal with the unknown.

221
00:16:40,710 --> 00:16:46,630
I think the process by which we select astronauts
and cosmonauts, the way we train together,

222
00:16:46,630 --> 00:16:52,500
not just the technical training but the psychological
and the interpersonal training that we get

223
00:16:52,500 --> 00:16:56,090
is a really important and vital part of being
successful in spaceflight.

224
00:16:56,090 --> 00:17:00,340
Any time you make a spaceflight you're going
to miss certain things on Earth.

225
00:17:00,340 --> 00:17:04,630
On this flight, it turns out you're going
to be away for Christmas and New Year's.

226
00:17:04,630 --> 00:17:08,449
What are your thoughts about spending those
holidays in space?

227
00:17:08,449 --> 00:17:10,020
My family lives all around the world.

228
00:17:10,020 --> 00:17:13,630
I have a son who lives in China, a son who
lives in Germany and a daughter who lives

229
00:17:13,630 --> 00:17:21,039
in Ireland and my wife is back and forth,
United States and Canada, so really at the

230
00:17:21,039 --> 00:17:23,220
Christmas holiday is when we get together.

231
00:17:23,220 --> 00:17:25,939
This year we've decided to bump it up a
little and we're going to get together for

232

00:17:25,939 --> 00:17:28,590
Christmas in Kazakhstan.

233
00:17:28,590 --> 00:17:31,919
Makes a nice card, Christmas in Kazakhstan,
that's where we'll be this year.

234
00:17:31,919 --> 00:17:33,640
So we're going to celebrate a little early.

235
00:17:33,640 --> 00:17:38,730
On the actual day, the traditional day, the
twenty-fifth, of course, it'll be like the

236
00:17:38,730 --> 00:17:42,809
times when I was working here in Houston in
Mission Control on Christmas Day, which I

237
00:17:42,809 --> 00:17:44,120
did several times.

238
00:17:44,120 --> 00:17:48,669
It'll be either we'll shift the date;
I'll phone in and have a video conference

239
00:17:48,669 --> 00:17:51,460
or talk to each of my family members all around
the world.

240
00:17:51,460 --> 00:17:54,510
It's an understood part of the job.

241
00:17:54,510 --> 00:17:59,669
This is a very special year for us as a family
and everyone understands that it's not going

242
00:17:59,669 --> 00:18:03,389
to be normal and this'll be a year, even
though it's not typical, a year to talk

243
00:18:03,389 --> 00:18:04,740
about for the rest of our lives.

244
00:18:04,740 --> 00:18:07,870
I want to get you to set the scene for me.

245
00:18:07,870 --> 00:18:11,570
Tell me about the International Space Station
that you're going to arrive at.

246
00:18:11,570 --> 00:18:13,100
Tell me, what's there now?

247
00:18:13,100 --> 00:18:19,379
What are the modules and the different facilities
there that are there to support you and your

248
00:18:19,379 --> 00:18:24,149
crewmates, your mission and yourselves?

249
00:18:24,149 --> 00:18:30,480
So you're in a spaceship, and you wake up
and in the far distance you see a star, and

250
00:18:30,480 --> 00:18:35,549
it's like almost miraculous in that all
the other stars stay the way they are but

251
00:18:35,549 --> 00:18:40,289
this one star, as you approach it gets bigger
and bigger and bigger, and then it stops being

252
00:18:40,289 --> 00:18:43,929
a point of light and starts becoming this
three-dimensional thing, and the closer you

253
00:18:43,929 --> 00:18:48,670
get to it, the more you're sort of staring
at it in incredulity and fascination because

254
00:18:48,670 --> 00:18:53,320
it turns this big bug of appendages and things
sticking out.

255
00:18:53,320 --> 00:18:58,710
Then it becomes enormous and then it’s the
size of a small town that you are approaching,

256
00:18:58,710 --> 00:18:59,889
it’s huge.

257
00:18:59,889 --> 00:19:03,470
I felt that way coming up to Mir, I felt that
way coming up to station even when it was

258
00:19:03,470 --> 00:19:08,549
small, and now, from our little Soyuz looking
out the window to come to station, as big

259
00:19:08,549 --> 00:19:15,149
as it is now, we’ll see it, of course, the
Japanese module, the European module, then

260
00:19:15,149 --> 00:19:19,909
all the American segments up the middle, all
of the Russian segments in the back, the huge

261
00:19:19,909 --> 00:19:27,450
truss and the huge solar arrays: it’s a
place away from Earth that humans have built.

262
00:19:27,450 --> 00:19:34,110
It’s truly a big outpost or a big first
great landing in another part of the universe

263
00:19:34,110 --> 00:19:40,610
and it feels miraculous to sneak up on one
of those and to find it in space, then drive

264
00:19:40,610 --> 00:19:46,080
ourselves in and dock with our little spaceship,
equalize pressure, open the hatch and go into

265
00:19:46,080 --> 00:19:47,080
this thing.

266
00:19:47,080 --> 00:19:54,309
It's every science fiction book, it's
every Arthur C. Clarke's imagination of

267
00:19:54,309 --> 00:20:00,850
what the orbital module might look like as
you come up, and it's this little astronaut

268
00:20:00,850 --> 00:20:02,720
kid's dream to be able to do that.

269
00:20:02,720 --> 00:20:07,179
It's a massive, capable, human creation
orbiting the world, and I'm really looking

270
00:20:07,179 --> 00:20:10,559
forward to opening that hatch.

271
00:20:10,559 --> 00:20:15,740
One of the pieces that were invaluable in
putting that together is Canadarm2.

272
00:20:15,740 --> 00:20:20,759
That's a hunk of technology that you delivered
to the space station.

273
00:20:20,759 --> 00:20:27,759
Tell me what else is still to come for Canadian
robotics and the station, for Canadarm and

274
00:20:27,759 --> 00:20:31,950
Dextre [Special Purpose Dexterous Manipulator]

and other things that are still in the pipeline.

275
00:20:31,950 --> 00:20:35,509
The space station, as far as construction
goes, is almost finished.

276
00:20:35,509 --> 00:20:40,960
There's a Russian laboratory to come up
and there are other piece parts to go on but

277
00:20:40,960 --> 00:20:43,150
fundamentally it's built.

278
00:20:43,150 --> 00:20:49,509
That was job one for Canadarm2, to grab things
out of the back of the shuttle or to hand

279
00:20:49,509 --> 00:20:54,700
off from the shuttle's arm to the Canadarm2,
take them around, build the station incrementally

280
00:20:54,700 --> 00:20:59,480
like a huge Meccano set or a huge LEGO set,
getting bigger and bigger.

281
00:20:59,480 --> 00:21:05,990
But that crane phase for the Canadarm, the
construction phase, is pretty much finished.

282
00:21:05,990 --> 00:21:10,020
Now it's really just an extension of ourselves
on the outside.

283
00:21:10,020 --> 00:21:14,730
When we need to go out and look at something,
it's nice to have a camera on the end that

284
00:21:14,730 --> 00:21:16,210
you can go have a good close look.

285
00:21:16,210 --> 00:21:25,530
When a new spaceship comes up, some of them
reach out, grab one, take it around, plug

286
00:21:25,530 --> 00:21:31,149
it in and help deliver all of the equipment
to station and then return them back to Earth

287
00:21:31,149 --> 00:21:33,480
or get rid of them again.

288
00:21:33,480 --> 00:21:41,370
Then also like a cherry picker or like a Wichita
lineman, sometimes you need to go out and

289
00:21:41,370 --> 00:21:42,370
fix something.

290
00:21:42,370 --> 00:21:48,759
You need to use both hands and with the Canadarm2,
as a spacewalker, you can click your feet

291
00:21:48,759 --> 00:21:54,169
into the foot restraint and the arm can drive
you around as if you were a tool on the end

292
00:21:54,169 --> 00:21:59,629
of a surgeon’s probe, and then it’ll get
you exactly where you need.

293
00:21:59,629 --> 00:22:04,490
As Suni [Williams] and Aki [Hoshide] did recently
in fixing the big electrical box on the outside

294
00:22:04,490 --> 00:22:05,860
of space station.

295
00:22:05,860 --> 00:22:10,960
The arm is just a wonderful extension and

tool for us to be able to work on the outside

296
00:22:10,960 --> 00:22:13,230
of the space station.

297
00:22:13,230 --> 00:22:20,549
Canadarm2 after having helped build the station
all the way through continues to keep the

298
00:22:20,549 --> 00:22:24,960
station vital and capable.

299
00:22:24,960 --> 00:22:29,010
When something comes up with new experiments,
fresh food and clean clothes, that's what

300
00:22:29,010 --> 00:22:35,309
we do, the grabbing and installing and have
our Christmas morning as a result of Canadarm2's

301
00:22:35,309 --> 00:22:36,309
work.

302
00:22:36,309 --> 00:22:41,419
You've mentioned that the assembly of the
station that has gone, taken over ten years,

303
00:22:41,419 --> 00:22:45,059
pretty much done, and the focus now is turning
on to science.

304
00:22:45,059 --> 00:22:52,169
How do you explain to people what the potential
is for what kind of science return the station

305
00:22:52,169 --> 00:22:56,610
can provide?

306
00:22:56,610 --> 00:23:00,690

Having the laboratory like the space station
functions on two different levels.

307
00:23:00,690 --> 00:23:06,820
One is the obvious one that you have a laboratory
with basically no gravity.

308
00:23:06,820 --> 00:23:12,749
You can then do experiments that are impossible
anywhere else—well, maybe you can go to

309
00:23:12,749 --> 00:23:15,799
the top of a building, drop your experiment
and it falls.

310
00:23:15,799 --> 00:23:20,049
The time that it's falling is sort of weightless;
we do that, drop it down old mine shafts so

311
00:23:20,049 --> 00:23:27,100
it can fall a couple thousand meters, but
that's only a short period of seconds and

312
00:23:27,100 --> 00:23:28,580
there's still the air drag slowing it down.

313
00:23:28,580 --> 00:23:32,710
You can put it in the back of an airplane
and maybe get 20 seconds of good weightlessness.

314
00:23:32,710 --> 00:23:39,149
On the space station we have perpetual absence
of gravity, and so there are all sorts of

315
00:23:39,149 --> 00:23:44,019
experiments that you can do on space station
that you can't do anywhere else, and that

316
00:23:44,019 --> 00:23:45,860
is the fundamental core of it.

317
00:23:45,860 --> 00:23:53,830
But the other part is, there are some things
that are just fundamentally exciting to people

318
00:23:53,830 --> 00:23:58,260
and one of them is exploration and leaving
Earth.

319
00:23:58,260 --> 00:24:02,899
To be able to do this thing that is new in
the human experience is fundamentally exciting.

320
00:24:02,899 --> 00:24:07,350
When I sit next to somebody on a bus or in
an airplane and they find out that I'm one

321
00:24:07,350 --> 00:24:11,169
of the humans that leaves Earth, that's
all we talk about from then on because no

322
00:24:11,169 --> 00:24:13,159
matter whom they are, this is an interesting
thing.

323
00:24:13,159 --> 00:24:14,669
This is new in the human experience.

324
00:24:14,669 --> 00:24:20,789
This is something that is sort of joyous and
exciting to hear about, and as a result of

325
00:24:20,789 --> 00:24:23,630
that it brings people together.

326
00:24:23,630 --> 00:24:28,610
That fundamental shared excitement of something
new in humanity's experience, no matter

327

00:24:28,610 --> 00:24:34,360
where you're from, it brings people together
and so it doesn't just bring astronauts

328
00:24:34,360 --> 00:24:40,360
together or people on the bus together, but
it brings scientists and researchers together.

329
00:24:40,360 --> 00:24:46,220
Not only have we built a place where you can
do experiments with no gravity, where we have

330
00:24:46,220 --> 00:24:52,100
a lot of electricity, a lot of time, a really
good environment, but also it challenges and

331
00:24:52,100 --> 00:24:56,919
it inspires people from all around the world
to try and use this new experience, to bring

332
00:24:56,919 --> 00:25:00,289
them together, to get people from one corner
of the world talking to people from the other

333
00:25:00,289 --> 00:25:05,960
corner of the world that without this shared
new capability and challenge, they would never

334
00:25:05,960 --> 00:25:07,330
have spoken to each other.

335
00:25:07,330 --> 00:25:12,700
And so it functions on both those levels,
we see it every day on board station, and

336
00:25:12,700 --> 00:25:19,280
a lot of the work that goes on is the daughter
or granddaughter of that type of great harmony

337
00:25:19,280 --> 00:25:20,280

of environments.

338
00:25:20,280 --> 00:25:22,470
Let’s talk about some of that research.

339
00:25:22,470 --> 00:25:29,539
One of the areas that station research focuses
on is finding out how being in that environment

340
00:25:29,539 --> 00:25:34,440
affects a human body and what we can do to
counteract the bad effects.

341
00:25:34,440 --> 00:25:39,370
Tell me about two or three of the human life
sciences investigations that you’re going

342
00:25:39,370 --> 00:25:42,950
to be involved with.

343
00:25:42,950 --> 00:25:49,690
If you’re going to do experiments on a space
station, some of them are going to be just

344
00:25:49,690 --> 00:25:51,790
taking advantage of the lack of gravity.

345
00:25:51,790 --> 00:25:55,960
Some of them are going to be to look at the
world, at the universe, to test equipment

346
00:25:55,960 --> 00:26:00,429
and to just look at things that are different
because there’s no gravity.

347
00:26:00,429 --> 00:26:06,220
One of the big differences is how a human
body functions when you take away gravity.

348

00:26:06,220 --> 00:26:07,769
Some of it is obvious.

349
00:26:07,769 --> 00:26:13,289
When you swallow your food it doesn't sit
in the bottom of your stomach, it floats around.

350
00:26:13,289 --> 00:26:17,250
When you are floating inside the station your
balance system doesn't know which way is

351
00:26:17,250 --> 00:26:19,340
up.

352
00:26:19,340 --> 00:26:28,190
You don't stand up and your body never has
to push the blood back up to your head again.

353
00:26:28,190 --> 00:26:33,620
For six months you don't have to hold your
head up, that's how lazy you can be.

354
00:26:33,620 --> 00:26:38,000
The resulting changes in the human body are
one of the things that we study.

355
00:26:38,000 --> 00:26:43,460
One of the experiments we have on board is
called Vascular [Cardiovascular Health Consequences

356
00:26:43,460 --> 00:26:46,590
of Long-Duration Space Flight], and it's
looking at what happens to the cardiovascular

357
00:26:46,590 --> 00:26:49,649
system when you live in an environment like
that.

358
00:26:49,649 --> 00:26:51,639
The heart actually shrinks.

359
00:26:51,639 --> 00:26:58,230
You’re aging on a rapidly accelerated scale,
your heart actually shrinks and your blood

360
00:26:58,230 --> 00:27:04,100
vessel response changes; it actually sets
us up to cardiovascular problems.

361
00:27:04,100 --> 00:27:07,929
If you had something that was pretty low grade
on Earth, after six months of an environment

362
00:27:07,929 --> 00:27:14,539
like that, a risk of a heart attack or a stroke
might actually be quite a bit higher.

363
00:27:14,539 --> 00:27:20,760
We have a sequence of experiments that’s
taking blood samples and monitoring our body

364
00:27:20,760 --> 00:27:23,960
while we’re exercising and doing different
things to try and understand what’s going

365
00:27:23,960 --> 00:27:25,960
on with our cardiovascular system.

366
00:27:25,960 --> 00:27:31,720
It also challenges people to try and do the
science in orbit.

367
00:27:31,720 --> 00:27:36,330
We have an experiment called Microflow [Microflow
technology demonstration] that used to be

368
00:27:36,330 --> 00:27:40,250
a big piece of equipment installed at a hospital,
they would try to figure out how can we actually

369
00:27:40,250 --> 00:27:45,429
sample the crew member's blood while they're
in orbit and get looking at the individual

370
00:27:45,429 --> 00:27:50,320
cellular level, as a result, have got it down
to the size of a toaster.

371
00:27:50,320 --> 00:27:56,249
It's like Tony Stark in "Iron Man,"
where he's trying to see if that thing in

372
00:27:56,249 --> 00:28:00,230
his chest has made his blood radioactive,
he puts this little thing in, tests his blood

373
00:28:00,230 --> 00:28:01,230
and looks at it.

374
00:28:01,230 --> 00:28:06,440
Now on orbit we have a thing the size of a
toaster, it's not quite movie grade yet,

375
00:28:06,440 --> 00:28:13,250
but we can take a tiny amount of blood, and
using an optical system that was very recently

376
00:28:13,250 --> 00:28:16,580
developed, that little bit of blood goes through
there and it can give us results in blood

377
00:28:16,580 --> 00:28:18,940
analysis within ten minutes.

378
00:28:18,940 --> 00:28:24,750
There's a capability driven by an opportunity,
driven by a set of circumstances that then

379
00:28:24,750 --> 00:28:28,190

has great opportunity on Earth.

380
00:28:28,190 --> 00:28:32,910
If you can now do blood work with a very small
machine, then remote communities can do it

381
00:28:32,910 --> 00:28:36,490
and food processing factories can do it.

382
00:28:36,490 --> 00:28:40,779
It’s taking this challenge and some of the
limitations of what we’re doing, coming

383
00:28:40,779 --> 00:28:45,429
up with a new product and then realizing that
this is going to be good all over the place.

384
00:28:45,429 --> 00:28:50,700
That’s a piece of hardware we’ll be testing
on our crew.

385
00:28:50,700 --> 00:28:53,739
There’s a lot of orthostatic stuff as well.

386
00:28:53,739 --> 00:29:08,220
The final piece I want to talk to you about
is the aging process; the loss of bone and

387
00:29:08,220 --> 00:29:10,299
the loss of muscle strength it is so rapid
for astronauts in space.

388
00:29:10,299 --> 00:29:14,950
It’s as if you spent months, years, or even
decades on Earth, happens in just a few months

389
00:29:14,950 --> 00:29:17,809
in orbit.

390

00:29:17,809 --> 00:29:24,840
Using changes in exercise and changes in diet,
we have basically found a way to beat that

391
00:29:24,840 --> 00:29:33,149
type of osteoporosis so that we can have crews
that used to come back with significant bone

392
00:29:33,149 --> 00:29:37,759
loss, now come back basically with no bone
loss at all.

393
00:29:37,759 --> 00:29:43,029
This is really important if we're going
to leave Earth, go to an asteroid or go to

394
00:29:43,029 --> 00:29:47,150
Mars, we don't want the person to show up
on Mars as a jellyfish.

395
00:29:47,150 --> 00:29:51,990
They have to show up and be able to put on
their spacesuit, go out and explore the surface,

396
00:29:51,990 --> 00:29:56,399
or if after six months on station you have
an emergency spacewalk you need to be strong

397
00:29:56,399 --> 00:29:59,700
and fit with a good skeleton to go fight the
suit and work outside.

398
00:29:59,700 --> 00:30:07,600
For the people here on Earth that are naturally
aging, getting osteoporosis and muscle wasting,

399
00:30:07,600 --> 00:30:14,799
there is a combination of specific resistive
exercise, a regimen of exercise, and a specific

400

00:30:14,799 --> 00:30:18,610
type of diet, that we have proven in this
environment.

401
00:30:18,610 --> 00:30:24,799
It will allow an astronaut to stay healthy
for the full six months, and therefore improving

402
00:30:24,799 --> 00:30:28,379
health of people on Earth and allowing us
to go further out into the solar system.

403
00:30:28,379 --> 00:30:34,169
And station is also packed with a lot of specialized
gear for science research in other scientific

404
00:30:34,169 --> 00:30:35,169
disciplines, too.

405
00:30:35,169 --> 00:30:39,039
Give me a couple of examples of the different
kinds of other science you're going to be

406
00:30:39,039 --> 00:30:42,269
working on.

407
00:30:42,269 --> 00:30:46,809
We don't know what the universe is made
of, strangely enough.

408
00:30:46,809 --> 00:30:52,200
We've been looking up at the sky, see things,
but we really fundamentally are just discovering

409
00:30:52,200 --> 00:30:54,679
that we don't even really know what the
universe is made of.

410
00:30:54,679 --> 00:31:01,200
If you measure how fast stars and galaxies

are moving away from each other the gravity,

411
00:31:01,200 --> 00:31:04,860
gravitational pull numbers, it all doesn't
make sense unless you say, there must be something

412
00:31:04,860 --> 00:31:06,869
out there causing these other effects.

413
00:31:06,869 --> 00:31:11,820
We call it dark matter and dark energy, by
all of our theories there should have been

414
00:31:11,820 --> 00:31:16,490
the same amount of matter and antimatter created
at the beginning of the universe.

415
00:31:16,490 --> 00:31:19,190
So how are you going to figure that out?

416
00:31:19,190 --> 00:31:23,980
It's hard down here on the surface; the
atmosphere filters most of that information.

417
00:31:23,980 --> 00:31:30,340
So we decided a little over a year ago to
mount on top of the space station a seven-ton

418
00:31:30,340 --> 00:31:37,779
magnet that collects the matter and the tiny
little particles of the universe.

419
00:31:37,779 --> 00:31:46,600
It's already processed 32 billion different
particles from the universe.

420
00:31:46,600 --> 00:31:51,559
The Alpha Magnetic Spectrometer and all of
the different sensors that are in it are trying

421
00:31:51,559 --> 00:31:58,600
to understand what the stuff of the universe
is: what are the origins of it and therefore

422
00:31:58,600 --> 00:32:01,009
what’s the future of it and what is our
place in it.

423
00:32:01,009 --> 00:32:03,869
That’s a really hard thing to do on the
surface of the Earth, it’s even hard to

424
00:32:03,869 --> 00:32:09,669
do on a satellite, but the station is a huge,
powerful, stable platform above the atmosphere

425
00:32:09,669 --> 00:32:14,480
for decades, and so it’s a great place to
mount a long-term sensing experiment like

426
00:32:14,480 --> 00:32:16,400
that.

427
00:32:16,400 --> 00:32:23,590
We also have a sensor on the outside looking
at all the x-ray sources in the universe,

428
00:32:23,590 --> 00:32:28,700
trying to understand black holes and some
of the less visible stars out.

429
00:32:28,700 --> 00:32:36,850
On the inside without gravity, heat doesn’t
rise; seems simple but it’s hard to get

430
00:32:36,850 --> 00:32:38,109
your mind around what that means.

431
00:32:38,109 --> 00:32:43,590

If you put a pot of water on a hot plate,
it doesn't boil right because you don't

432
00:32:43,590 --> 00:32:47,159
get cold water at the top and hot water at
the bottom then the heat rises and causes

433
00:32:47,159 --> 00:32:49,049
those nice convection patterns.

434
00:32:49,049 --> 00:32:53,239
So what happens if you take a tube of water
on the space station and you heat one end?

435
00:32:53,239 --> 00:32:57,009
Does the water just get warm at this end and
stay cold down here?

436
00:32:57,009 --> 00:33:02,999
Well, there was an Italian physicist, Marangoni,
who realized that surface tension, if you

437
00:33:02,999 --> 00:33:09,309
take a glass of wine and you swirl your glass
of wine around and you see how it sticks to

438
00:33:09,309 --> 00:33:14,700
the wine glass, that's the surface tension,
the viscosity of the wine.

439
00:33:14,700 --> 00:33:20,190
That viscosity changes with temperature, so
if you have a tube of water and you heat one

440
00:33:20,190 --> 00:33:25,909
end, the Marangoni Effect, viscosity of the
water, changes as you heat it; in effect,

441
00:33:25,909 --> 00:33:30,029
the water starts to move around due to an

entirely different process than we normally

442
00:33:30,029 --> 00:33:39,869
can see
on Earth.

443
00:33:39,869 --> 00:33:45,190
If you start thinking about it, you can then
study all sorts of fundamental fluid physics

444
00:33:45,190 --> 00:33:47,249
that we just can never study on Earth.

445
00:33:47,249 --> 00:33:52,960
We can look at how stars form because here
we have an environment with particulate in

446
00:33:52,960 --> 00:33:58,450
it just like little bits of matter in the
universe and get it spinning and see how those

447
00:33:58,450 --> 00:34:02,750
things behave over time, how they flow with
these Marangoni currents.

448
00:34:02,750 --> 00:34:10,300
We can design a blood sensor with just a tiny
little bit of human blood, but because we

449
00:34:10,300 --> 00:34:14,280
understand due to the Marangoni forces how
it will flow, we can then take a tiny blood

450
00:34:14,280 --> 00:34:18,490
sample and just using the viscosity of it,
move it around and sample it, so that’s

451
00:34:18,490 --> 00:34:23,990
an application for here on Earth.

452
00:34:23,990 --> 00:34:27,280
When you're welding something it's not
just gravity that's moving the liquid metal

453
00:34:27,280 --> 00:34:29,600
around but it's a lot of those Marangoni
forces.

454
00:34:29,600 --> 00:34:36,490
The viscosity forces melt the flux and the
metal all together, and we can better understand

455
00:34:36,490 --> 00:34:40,329
how welding works and improve quality of welding.

456
00:34:40,329 --> 00:34:50,520
So the space station is this incredible, unique
laboratory, an environment that has been really

457
00:34:50,520 --> 00:34:54,640
hard to build, but we've created this thing.

458
00:34:54,640 --> 00:34:59,490
So many of the leading minds of the world,
right up to Nobel laureates, are using that

459
00:34:59,490 --> 00:35:04,760
capability up there to push further back into
our understanding of fundamental processes

460
00:35:04,760 --> 00:35:07,590
and where we are in the universe.

461
00:35:07,590 --> 00:35:12,451
And for the crew, you're not only there
to help run those experiments, you're there

462
00:35:12,451 --> 00:35:18,420
to make sure that the station continues to

operate so that those experiments can run.

463
00:35:18,420 --> 00:35:20,320
What do you do during the day?

464
00:35:20,320 --> 00:35:25,340
What's a crew member's day like on board
the station?

465
00:35:25,340 --> 00:35:31,761
For the people that have been out on a sailboat
or a ship for a long time, where you get out

466
00:35:31,761 --> 00:35:35,190
of sight of land, you're there for some
purpose.

467
00:35:35,190 --> 00:35:38,990
Maybe you're transporting equipment somewhere,
you're going to do research, going to go

468
00:35:38,990 --> 00:35:44,990
look at coral reef life, or maybe you're
just out for a day sailing and you want to

469
00:35:44,990 --> 00:35:47,990
get a tan or go visit or just have a nice
time.

470
00:35:47,990 --> 00:35:53,660
Part of your day is to do what you went for,
to look at the coral reef or to lay back and

471
00:35:53,660 --> 00:35:58,620
look at your tan, but part of it is getting
the sailboat ready when you're about to

472
00:35:58,620 --> 00:36:00,020
take it out of harbor.

473
00:36:00,020 --> 00:36:04,560
It is operating the sailboat, steer it, get
the sail trimmed right; you have to pay attention,

474
00:36:04,560 --> 00:36:06,490
things break.

475
00:36:06,490 --> 00:36:12,530
Your compass starts sticking, your radio or
the toilet in the sailboat doesn't work

476
00:36:12,530 --> 00:36:15,190
properly—part of your day is going to be
that.

477
00:36:15,190 --> 00:36:19,710
Then part of your day is just taking care
of yourself as a human being, you need to

478
00:36:19,710 --> 00:36:23,020
sleep, eat, and wash.

479
00:36:23,020 --> 00:36:24,600
Space station's exactly the same.

480
00:36:24,600 --> 00:36:26,900
You spend part of your day just being a person.

481
00:36:26,900 --> 00:36:31,480
You wake up in the morning, take care of all
of your typical morning activities: breakfast,

482
00:36:31,480 --> 00:36:36,390
read the news, use the toilet, get cleaned
up, maybe exercise.

483
00:36:36,390 --> 00:36:40,680
We don't get exercise for free on the space
station just by walking around, raising our

484
00:36:40,680 --> 00:36:47,710
arm or picking up water, you don’t fight
gravity ever, therefore you can be so lazy

485
00:36:47,710 --> 00:36:51,400
and you have to deliberately exercise, sort
of like if you were living on a boat, you

486
00:36:51,400 --> 00:36:53,560
have to deliberately exercise.

487
00:36:53,560 --> 00:36:55,020
Then part of your day is fixing things.

488
00:36:55,020 --> 00:36:59,360
It’s a big, complicated structure and things
break, so part of the life of an astronaut

489
00:36:59,360 --> 00:37:06,260
is fixing everything from a cord in the back
of a laptop that has stopped working to the

490
00:37:06,260 --> 00:37:11,840
air purification system, or maybe something
as huge as going outside to replace or repair

491
00:37:11,840 --> 00:37:14,340
a big piece of the station that has broken.

492
00:37:14,340 --> 00:37:19,280
Another part of the day is running the experiments
on board, which is the real core purpose of

493
00:37:19,280 --> 00:37:20,800
being there.

494
00:37:20,800 --> 00:37:22,720
Your days are divided up just like that.

495
00:37:22,720 --> 00:37:28,600
Every day you're a human being staying alive,
a technician keeping the space station alive,

496
00:37:28,600 --> 00:37:31,980
and a scientist doing research.

497
00:37:31,980 --> 00:37:36,820
When you arrive on the Soyuz spacecraft, you're
going to join the International Space Station

498
00:37:36,820 --> 00:37:43,310
crew as a flight engineer, but in the midst
of your mission, when Expedition 35 begins,

499
00:37:43,310 --> 00:37:46,350
you're going to become the commander of
the International Space Station.

500
00:37:46,350 --> 00:37:50,450
How's that change life for you?

501
00:37:50,450 --> 00:37:56,640
I'm lucky enough to be able to spend just
a little under six months, on the space station.

502
00:37:56,640 --> 00:38:05,800
It is a long time, six months, a lot of things
can happen, but for the first half, which

503
00:38:05,800 --> 00:38:10,940
I count myself really lucky, is that I don't
have to show up there and be in charge.

504
00:38:10,940 --> 00:38:16,420
I show up and the commander will be Kevin
Ford, and what a great opportunity for me

505

00:38:16,420 --> 00:38:21,251
to learn because eventually I'm going to
be asked to command the space station, but

506
00:38:21,251 --> 00:38:25,750
I don't have to jump in and be full speed,
running and take over right away.

507
00:38:25,750 --> 00:38:28,510
I can do a bunch of on the job training.

508
00:38:28,510 --> 00:38:35,380
I can "fleet up," as they say in the Navy,
and I can do my job, be a flight engineer

509
00:38:35,380 --> 00:38:39,290
answerable to the commander, and listen to
all the ways that Kevin has decided.

510
00:38:39,290 --> 00:38:43,070
Kevin is learning them from Suni Williams
who learned them from Gennady Padalka so there's

511
00:38:43,070 --> 00:38:49,710
this long pedigree of refined and proven ways
to do things that are never going to be seen

512
00:38:49,710 --> 00:38:51,110
properly here on our simulators.

513
00:38:51,110 --> 00:38:56,690
There's always subtle differences, so I
will have three months to really learn how

514
00:38:56,690 --> 00:39:01,650
Kevin's running things and look at it: if
I were the commander I would do that; I would

515
00:39:01,650 --> 00:39:05,950
do that differently, I wouldn't do that,

and I'll be able to pick and choose.

516
00:39:05,950 --> 00:39:11,290
Come March, when it's time for Kevin and
his crew to get into their Soyuz and go home,

517
00:39:11,290 --> 00:39:17,450
he and I will have a ceremony on board, salute
each other, and from that moment on the health

518
00:39:17,450 --> 00:39:23,290
of my crew, the space station, and all of
the things we're trying to do productively,

519
00:39:23,290 --> 00:39:28,750
are all resting on my shoulders, weightlessly,
but resting on my shoulders.

520
00:39:28,750 --> 00:39:32,270
I need to be ready for that.

521
00:39:32,270 --> 00:39:36,520
I've been training with that in mind for
several years here on Earth, working to build

522
00:39:36,520 --> 00:39:42,230
the crew, to make sure we have the skills
but also the relationship that would allow

523
00:39:42,230 --> 00:39:47,320
us to be healthy and productive during that
time, and also making sure that I understand

524
00:39:47,320 --> 00:39:48,320
things well enough.

525
00:39:48,320 --> 00:39:52,200
No matter what breaks on the station or no
matter what experiment's going on, I have

526
00:39:52,200 --> 00:39:58,810
to have some understanding so that I can make
the right decisions, as things happen during

527
00:39:58,810 --> 00:40:00,380
the six months.

528
00:40:00,380 --> 00:40:06,190
At this stage in my career, in my 50s, I've
been an astronaut 20 years, flown a couple

529
00:40:06,190 --> 00:40:14,080
times, I consider it a huge lucky break, because
I've been gathering experience, I've been

530
00:40:14,080 --> 00:40:15,590
trying to see how to do these things.

531
00:40:15,590 --> 00:40:22,040
I've been learning from other people, and
to be given the opportunity to command what

532
00:40:22,040 --> 00:40:27,870
is essentially the world's spaceship, now
at this stage of my career, I consider it

533
00:40:27,870 --> 00:40:35,680
a great responsibility but also a great turn
of events and a great challenge and opportunity

534
00:40:35,680 --> 00:40:36,890
for myself.

535
00:40:36,890 --> 00:40:39,460
I'm really looking forward to it.

536
00:40:39,460 --> 00:40:42,960
You're also going to be the first Canadian
astronaut to command the space station.

537
00:40:42,960 --> 00:40:49,740
What’s it mean for Canada and Canada’s
space agency to have a commander?

538
00:40:49,740 --> 00:40:54,550
Canada had its first spacecraft go to orbit
50 years ago; it was called Alouette.

539
00:40:54,550 --> 00:40:58,160
We were the third nation on Earth to have
a satellite in space.

540
00:40:58,160 --> 00:41:02,630
We did it cooperatively—it was on an American
rocket, but a Canadian satellite, so it kind

541
00:41:02,630 --> 00:41:05,380
of laid the grounds for how we’re doing
everything.

542
00:41:05,380 --> 00:41:08,260
We have some specialty back home in Canada.

543
00:41:08,260 --> 00:41:11,320
We have a set of our own interests, in this
case, the upper atmosphere and the northern

544
00:41:11,320 --> 00:41:12,320
lights.

545
00:41:12,320 --> 00:41:17,770
Living in the north, we had a need, a capability,
we cooperated with another nation and we got

546
00:41:17,770 --> 00:41:19,220
ourselves into space.

547
00:41:19,220 --> 00:41:26,100

So we've been in the game from the beginning
right on the accomplishments of Alouette,

548
00:41:26,100 --> 00:41:27,730
that very first satellite.

549
00:41:27,730 --> 00:41:35,140
Canada has almost linearly built our capability
and our responsibility and therefore our international

550
00:41:35,140 --> 00:41:36,340
respect over time.

551
00:41:36,340 --> 00:41:42,730
We went from that to sensing satellites, telecommunications
satellites, RADARSAT, the first Canadian to

552
00:41:42,730 --> 00:41:47,980
fly on the shuttle, Canadarm which did so
many things from the Hubble telescope to all

553
00:41:47,980 --> 00:41:49,040
of the satellites.

554
00:41:49,040 --> 00:41:54,200
It grabbed and released, and then with the
other arm, onto the space station.

555
00:41:54,200 --> 00:41:58,340
We've had Canadians go, from Mark Garneau,
our first who was a payload specialist back

556
00:41:58,340 --> 00:42:04,720
in the early '80s, through to Julie Payette
who was the main flight engineer running the

557
00:42:04,720 --> 00:42:09,320
space shuttle during her last flight, and
then Bob Thirsk who lived on station as a

558
00:42:09,320 --> 00:42:11,140
flight engineer.

559
00:42:11,140 --> 00:42:16,930
Even though no one could map it out on purpose
that way, it has appeared fairly linearly

560
00:42:16,930 --> 00:42:22,040
and progressive to now where Canada is in
a position to have a Canadian command the

561
00:42:22,040 --> 00:42:25,550
International Space Station.

562
00:42:25,550 --> 00:42:29,970
Each has been a door opening of possibilities
for young Canadian kids: this is something

563
00:42:29,970 --> 00:42:34,020
you can do, this isn't just a dream but
this is an actual career choice; this is a

564
00:42:34,020 --> 00:42:37,660
thing that can happen in your life.

565
00:42:37,660 --> 00:42:40,410
As a result, this is a big deal in Canada.

566
00:42:40,410 --> 00:42:43,320
This is a brand new capability.

567
00:42:43,320 --> 00:42:50,560
It's something to be proud of, something
to look at in perspective of time, look backwards

568
00:42:50,560 --> 00:42:53,790
and see how we got here, look forwards and
say, look where this is going.

569
00:42:53,790 --> 00:42:59,050
We're going to other planets eventually
and Canada is part of this.

570
00:42:59,050 --> 00:43:03,750
I feel the responsibility of that as the first
Canadian to do it.

571
00:43:03,750 --> 00:43:05,570
Fundamentally, for me it's the first time.

572
00:43:05,570 --> 00:43:10,490
Regardless, it's a big deal for me, but
also it's a big deal for my country, for

573
00:43:10,490 --> 00:43:17,010
my space agency and for where I'm from,
and I'm happy that people are interested

574
00:43:17,010 --> 00:43:18,160
in it.

575
00:43:18,160 --> 00:43:25,650
I'm fundamentally happy that this is a continuation
of all of those capabilities and it continues

576
00:43:25,650 --> 00:43:29,320
to open opportunities for the Canadians that
follow after me.

577
00:43:29,320 --> 00:43:37,530
What'll it mean to you to have been that
Canadian who was first?

578
00:43:37,530 --> 00:43:41,760
I hate to jinx something by talking about
things in advance because I would like things

579
00:43:41,760 --> 00:43:48,930

to go well; that's been my goal for a decade,
preparing for this flight of getting myself

580
00:43:48,930 --> 00:43:54,240
into a position to try and do this job well.

581
00:43:54,240 --> 00:43:59,380
Since the outset I've said I want to come
back with a healthy crew, with a crew that

582
00:43:59,380 --> 00:44:03,160
sort of my measure is, would they want to
go do this again right away and if they want

583
00:44:03,160 --> 00:44:05,700
to go do this again, then it was a good human
experience.

584
00:44:05,700 --> 00:44:10,890
I want to come back with a healthy space station,
and having done as much of the science as

585
00:44:10,890 --> 00:44:20,040
we possibly could in our six months on the
station.

586
00:44:20,040 --> 00:44:24,740
If through luck and the work of the crew we
get all those things done, then of course

587
00:44:24,740 --> 00:44:30,540
this is one of the pinnacles of what I was
asked to do during my life, and this is a

588
00:44:30,540 --> 00:44:33,530
big event for me personally.

589
00:44:33,530 --> 00:44:40,190
It takes a lot of work, a lot of focus, but
it deserves it and I'm really working hard

590
00:44:40,190 --> 00:44:45,770
hoping that when we land at the end of May
that I'll be able to look back and say I

591
00:44:45,770 --> 00:44:51,140
did what I set out to do and I handed the
station off to Pavel Vinogradov in as good

592
00:44:51,140 --> 00:44:53,530
a state as I possibly could.

593
00:44:53,530 --> 00:44:59,030
It's something that I can look back on as
an accomplishment and a threshold of my life

594
00:44:59,030 --> 00:45:00,940
that was really important for me.

595
00:45:00,940 --> 00:45:06,510
Anyone who has taken a look at your biography
sees that among many interests that you have,

596
00:45:06,510 --> 00:45:11,420
music is one of them, and you've got some
special music plans for this mission.

597
00:45:11,420 --> 00:45:16,380
Tell me about your plans for recording music
and a sing-along with students all across

598
00:45:16,380 --> 00:45:18,490
Canada.

599
00:45:18,490 --> 00:45:20,790
On board the space station there's a Canadian
guitar.

600
00:45:20,790 --> 00:45:23,440

It’s a Larrivee, made in Vancouver.

601
00:45:23,440 --> 00:45:27,740
That’s just luck, I didn’t get the guitar
up there, but it turns out when they bought

602
00:45:27,740 --> 00:45:32,830
one in a local guitar shop here in Houston,
they ended up buying a Larrivee, which is

603
00:45:32,830 --> 00:45:34,650
great, it’s a nice guitar.

604
00:45:34,650 --> 00:45:36,970
I play guitar in a couple bands and sing.

605
00:45:36,970 --> 00:45:42,280
I’ve fronted bands here in Houston for 20
years, and it’s just a natural extension

606
00:45:42,280 --> 00:45:46,690
for me to play music no matter where I am,
whether it’s at Star City or Tsukuba, Japan,

607
00:45:46,690 --> 00:45:50,930
or on board the space station; I played guitar
on board Mir when I was there back in 1995.

608
00:45:50,930 --> 00:46:00,450
I thought, since I’m there long enough;
why not write music about the experience of

609
00:46:00,450 --> 00:46:01,710
traveling in space.

610
00:46:01,710 --> 00:46:08,160
The early sailors, the early miners, the early
cowboys, the pioneers that moved into a new

611

00:46:08,160 --> 00:46:17,810
human environment, all of them have recorded
the experience not just in journals, but also

612
00:46:17,810 --> 00:46:20,930
in song and in music.

613
00:46:20,930 --> 00:46:27,760
To be able to use that new environment to
help inspire art in the form of music is a

614
00:46:27,760 --> 00:46:29,420
way that I thrive on Earth.

615
00:46:29,420 --> 00:46:34,930
I'm not by any means the world's best
musician, but I love it and I've had lots

616
00:46:34,930 --> 00:46:37,490
of people to play music with.

617
00:46:37,490 --> 00:46:42,451
To be able to do that on space station is
fairly new in the human experience and I want

618
00:46:42,451 --> 00:46:44,120
to make the most of it.

619
00:46:44,120 --> 00:46:45,990
You can record it lots of different ways.

620
00:46:45,990 --> 00:46:50,860
You can write a journal, a blog every day,
take a million photographs out the window,

621
00:46:50,860 --> 00:46:55,690
try and capture this new human experience
different ways.

622

00:46:55,690 --> 00:46:58,640
For me, music is a great way to do that recording.

623
00:46:58,640 --> 00:47:02,340
I've half-written a bunch of songs and I've
completed some.

624
00:47:02,340 --> 00:47:06,160
I've made sure that we have the equipment
on board, not just the guitar but the right

625
00:47:06,160 --> 00:47:12,290
combinations of pickups, microphones, recording
equipment, and files and how to get it down

626
00:47:12,290 --> 00:47:18,290
to the ground, so that we have a reasonable
recording studio on the International Space

627
00:47:18,290 --> 00:47:19,290
Station.

628
00:47:19,290 --> 00:47:25,760
I'm going to have the chance to float weightless
inside the Cupola with the world rolling by

629
00:47:25,760 --> 00:47:31,940
underneath playing a guitar inside probably
the most scenic recording studio that's

630
00:47:31,940 --> 00:47:37,890
ever existed, and a chance to record the songs
that I have written, to work and write new

631
00:47:37,890 --> 00:47:45,500
songs or expand the songs while I'm up there,
and for the rest of my life, to have those

632
00:47:45,500 --> 00:47:55,400
as my souvenirs, my memories of living away

from the Earth.

633
00:47:55,400 --> 00:48:00,290
My brother, who I write songs with, said,
imagine if the first people going to Mars,

634
00:48:00,290 --> 00:48:03,660
if when they sit around their mess table on
the six months on the way to Mars and they

635
00:48:03,660 --> 00:48:07,080
sing old space songs and one of the songs
they sing is something that you wrote on board

636
00:48:07,080 --> 00:48:14,450
the space station, a space shanty or whatever,
what an interesting idea, and it's not inconceivable,

637
00:48:14,450 --> 00:48:19,810
so I'm really looking forward to that.

638
00:48:19,810 --> 00:48:24,750
Playing music in space also attracts a lot
of interest from other musicians.

639
00:48:24,750 --> 00:48:29,400
Lots of musicians of all different levels,
right up to some pretty famous bands have

640
00:48:29,400 --> 00:48:31,930
said, hey, we would love to play with you
while you're up there or record something

641
00:48:31,930 --> 00:48:38,660
and we'll incorporate you into our concert
or something like that.

642
00:48:38,660 --> 00:48:42,130
I've been looking at what's the best way
to do that.

643
00:48:42,130 --> 00:48:44,890
One of them is with schools across Canada.

644
00:48:44,890 --> 00:48:49,710
How do you get involved with all the grade
school and high school bands across the country,

645
00:48:49,710 --> 00:48:51,660
and there are couple good programs that exist.

646
00:48:51,660 --> 00:49:00,010
One is called MusiCounts, and they try to
have one Canadian celebrity song a year that

647
00:49:00,010 --> 00:49:04,050
is then learned by the school choirs and played
during the year and it's themed for the

648
00:49:04,050 --> 00:49:06,330
year or some sort of particular theme.

649
00:49:06,330 --> 00:49:10,870
This year they decided to make a space theme
and they teamed me with one of the musicians

650
00:49:10,870 --> 00:49:15,540
in the Canadian band called Barenaked Ladies,
guy named Ed Robertson; Ed's a great songwriter,

651
00:49:15,540 --> 00:49:17,880
he's from the part of the world that I'm
from.

652
00:49:17,880 --> 00:49:22,080
So we've been working together for about
a year now on a song, and actually this week

653
00:49:22,080 --> 00:49:32,320

we just recorded sort of the final version
of the song, and it will be put into full

654
00:49:32,320 --> 00:49:36,390
orchestrated form and sent to schools so that
the high school bands all have their particular,

655
00:49:36,390 --> 00:49:39,660
the third trumpet has his part to play and
the whole thing put together, choirs will

656
00:49:39,660 --> 00:49:45,500
learn the words, and then I will be recording
a part of it on the space station as well

657
00:49:45,500 --> 00:49:47,620
and sending it down.

658
00:49:47,620 --> 00:49:51,400
There will then be a way to have the Barenaked
Ladies' version of it with me adding in

659
00:49:51,400 --> 00:49:58,200
harmonies and singing verses and playing a
little bit of guitar, and then at school concerts

660
00:49:58,200 --> 00:50:03,240
throughout the school year, they will be able
to play along with us.

661
00:50:03,240 --> 00:50:07,550
They'll be able to use our recording, our
music, or even conceivably the whole thing

662
00:50:07,550 --> 00:50:12,850
happening live or partially live with my recording
and Ed Robertson and company.

663
00:50:12,850 --> 00:50:20,340
It's a really nice different way, to tie

the newness of the experience and the imaginative

664
00:50:20,340 --> 00:50:24,790
part of the experience with people all across
the country.

665
00:50:24,790 --> 00:50:27,450
It’s a real privilege to be a part of that.

666
00:50:27,450 --> 00:50:29,680
Sounds like it’ll be fun.

667
00:50:29,680 --> 00:50:32,360
Oh yeah, it’ll be fun, too.

668
00:50:32,360 --> 00:50:39,410
Any increment on the space station has the
plan to remain flexible to respond to things

669
00:50:39,410 --> 00:50:42,170
that you made reference to earlier.

670
00:50:42,170 --> 00:50:44,270
Sometimes that means going outside.

671
00:50:44,270 --> 00:50:50,160
What is, as we speak today, what is the plan
for spacewalks during your time on board?

672
00:50:50,160 --> 00:50:53,400
We have a richness of experience in our crew.

673
00:50:53,400 --> 00:50:57,950
People have done multiple spacewalks in the
past, both on the Russian side and on the

674
00:50:57,950 --> 00:51:08,040
U.S. side or the Canadian side, so we’ve
been training for years to do spacewalks.

675
00:51:08,040 --> 00:51:11,760
There are all sorts of things that we have
looked at and said, if this fails we have

676
00:51:11,760 --> 00:51:16,240
to go out and do a spacewalk within this number
of days to go fix it—electrical things,

677
00:51:16,240 --> 00:51:19,420
cooling things or something like that.

678
00:51:19,420 --> 00:51:23,970
So we're ready to go do those.

679
00:51:23,970 --> 00:51:28,570
Right now, as of today, there is nothing broken
on the space station that will absolutely,

680
00:51:28,570 --> 00:51:35,180
black and white, hard-require us to go outside,
but sort of like maintenance on your car—well,

681
00:51:35,180 --> 00:51:38,540
I think I can get another hundred miles out
or another thousand miles out before I have

682
00:51:38,540 --> 00:51:42,160
to change the oil or get the air conditioner
fixed.

683
00:51:42,160 --> 00:51:46,580
Well, another thousand miles go by and you
go, maybe another 500—there's a lot of

684
00:51:46,580 --> 00:51:48,080
things on station like that, too.

685
00:51:48,080 --> 00:51:51,660

You don’t want to replace things that don’t
need replacing, but there is some sort of

686
00:51:51,660 --> 00:51:56,220
regular maintenance required to keep a machine
running, and, unlike your car, where if it

687
00:51:56,220 --> 00:52:00,480
breaks you can just pull over to the side
and call AAA or call a tow truck, if the station

688
00:52:00,480 --> 00:52:06,240
has a serious problem we have to continue
to live and survive up there, so it’s a

689
00:52:06,240 --> 00:52:13,800
real balance, juggling, guessing game as to
when you have to go outside and fix things.

690
00:52:13,800 --> 00:52:20,510
We’re trying to make sure that the crew
can go outside and do any of the spacewalks

691
00:52:20,510 --> 00:52:25,090
it may be asked to do, everything from something
minor like retrieving a payload, the MISSE

692
00:52:25,090 --> 00:52:28,490
[Materials International Space Station Experiment]
payload that is collecting particles of the

693
00:52:28,490 --> 00:52:33,130
universe, it’s been out there collecting
them for years, we can fold that up like a

694
00:52:33,130 --> 00:52:35,670
big suitcase and bring it inside, and that
would be a good thing to do.

695
00:52:35,670 --> 00:52:39,830

There are cameras and lights outside that have failed that decrease our capability to

696
00:52:39,830 --> 00:52:44,530
see what we're doing; some of those need to be swapped out.

697
00:52:44,530 --> 00:52:49,240
There are covers that need to go on certain parts of the station to improve and lengthen

698
00:52:49,240 --> 00:52:54,310
their life because of all the thermal cycles and the micrometeorite damage.

699
00:52:54,310 --> 00:52:57,450
There's a big long shopping list of stuff we really should do as soon as we get outside

700
00:52:57,450 --> 00:52:58,510
and have the spare time.

701
00:52:58,510 --> 00:53:01,370
Like doing maintenance on your house; I have to clean out the gutters—that can wait a

702
00:53:01,370 --> 00:53:03,640
little while but the next time it rains it's going to be a mess.

703
00:53:03,640 --> 00:53:05,860
That's kind of the boat we're in.

704
00:53:05,860 --> 00:53:12,860
So as a crew we're trained, we're ready, and we're optimistic that something'll

705
00:53:12,860 --> 00:53:13,860
break.

706
00:53:13,860 --> 00:53:16,270
The landscape of spaceflight is changing these days.

707
00:53:16,270 --> 00:53:22,800
Now we've got private companies even flying supply ships to the space station and, and

708
00:53:22,800 --> 00:53:26,340
all the different countries in the world working together instead of competing.

709
00:53:26,340 --> 00:53:31,870
Is this the kind of arrangement, that you see continuing on into the future of human

710
00:53:31,870 --> 00:53:34,260
space exploration?

711
00:53:34,260 --> 00:53:36,320
Space travel is hard.

712
00:53:36,320 --> 00:53:40,670
It's easy to do if you're willing to kill people regularly—like in the early days

713
00:53:40,670 --> 00:53:46,210
of aviation, planes crashed all the time, people got injured, it was sort of [the attitude]

714
00:53:46,210 --> 00:53:49,110
"you know, it's a risky business, OK, people are going to die."

715
00:53:49,110 --> 00:53:52,870
That's not acceptable in space travel.

716
00:53:52,870 --> 00:53:58,400
Because of the complexity, the cost and the

visibility of it, we want it to be safe, as

717
00:53:58,400 --> 00:54:05,330
safe as we possibly can, and therefore it
takes a lot of preparation and it's expensive

718
00:54:05,330 --> 00:54:06,750
and it's rare.

719
00:54:06,750 --> 00:54:11,080
When something takes a lot of preparation
and it's expensive and rare, it's hard

720
00:54:11,080 --> 00:54:16,160
to do as one person, it's hard to do as
a small group or even as an individual company,

721
00:54:16,160 --> 00:54:17,290
sometimes even as a nation.

722
00:54:17,290 --> 00:54:22,270
I mean, Canada has not decided to launch their
own people into space because of the complexity

723
00:54:22,270 --> 00:54:27,870
and the cost; we would rather share the costs
with another country or another group of countries

724
00:54:27,870 --> 00:54:34,670
in order to make it as economically logical
as possible, and the whole world is doing

725
00:54:34,670 --> 00:54:39,110
that for the International Space Station,
or at least 15 of the leading nations of the

726
00:54:39,110 --> 00:54:40,110
world.

727

00:54:40,110 --> 00:54:41,940
That makes sense.

728
00:54:41,940 --> 00:54:46,270
If we had some huge breakthrough in engines
so that suddenly getting to space was just

729
00:54:46,270 --> 00:54:53,050
as easy as driving to the corner store, if
you could just have your “Back to the Future”

730
00:54:53,050 --> 00:54:55,690
little thing on top of your car where you
throw in a banana peel and “poof!”

731
00:54:55,690 --> 00:54:59,500
you’re off to space, the whole game would
be different and people would be going all

732
00:54:59,500 --> 00:55:00,500
the time.

733
00:55:00,500 --> 00:55:05,590
But it is still complex, hard, dangerous and
expensive, and so for the foreseeable future

734
00:55:05,590 --> 00:55:12,830
it is going to be, both at the business level
and at the governmental level, an international

735
00:55:12,830 --> 00:55:17,950
venture to build and live on the space station,
go to the moon, go to asteroids, and go to

736
00:55:17,950 --> 00:55:20,160
Mars.

737
00:55:20,160 --> 00:55:22,210
I think it’s the right thing to do.

738
00:55:22,210 --> 00:55:29,760
I think as a species, as a shared group of
people living on the surface of this planet,

739
00:55:29,760 --> 00:55:34,460
it makes sense if we're going to leave it
and go somewhere else in the solar system

740
00:55:34,460 --> 00:55:38,860
that we should try and do it as collectively
as possible, both to share the cost of it

741
00:55:38,860 --> 00:55:41,330
but also to share the benefits of it.

742
00:55:41,330 --> 00:55:46,730
So it's kind of driven by the physics and
the complexity, but there's certain purity

743
00:55:46,730 --> 00:55:48,270
and a beauty to that.

744
00:55:48,270 --> 00:55:53,820
The result that we're doing it internationally
and collectively, I think, is a really good

745
00:55:53,820 --> 00:56:00,440
one, and I hope that we can prolong that as
long as possible and not turn it into just

746
00:56:00,440 --> 00:56:08,430
a purely competitive, a one-shot deal or kind
of a thoughtless, selfish way of exploring

747
00:56:08,430 --> 00:56:09,430
the universe.

748
00:56:09,430 --> 00:56:12,200
I really like the way we're doing it as

a species right now and I want to help prolong

749
00:56:12,200 --> 00:56:13,620
that.

750
00:56:13,620 --> 00:56:20,660
What is it that we are learning now on this
space station that is preparing us for future

751
00:56:20,660 --> 00:56:24,990
exploration further beyond Earth orbit?

752
00:56:24,990 --> 00:56:30,810
On the space station, let’s look at something
really simple; a little pump that has to move

753
00:56:30,810 --> 00:56:34,450
water around like the pump in your radiator
in your car.

754
00:56:34,450 --> 00:56:39,800
Well, pumps have liquid in there, the pump
spins and it moves the liquid through.

755
00:56:39,800 --> 00:56:44,810
Without gravity the liquid doesn’t stay
in the bottom part of the pipe.

756
00:56:44,810 --> 00:56:48,530
It will stick to the walls of the pipe and
the pump will just be spinning and moving

757
00:56:48,530 --> 00:56:52,230
air through the middle, so a pump doesn’t
work in space.

758
00:56:52,230 --> 00:56:56,410
You need to redesign it, and once redesigned,
it doesn’t cool itself normally because

759
00:56:56,410 --> 00:57:00,380
heat doesn’t rise, so how do you keep your
pump from overheating?

760
00:57:00,380 --> 00:57:03,560
Seems trivial and simple, but you have to
solve that problem.

761
00:57:03,560 --> 00:57:05,420
How do you build a space pump?

762
00:57:05,420 --> 00:57:06,520
How do you build a space fan?

763
00:57:06,520 --> 00:57:11,580
How do you build a space computer, a space
toilet, a space everything?

764
00:57:11,580 --> 00:57:14,050
How do you make sure that it’s going to
work?

765
00:57:14,050 --> 00:57:22,790
Because if you say, let’s go to the biggest
rock in the asteroid belt; OK, and now we

766
00:57:22,790 --> 00:57:24,270
are, our spaceship needs pumps.

767
00:57:24,270 --> 00:57:27,370
Well, if you launch from Earth and you start
leaving Earth and you find out that you had

768
00:57:27,370 --> 00:57:32,250
a bad idea how to build pumps, then you can’t
just turn around and come home and you’re

769
00:57:32,250 --> 00:57:33,250
fundamentally flawed.

770
00:57:33,250 --> 00:57:38,490
You need to test those somewhere, and you
can’t test things perfectly here on the

771
00:57:38,490 --> 00:57:42,520
surface of the Earth because you can’t escape
gravity and the effects of gravity, so the

772
00:57:42,520 --> 00:57:48,140
space station is the test-bed for the spaceships
of the future.

773
00:57:48,140 --> 00:57:52,030
Just by its very nature we’re learning what
works and what doesn’t work, how to collect

774
00:57:52,030 --> 00:57:58,720
solar energy from the sun, make it power and
cool a spaceship; how to, what thrusters,

775
00:57:58,720 --> 00:58:03,520
what fuel should you use, how do you have
your thrusters work; what material do you

776
00:58:03,520 --> 00:58:07,560
build your spaceship from—if you know you’re
going to get peppered by micrometeorites and

777
00:58:07,560 --> 00:58:11,930
ultraviolet energy from the sun and radiation
from the universe, what do you build it out

778
00:58:11,930 --> 00:58:13,010
of?

779
00:58:13,010 --> 00:58:19,630
We’re experimenting deliberately, and just
by de facto, just by being there, with all

780
00:58:19,630 --> 00:58:24,770
of those things on the space station, and
it is our big proving ground.

781
00:58:24,770 --> 00:58:30,840
It is our test track for building spaceships
in the future, and it is therefore the diving

782
00:58:30,840 --> 00:58:35,270
board, the launching board, that’s going
to allow us to confidently go further away