



1
00:00:09,790 --> 00:00:10,830

.
>>> WELCOME TO THE NATIONAL AIR

2
00:00:10,830 --> 00:00:13,700
AND SPACE MUSEUM AND OUR
BEAUTIFUL MOVING BEYOND EARTH

3
00:00:13,700 --> 00:00:17,510
GALLERY.
TODAY WE'RE GOING TO TALK ABOUT

4
00:00:17,510 --> 00:00:22,160
PRACTICING UNDERWATER FOR
WALKING IN SPACE.

5
00:00:22,160 --> 00:00:24,050
THIS IS A REALLY IMPORTANT
TECHNIQUE.

6
00:00:24,050 --> 00:00:27,880
WE WOULDN'T KNOW HOW TO DO EXTRA
VEHICULAR ACTIVITY, OR EVA,

7
00:00:27,880 --> 00:00:31,000
WITHOUT HAVING MASTERED THIS
TECHNIQUE OF WORKING UNDERWATER.

8
00:00:31,000 --> 00:00:38,100
I WOULD ALSO LIKE TO WELCOME ALL
OF OUR VIEWERS ON NASA-TV AND

9
00:00:38,100 --> 00:00:41,070
ONLINE.
LATER IN THE PROGRAM WE WILL

10
00:00:41,070 --> 00:00:46,220
HAVE A Q AND A SESSION, AND IF
YOU GO TO OUR WEBSITE YOU CAN

11
00:00:46,220 --> 00:00:50,850
SEND QUESTIONS TO BE ASKED IN
THE Q AND A SESSION, AND IF

12
00:00:50,850 --> 00:00:53,650
WE'RE LUCKY WE WILL ALSO BE ABLE
TO SEND QUESTIONS TO THE

13
00:00:53,650 --> 00:00:56,579
ENGINEERS WORKING IN THE POOL
BECAUSE TODAY WE'RE GOING TO

14
00:00:56,579 --> 00:01:01,520
CONNECT LIVE TO THE BUOYANCY
LABORATORY IN HOUSTON, OUTSIDE

15
00:01:01,520 --> 00:01:04,610
THE JOHNSON SPACE CENTER, AND
ACTUALLY TALK TO THEM WHEN

16
00:01:04,610 --> 00:01:09,250
THEY'RE WORKING UNDERWATER.
BUT FIRST, I WANT TO SHOW YOU A

17
00:01:09,250 --> 00:01:14,270
SHORT VIDEO WHICH KIND OF GIVES
A PREVIEW OF WHAT I WANT TO TALK

18
00:01:14,270 --> 00:01:19,770
ABOUT ON THE HISTORY OF NEUTRAL
BUOYANCY, WORKING UNDERWATER FOR

19
00:01:19,770 --> 00:01:24,150
EVA.
SO WHY DON'T WE ROLL THE VIDEO.

20
00:01:24,150 --> 00:01:31,190
>> 50th ANNIVERSARY†-- OR
YESTERDAY WAS THE 50th

21
00:01:31,190 --> 00:01:35,190
ANNIVERSARY OF THE FIRST MAN TO
WALK IN SPACE.

22
00:01:35,190 --> 00:01:38,690
AND HE WENT OUTSIDE OF HIS
SPACECRAFT FOR 12 MINUTES IN

23
00:01:38,690 --> 00:01:42,659
I-65.
A FEW MONTHS LATER, JUNE 3rd,

24
00:01:42,659 --> 00:01:46,549
1965, ED WHITE BECAME THE FIRST
AMERICAN TO WALK IN SPACE.

25
00:01:46,549 --> 00:01:50,490
THIS IS A PICTURE OF MOVIE OF
HIM LEAVING THE SPACE CRAFTOPIA

26
00:01:50,490 --> 00:01:53,600
JIMINY IV, RIGHT DOWN THE HALL
IN THIS MUSEUM.

27
00:01:53,600 --> 00:01:56,700
AND A LOT OF THE EQUIPMENT YOU
SEE HIM WEARING IS IN A GALLERY

28
00:01:56,700 --> 00:02:02,260
CALLED OR EXHIBIT CALLED OUTSIDE
THE SPACECRAFT.

29
00:02:02,260 --> 00:02:04,280
IT'S JUST UPSTAIRS IN THE
MUSEUM.

30
00:02:04,280 --> 00:02:07,460
THIS VIDEO IS ACTUALLY OF SOME
OF THE THINGS I'M GOING TO TALK

31
00:02:07,460 --> 00:02:09,789
ABOUT TODAY.
IT'S FROM A LITTLE COMPANY

32
00:02:09,789 --> 00:02:14,790
CALLED ERA, OUTSIDE BALTIMORE,
WORKING IN THE MID 1960s.

33
00:02:14,790 --> 00:02:18,430
THEY ARE ONE OF THE PIONEERS IN
THE DEVELOPMENT OF THE TECHNIQUE

34
00:02:18,430 --> 00:02:21,319
OF WORKING UNDERWATER FOR
PRACTICING EVA.

35
00:02:21,319 --> 00:02:25,180
THIS SHOWS†-- VIDEO SHOWS SOME
OF THAT EARLY WORK WITH AN AIR

36
00:02:25,180 --> 00:02:29,129
LOCK AND THE PICTURES THAT
FOLLOW SHOW MORE OF THIS WORK

37
00:02:29,129 --> 00:02:31,540
THAT'S GOING TO BE†-- THEY GOING
TO TALK ABOUT A LITTLE BIT MORE

38
00:02:31,540 --> 00:02:36,409
IN MY INTRODUCTORY POWER POINT.
HERE'S SOMEBODY COMING OUT OF AN

39
00:02:36,409 --> 00:02:39,239
AIR LOCK.
THEY'RE WEARING A SO-CALLED MARK

40
00:02:39,239 --> 00:02:43,519
IV ARROWHEAD SUIT AND THESE ARE
SOME OF THE TESTS THAT TOOK

41
00:02:43,519 --> 00:02:47,079
PLACE OUTSIDE BALTIMORE IN THE
MID '60s.

42
00:02:47,079 --> 00:02:49,609
THEY MOVED ON TO USING A GEMINI
SUIT.

43
00:02:49,609 --> 00:02:52,359
THIS IS ONE OF THE FOUNDERS I
WILL TALK ABOUT MORE IN A MINUTE

44
00:02:52,359 --> 00:02:55,950
OF ERA.
SCOTT CARPENTER WORKING

45
00:02:55,950 --> 00:03:01,069
UNDERWATER WITH A TEST SECTION
FOR SKY LAB.

46
00:03:01,069 --> 00:03:05,019
YOU CAN SEE THE SKY LAB MODULE
JUST OUTSIDE HERE.

47
00:03:05,019 --> 00:03:11,489
AND THIS†-- THESE PICTURES ARE
FROM GEMINI 12 AND GEMIN 9

48
00:03:11,489 --> 00:03:14,529
SIMULATIONS THAT TOOK PLACE.
THIS IS GENE CERNAN, THE

49
00:03:14,529 --> 00:03:18,480
ASTRONAUT, AND GENE WORKING
UNDERWATER.

50
00:03:18,480 --> 00:03:23,879
HERE'S ED "BUZZ" ALDRIN IN
BALTIMORE IN ABOUT NOVEMBER

51
00:03:23,879 --> 00:03:26,510
1966.
AND SHOWS HIM GETTING INTO THE

52
00:03:26,510 --> 00:03:31,760
WATER AND WORKING UNDERWATER.
I'LL COME BACK TO THIS WAS THE

53
00:03:31,760 --> 00:03:36,010
FIRST TIME THAT WALKING IN SPACE
WAS REALLY TRAINED AND

54
00:03:36,010 --> 00:03:38,640
ASTRONAUTS WERE TRAINED TO DO
IT.

55
00:03:38,640 --> 00:03:41,659
AND THEN YOU SEE HERE SOME OF
THE APOLLO ERA.

56
00:03:41,659 --> 00:03:46,730
SO ONCE HOUSTON HAD ITS OWN
EVERYTHING A IN 1967 IT BEGAN

57
00:03:46,730 --> 00:03:50,339
WORKING ON THE UNDERWATER
TRAINING AND FOR THE LATER

58
00:03:50,339 --> 00:03:53,230
APOLLO MISSIONS THEY HAD TO GO
OUTSIDE AND RETRIEVE FILM FROM

59
00:03:53,230 --> 00:03:57,169
THE SERVICE MODULE.
THIS SHOWS A TANK THAT†-- AND

60
00:03:57,169 --> 00:04:01,329
THEN THE CONSTRUCTION OF A NEW
FACILITY WHICH I'LL AGAIN

61
00:04:01,329 --> 00:04:06,629
MENTION IN MY TALK.
AND THIS IS THE SECOND HOUSTON

62
00:04:06,629 --> 00:04:10,489
FACILITY, AND THEN YOU HAVE HERE
SOME OF THE TRAINING THAT TOOK

63
00:04:10,489 --> 00:04:14,529
PLACE IN THE SHUTTLE ERA
UNDERWATER FOR WORKING IN THE

64
00:04:14,529 --> 00:04:20,449
SHUTTLE PAYLOAD DAY.
AND THEN FOR GOING OUTSIDE, THIS

65
00:04:20,449 --> 00:04:24,760
IS, OF COURSE, CHRIS McCANNLESS
IN SPACE.

66
00:04:24,760 --> 00:04:27,670
AND FINALLY AT THE END OF THIS
VIDEO YOU SEE A LITTLE BIT OF

67
00:04:27,670 --> 00:04:31,020
THE TRAINING FOR THE HUBBLE
REPAIR MISSION.

68
00:04:31,020 --> 00:04:35,990
THIS IS A VIDEO FROM THE
TRAINING FOR THE LAST HUBBLE

69
00:04:35,990 --> 00:04:38,380
REPAIR MISSION.
IF YOU GO RIGHT OUTSIDE THIS

70
00:04:38,380 --> 00:04:41,941
GALLERY YOU CAN SEE THE
INSTRUMENTS REMOVED FROM THE

71
00:04:41,941 --> 00:04:45,890
HUBBLE AND YOU CAN SEE MUCH MORE
ABOUT THIS, AND ALSO WITHIN THIS

72
00:04:45,890 --> 00:04:52,020
GALLERY THERE'S INFORMATION AND
ARTIFACTS RELATED TO THE WORKING

73
00:04:52,020 --> 00:04:57,130
IN SPACE BY THE ASTRONAUTS ON
THE HUBBLE REPAIR.

74
00:04:57,130 --> 00:05:03,530
SO WHY WANT TO TALK ABOUT TODAY
IS HOW DO WE GET HERE AND THE

75
00:05:03,530 --> 00:05:08,280
BEGINNING OF OUR UNDERSTANDING
THAT WORKING UNDERWATER WAS

76
00:05:08,280 --> 00:05:13,430
ABSOLUTELY CRUCIAL TO LEARNING
HOW TO DO EVA.

77
00:05:13,430 --> 00:05:16,280
THIS WAS NOT AS STRAIGHTFORWARD
AS IT SEEMED TO BE.

78
00:05:16,280 --> 00:05:19,120
IF I COULD HAVE MY FIRST SLIDE,
PLEASE.

79
00:05:19,120 --> 00:05:24,350
AND GO TO THE NEXT ONE.
SO EARLY ON IN THE PROGRAM THERE

80
00:05:24,350 --> 00:05:27,510
WAS A VERY†-- IT WASN'T A VERY
GOOD IDEA ABOUT HOW TO TRAIN FOR

81
00:05:27,510 --> 00:05:30,870
EVA, HOW TO GO INTO SPACE.
THERE'S A PICTURE ON THE UPPER

82
00:05:30,870 --> 00:05:36,160
LEFT, NASA PICTURE, A CONCEPTION
THAT A GUY IN A SPACE SUIT WAS

83
00:05:36,160 --> 00:05:40,240
TURNING A WRENCH AND YOU CAN SEE
HE HAS ABSOLUTELY NOTHING TO

84
00:05:40,240 --> 00:05:43,240
SUPPORT HIM OR HOLD HIM INTO
PLACE.

85
00:05:43,240 --> 00:05:46,900
IN MANY WAYS SOME OF THE EFFECTS
IN WORKING IN WEIGHTLESSNESS

86
00:05:46,900 --> 00:05:51,100
WERE JUST NOT ANTICIPATED.
WHAT NASA HAD FOR TRAINING FOR

87
00:05:51,100 --> 00:05:55,620
EVA OR FOR WEIGHTLESSNESS WAS
THE AIRCRAFT.

88
00:05:55,620 --> 00:05:59,800
YOU CAN, IN AN AIRCRAFT,
ACTUALLY EXPERIENCE FREE-FALL

89
00:05:59,800 --> 00:06:03,100
FOR 10 TO 30 SECONDS.
THAT'S NOT A SIMULATION.

90
00:06:03,100 --> 00:06:06,500
THAT IS ACTUALLY WEIGHTLESSNESS.
BUT THE AIRCRAFT GOES UP AND

91
00:06:06,500 --> 00:06:09,560
DOWN AND YOU ONLY HAVE AT MOST
MAYBE AROUND 30 SECONDS OF

92
00:06:09,560 --> 00:06:14,240
ACTUAL WEIGHTLESS EXPERIENCE.
IT'S PRETTY HARD TO SIMULATOR

93
00:06:14,240 --> 00:06:17,561
EXPERIENCE WHAT IT'S LIKE TO
WORK IN WEIGHTLESSNESS IF YOU

94
00:06:17,561 --> 00:06:21,371
ONLY HAVE 30 SECONDS.
AND ANOTHER TOOL THEY HAD WAS A

95
00:06:21,371 --> 00:06:24,530
SO-CALLED AIR BEARING TABLE
WHERE THERE WAS AN EXTREMELY

96
00:06:24,530 --> 00:06:28,630
SMOOTH SURFACE AND A THING THAT
CREATE AND AIRFLOW, THAT CREATED

97
00:06:28,630 --> 00:06:31,330
THAT FLOATED YOU ABOVE THE
SURFACE AND YOU COULD PRACTICE

98
00:06:31,330 --> 00:06:34,870
ON A FRICTION-FREE SURFACE BUT
IT ONLY ALLOWED YOU TO MOVE

99
00:06:34,870 --> 00:06:37,560
AROUND IN TWO DIMENSIONS.
IT DIDN'T ALLOW YOU TO REALLY

100
00:06:37,560 --> 00:06:42,240
EXPERIENCE WHAT IT'S LIKE TO
WORK IN ZERO GRAVITY.

101
00:06:42,240 --> 00:06:45,240
NEXT, PLEASE.
AND THIS IS†-- THERE WAS SOME

102
00:06:45,240 --> 00:06:48,980
INTEREST IN USING WATER TO
UNDERSTAND THE EFFECTS ON THE

103
00:06:48,980 --> 00:06:51,410
HUMAN BODY.
SO THERE WERE PHYSIOLOGICAL

104
00:06:51,410 --> 00:06:54,450
EXPERIMENTS MADE, LIKE THIS ONE
AT BROOKS AIR FORCE BASE IN SAN

105
00:06:54,450 --> 00:06:59,520
ANTONIO IN THE EARLY '60s.
WHAT WERE THE EFFECTS OF ZERO

106
00:06:59,520 --> 00:07:03,040
GRAVITY ON THE HUMAN BODY?
SO SUBJECTS WERE IMMERSED IN THE

107
00:07:03,040 --> 00:07:06,639
WATER FOR SOME TIME.
NO ONE REAL LITTLE THOUGHT ABOUT

108
00:07:06,639 --> 00:07:08,910
CAN WE TRAIN ASTRONAUTS THAT
WAY.

109
00:07:08,910 --> 00:07:12,380
CERTAINLY AFTER THE PROGRAM
MOVED TO HOUSTON THEY JUST

110
00:07:12,380 --> 00:07:16,150
REALLY WEREN'T INTERESTED IN
THIS TECHNIQUE YET.

111

00:07:16,150 --> 00:07:22,000

NEXT SLIDE, PLEASE.

SO THE ACTUAL HISTORY OF

112

00:07:22,000 --> 00:07:26,990

LEARNING HOW TO USE THE WATER

CAME OUT OF LANGLEY†-- NASA

113

00:07:26,990 --> 00:07:29,960

LANGLEY, WHICH IS DOWN IN

HAMPTON, VIRGINIA, DOWN NEAR

114

00:07:29,960 --> 00:07:32,611

NORFOLK.

IT STARTED WITH A SPACE STATION

115

00:07:32,611 --> 00:07:35,780

PROJECT CALLED MAN ORBITING

RESEARCH LABORATORY.

116

00:07:35,780 --> 00:07:41,450

THIS MODEL SHOWS A CONCEPT FOR A

SMALL SPACE STATION THAT A GEMIN

117

00:07:41,450 --> 00:07:44,580

I CAPSULE ATTACHED TO THE TOP

WOULD GO TO.

118

00:07:44,580 --> 00:07:48,700

SO COULD WE START A SMALL

STATION IN SPACE, MEANWHILE OF

119

00:07:48,700 --> 00:07:51,700

COURSE BECAUSE THE PRESIDENT

COMMITTED US TO GO TO THE MOON.

120

00:07:51,700 --> 00:07:55,320

THAT WAS OUR OVERWHELMING AND

IMPORTANT MISSION.

121

00:07:55,320 --> 00:08:04,380

THE NEXT THING IS HOW DO YOU GET
IN AND OUT OF IT?

122

00:08:04,380 --> 00:08:06,669

ONE OF THE FOUNDERS OF THIS
LITTLE COMPANY I'M GOING TO TALK

123

00:08:06,669 --> 00:08:13,220

ABOUT NOW ACTUALLY SUGGESTED TO
THEM THAT THEY NEEDED AN AIR

124

00:08:13,220 --> 00:08:15,590

LOCK ON THE STATION.
YOU NEEDED A WAY TO GET IN AND

125

00:08:15,590 --> 00:08:18,220

OUT OF THE STATION WITHOUT
LETTING THE PRESSURE OUT OF THE

126

00:08:18,220 --> 00:08:21,810

WHOLE STATION.
THIS PICTURE SHOWS A COUPLE OF

127

00:08:21,810 --> 00:08:26,170

SPACE SUITED TEST SUBJECTS
WORKING INSIDE A PLASTIC AIR

128

00:08:26,170 --> 00:08:30,440

LOCK WHICH LANGLEY BUILT TO TRY
TO UNDERSTAND HOW YOU WOULD GO

129

00:08:30,440 --> 00:08:33,500

THROUGH SUCH A THING AND OPEN
THE HATCH AND CLOSE THE HATCH,

130

00:08:33,500 --> 00:08:36,370

BUT THE PROBLEM WAS, OF COURSE,
THIS IS A 1-G SIMULATION.

131

00:08:36,370 --> 00:08:38,860

THIS IS ON EARTH.
THEY'RE NOT FLOATING.

132

00:08:38,860 --> 00:08:43,360

THEY'RE NOT†-- THEY DO NOT HAVE
THE REALITY OF ZERO GRAVITY.

133

00:08:43,360 --> 00:08:46,459

AND SO THE SUGGESTION WAS, WE
SHOULD TAKE THIS AIR LOCK AND

134

00:08:46,459 --> 00:08:50,899

IMMERSE IT IN A POOL.
AND THAT SUGGESTION ACTUALLY

135

00:08:50,899 --> 00:08:53,990

CAME OUT OF THIS LITTLE COMPANY,
ERA.

136

00:08:53,990 --> 00:08:58,930

NEXT SLIDE, PLEASE.
THESE ARE THE FOUNDERS OF ERA,

137

00:08:58,930 --> 00:08:59,930

ENVIRONMENTAL RESEARCH
ASSOCIATES.

138

00:08:59,930 --> 00:09:03,930

IT WAS A TINY COMPANY OUTSIDE
BALTIMORE, HEADQUARTERED IN

139

00:09:03,930 --> 00:09:06,910

RANDALLS TOWN.
THE FOUNDERS WERE HARRY LOATS,

140

00:09:06,910 --> 00:09:11,649

WHO WAS THE SCIENTIST†-- THE ONE
WITH MORE SCIENCE TRAINING AND

141

00:09:11,649 --> 00:09:15,329

G. SAMUEL MATTINGLY, THE
BUSINESS AND ENGINEERING GENIUS

142

00:09:15,329 --> 00:09:18,100

BEHIND THIS COMPANY.
AND I WANTED TO RECOGNIZE TODAY,

143

00:09:18,100 --> 00:09:23,370

BECAUSE WE HAVE IN THE AUDIENCE
ACTUALLY THE SONS AND GRANDSON,

144

00:09:23,370 --> 00:09:28,629

SON RANDY AND GRANDSON BRETT AND
TWO OF THE DIVERS AND GUYS WHO

145

00:09:28,629 --> 00:09:33,100

WORKED IN THE POOL AT ERA, BRUCE
AND JOHN MICK.

146

00:09:33,100 --> 00:09:44,000

SO IF YOU COULD WELCOME THEM.
SO THIS TINY COMPANY BEGAN TO

147

00:09:44,000 --> 00:09:48,749

WORK WITH LANGLEY ON HOW YOU
WOULD IMMERSE THIS AIR LOCK IN A

148

00:09:48,749 --> 00:09:53,139

POOL, SO IF YOU GO TO THE NEXT
SLIDE, PLEASE.

149

00:09:53,139 --> 00:09:57,870

THEY ACTUALLY WENT TO A SCHOOL
OUTSIDE BALTIMORE, THE McDONOGH

150

00:09:57,870 --> 00:10:02,329

SCHOOL, WHICH IS STILL THERE IN
OWINGS MILLS.

151

00:10:02,329 --> 00:10:06,019

SAM MATTINGLY KNEW THEIR POOL
WAS A PRETTY GOOD QUALITY POOL

152

00:10:06,019 --> 00:10:08,269

AND THEY DIDN'T HAVE A POOL OF
THEIR OWN SO THEY SUGGESTED TO

153

00:10:08,269 --> 00:10:12,671

LANGLEY THAT THEY TAKE THEIR
EXPERIMENT INTO THIS AND THEY

154

00:10:12,671 --> 00:10:18,350

MADE A DEAL WITH McDONOGH SCHOOL
TO WORK IN THIS POOL LITERALLY

155

00:10:18,350 --> 00:10:23,850

OUTSIDE OF NORMAL WATERS OR WHEN
THE SWIM TEAM†-- SCHOOL POOL.

156

00:10:23,850 --> 00:10:26,149

SWIM TEAM.
SWIM HOUR OR WHATEVER.

157

00:10:26,149 --> 00:10:29,180

YOU'RE GOING TO FIT SOME
EXPERIMENTATION IN AT NIGHT OR

158

00:10:29,180 --> 00:10:31,790

ON THE WEEKENDS OR IN THE
MORNING, EARLY MORNINGS AND

159

00:10:31,790 --> 00:10:34,350

THINGS LIKE THAT.
IT'S A PICTURE ACTUALLY TAKEN OF

160

00:10:34,350 --> 00:10:36,769

THE McDONOGH SCHOOL POOL IN THE
MID '60s.

161

00:10:36,769 --> 00:10:40,100

JUST GO TO THE NEXT SLIDE,
PLEASE.

162

00:10:40,100 --> 00:10:42,710

AND THIS SHOWS SOME OF THE
EXPERIMENT THAT TOOK PLACE AT

163

00:10:42,710 --> 00:10:44,689

THE POOL.
SOME OF THE SLIDES YOU SAW

164

00:10:44,689 --> 00:10:48,569

BEFORE IN THE INITIAL
PRESENTATION.

165

00:10:48,569 --> 00:10:51,350

SHOWS THE TESTING OF GOING
THROUGH THE AIR LOCK, HOW YOU

166

00:10:51,350 --> 00:10:54,709

WOULD OPEN THE HATCHES, CLOSE
THE HATCHES, TURN AROUND INSIDE

167

00:10:54,709 --> 00:10:58,149

WITH WATER.
ONE OF THE REALLY IMPORTANT

168

00:10:58,149 --> 00:11:04,459

THINGS THAT THE HARRY LOATS, SAM
MATTINGLY, AND DIVERS INCLUDING

169

00:11:04,459 --> 00:11:09,160

JOHN AND BRUCE HERE, JUST HOW TO
WORK IN THIS ENVIRONMENT AND

170

00:11:09,160 --> 00:11:13,499

MAKE IT A REALISTIC SIMULATION.
SO IF YOU'RE IN A SPACE SUIT

171

00:11:13,499 --> 00:11:16,689

YOU'RE GOING TO FLOAT.

I MEAN, YOU'RE IN A BAG OF AIR,

172

00:11:16,689 --> 00:11:19,649

ESSENTIALLY.

SO IF YOU HAVE NO WEIGHT ON YOU,

173

00:11:19,649 --> 00:11:21,189

YOU'RE JUST GOING TO POP TO THE
SURFACE.

174

00:11:21,189 --> 00:11:24,079

AND SO ONE OF THE MANY THINGS
THEY HAD TO LEARN WAS THE PROPER

175

00:11:24,079 --> 00:11:28,210

WEIGHTING OF LEAD WEIGHTS AROUND
THE SUIT TO CREATE A NEUTRAL

176

00:11:28,210 --> 00:11:32,430

BALANCE, SO-CALLED NEUTRAL
BUOYANCY IN ALL AXIS, NOT JUST

177

00:11:32,430 --> 00:11:35,689

GOING UP AND DOWN BUT IN EVERY
DIMENSION YOU MOVE AROUND AND

178

00:11:35,689 --> 00:11:40,249

MAKES A PRETTY REASONABLE
SIMULATION OF WHAT ZERO G IS

179

00:11:40,249 --> 00:11:42,490

LIKE.

NEXT SLIDE.

180

00:11:42,490 --> 00:11:46,970

AND YOU SEE IN THIS NEXT SLIDE
ANOTHER ONE OF THESE TESTS

181

00:11:46,970 --> 00:11:48,920

GETTING IN AND OUT OF THE AIR
LOCK.

182

00:11:48,920 --> 00:11:50,689

THEY ALSO HAD TO LEARN SAFETY
CULTURE.

183

00:11:50,689 --> 00:11:53,029

I THINK THAT'S ONE OF THE REALLY
IMPORTANT THINGS I LEARNED IN

184

00:11:53,029 --> 00:11:55,309

STUDYING ABOUT THIS.
THEY HAD TO LEARN A SAFETY

185

00:11:55,309 --> 00:11:56,879

CULTURE ABOUT HOW TO WORK IN
THIS.

186

00:11:56,879 --> 00:12:00,119

YOU HAD TO HAVE DIVERS, YOU HAD
TO HAVE SCUBA DIVERS ALWAYS WITH

187

00:12:00,119 --> 00:12:03,920

YOU IN CASE THERE WAS A PROBLEM
WITH THE SUIT AND THEN AT TIMES

188

00:12:03,920 --> 00:12:09,009

PEOPLE, INCLUDING BRUCE WHO IS
HERE, EXPERIENCE PERSONALLY AN

189

00:12:09,009 --> 00:12:12,980

EMERGENCY CREATED BY LOSING THE
AIR CONNECTION TO THE SUIT,

190

00:12:12,980 --> 00:12:16,610

WATER POTENTIALLY COMING IN TO
YOUR SUIT OR YOUR FACE MASK.

191

00:12:16,610 --> 00:12:18,399

AND SO THEY HAD TO LEARN HOW TO
WORK WITH THIS.

192

00:12:18,399 --> 00:12:25,990

NEXT SLIDE, PLEASE.

NOW, SIMULTANEOUSLY†--

193

00:12:25,990 --> 00:12:30,160

SIMULTANEOUSLY MARSHALL SPACE IT
FLIGHT CENTER IN HUNTSVILLE,

194

00:12:30,160 --> 00:12:36,249

ALABAMA, WAS WORKING ON NEUTRAL
BUOYANCY.

195

00:12:36,249 --> 00:12:42,339

THIS IS A PICTURE†-- THIS IS A
PICTURE OF AN OUTDOOR TANK THAT

196

00:12:42,339 --> 00:12:45,629

WAS AT MARSHALL AND THEN ALSO
LATER THEY DEVELOPED THE OUTDOOR

197

00:12:45,629 --> 00:12:47,679

TANK.
THEY COVERED IT, HEATED IT.

198

00:12:47,679 --> 00:12:52,610

AND SO NEUTRAL BUOYANCY TRAINING
BEGAN IN TWO PLACES IN NASA.

199

00:12:52,610 --> 00:12:57,700

ONE WAS THROUGH LANGLEY AND THE
ERA PROJECT AND SECOND ONE WAS

200

00:12:57,700 --> 00:13:00,550

THROUGH MARSHALL.
NEXT SLIDE, PLEASE.

201

00:13:00,550 --> 00:13:05,360

NOW IN BETWEEN, AS I MENTIONED,
THE FIRST HUMANS WENT INTO

202

00:13:05,360 --> 00:13:12,020

OUTSIDE THE SPACECRAFT, LEXI AND
ED WHITE.

203

00:13:12,020 --> 00:13:16,189

THESE WALKS IN SPACE†-- COULD I
HAVE THE NEXT SLIDE, PLEASE?

204

00:13:16,189 --> 00:13:20,050

THESE WALKS IN SPACE
DEMONSTRATED WE COULD GO OUTSIDE

205

00:13:20,050 --> 00:13:21,939

BUT THEY WERE ALSO KIND OF
MISLEADING.

206

00:13:21,939 --> 00:13:25,999

WE DIDN'T REALIZE HOW HARD IT
WAS BECAUSE THEY WERE JUST

207

00:13:25,999 --> 00:13:29,529

FLOATING AROUND FOR THE MOST
PART AND, SECONDLY, THE SOVIETS

208

00:13:29,529 --> 00:13:33,930

COVERED UP THE DIFFICULTIES THAT
HE HAD GETTING BACK IN HIS AIR

209

00:13:33,930 --> 00:13:37,620

LOCK AND HIS SPACECRAFT.
AND EVEN ED WHITE HAD A LOT OF

210

00:13:37,620 --> 00:13:40,670

PROBLEM GETTING DOWN IN HIS SUIT
AND CLOSING THE HATCH.

211

00:13:40,670 --> 00:13:43,490

BUT IN GENERAL, THE MESSAGE WE
GOT FROM THE FIRST TWO WALKS IN

212

00:13:43,490 --> 00:13:46,699

SPACE IN 1965, THAT ISN'T SO
HARD.

213

00:13:46,699 --> 00:13:50,710

NEXT SLIDE, PLEASE.
THIS IS A PICTURE OF†-- THAT YOU

214

00:13:50,710 --> 00:13:55,449

SAW BEFORE OF GENE CERNAN.
WHEN WE REALLY FOUND OUT HOW

215

00:13:55,449 --> 00:13:58,660

HARD IT WAS TO WALK IN SPACE
WITHOUT PROPER PREPARATION AND

216

00:13:58,660 --> 00:14:03,660

TRAINING WAS WHEN GENE CERNAN
WENT OUTSIDE ALMOST EXACTLY ONE

217

00:14:03,660 --> 00:14:07,489

YEAR AFTER ED WHITE.
ON JUNE 5th, 1966.

218

00:14:07,489 --> 00:14:09,879

HE WENT OUTSIDE.
HE WAS TO GO ON THE BACK OF THE

219

00:14:09,879 --> 00:14:14,699

GEMINI 9 SPACECRAFT, PUT ON THIS
FANCY BACKPACK THE AIR FORCE HAD

220

00:14:14,699 --> 00:14:19,410

BUILT AND HE WAS SUPPOSED TO JET
AROUND WITH THIS JET PACK ON HIS

221

00:14:19,410 --> 00:14:21,770

BACK.

BUT THAT TURNED OUT TO BE A

222

00:14:21,770 --> 00:14:25,480

DISASTER BECAUSE JUST GETTING

INTO THIS†-- STRAPPING HIMSELF

223

00:14:25,480 --> 00:14:28,360

IN, HOOKING UP THE HOSES,

HOOKING EVERYTHING UP AND

224

00:14:28,360 --> 00:14:32,369

GETTING READY TO GO PROVED TO BE

SO INCREDIBLY EXHAUST THAT HE

225

00:14:32,369 --> 00:14:37,889

WAS COMPLETELY FATIGUED.

HIS SWEAT RAN DOWN FROM HIS

226

00:14:37,889 --> 00:14:41,360

FOREHEAD, RAN INTO HIS EYES,

FOGGED UP HIS FACE PLATE.

227

00:14:41,360 --> 00:14:43,749

HE COULDN'T SEE.

HE WAS ALMOST COMPLETELY

228

00:14:43,749 --> 00:14:47,139

EXHAUSTED.

AND HIS COMMANDER, TOM STAFFORD,

229

00:14:47,139 --> 00:14:49,170

TOLD HIM TO GET BACK IN THE

SPACECRAFT.

230

00:14:49,170 --> 00:14:52,119

SO HE HAD TO COME BACK TO THE

SPACECRAFT.

231

00:14:52,119 --> 00:14:56,529

IT WAS A NEAR FATAL ACCIDENT AND
IT DEMONSTRATED HOW LITTLE

232

00:14:56,529 --> 00:15:01,310

PREPARED WE WERE TO ACTUALLY DO
EFFECTIVE WORK IN SPACE.

233

00:15:01,310 --> 00:15:04,050

HOW LITTLE WE ACTUALLY KNEW
ABOUT IT.

234

00:15:04,050 --> 00:15:09,129

NEXT SLIDE, PLEASE.
NOW, COINCIDENTALLY ERA TEN DAYS

235

00:15:09,129 --> 00:15:12,730

AFTER THE WALK GAVE A
DEMONSTRATION TO A BUNCH OF

236

00:15:12,730 --> 00:15:15,360

OFFICIALS AT NASA.
THIS WAS DONE IN LARGE PART

237

00:15:15,360 --> 00:15:19,239

BECAUSE AT THAT POINT ERA'S
CONTRACT WAS ABOUT TO RUN OUT

238

00:15:19,239 --> 00:15:23,309

AND THE WHOLE BUSINESS MIGHT GO
AWAY, AND ERA STAGED A

239

00:15:23,309 --> 00:15:25,220

DEMONSTRATION FOR NASA
OFFICIALS.

240

00:15:25,220 --> 00:15:28,829

WELL, IT HAPPENED TO COME AT
EXACTLY THE RIGHT TIME BECAUSE

241

00:15:28,829 --> 00:15:33,259

NOW SOMEBODY FROM HOUSTON WAS
SYMPATHETIC TO THE IDEA THAT

242

00:15:33,259 --> 00:15:36,220

MAYBE WE COULD LEARN SOMETHING
FROM WORKING UNDERWATER FOR

243

00:15:36,220 --> 00:15:38,379

WALKING IN SPACE.
AND SO ON THE UPPER LEFT THERE'S

244

00:15:38,379 --> 00:15:41,120

A PICTURE OF A GEMINI 10
SIMULATION.

245

00:15:41,120 --> 00:15:44,600

IT WAS GOING TO BE LAUNCHED NEXT
IN JULY.

246

00:15:44,600 --> 00:15:51,860

AND THEN GENE CERNON CAME BACK.
NEXT SLIDE, PLEASE.

247

00:15:51,860 --> 00:15:56,660

AND THIS IS A GEMINI 9
SIMULATION THAT TOOK PLACE IN

248

00:15:56,660 --> 00:16:00,910

THE SUMMER OF '56.
NEXT SLIDE, PLEASE.

249

00:16:00,910 --> 00:16:08,240

REALLY IMPORTANT MOMENT FOR
HOUSTON IS WHEN BOB DECIDED ON

250

00:16:08,240 --> 00:16:13,370

JULY 20th OF '66 WE WANT TO HAVE
A†-- WE WANT TO HAVE OUR OWN

251

00:16:13,370 --> 00:16:16,939

TANK AND WE WANT TO LEARN FROM
WHAT ERA HAS DONE.

252

00:16:16,939 --> 00:16:22,899

FROM THAT POINT ON HOUSTON THEN
COMMITTED TO WORKING ON NEUTRAL

253

00:16:22,899 --> 00:16:25,600

BUOYANCY.
NEXT SLIDE, PLEASE.

254

00:16:25,600 --> 00:16:29,810

AND ONE OF THESE THINGS WAS
WORKING ON A SO-CALLED SKY LAB

255

00:16:29,810 --> 00:16:33,089

TYPE SIMULATION WITH SCOTT
CARPENTER.

256

00:16:33,089 --> 00:16:37,689

NEXT.
WORKING ON GEMINI 11 ON A

257

00:16:37,689 --> 00:16:43,939

SIMULATION.
AND THEN, NEXT, BUZZ ALDRIN

258

00:16:43,939 --> 00:16:48,670

BEING PREPPED FOR THE POOL.
NEXT.

259

00:16:48,670 --> 00:16:52,179

GOING INTO THE POOL.
NEXT.

260

00:16:52,179 --> 00:16:55,920

AND WORKING UNDERWATER.
THE TRAINING OF BUZZ ALDRIN WAS

261

00:16:55,920 --> 00:16:59,040

A CRUCIAL THING.

THAT WAS THE POINT AT WHICH THE

262

00:16:59,040 --> 00:17:03,319

ERA EXPERIENCES PASSED ON TO

HOUSTON AND THEY UNDERSTOOD HOW

263

00:17:03,319 --> 00:17:08,720

IMPORTANT IT WAS.

YOU CAN SEE HERE THE GEMINI

264

00:17:08,720 --> 00:17:13,059

MOCKUP ENTIRELY IN THE POOL AND

BUZZ ALDRIN WORKING UNDERWATER

265

00:17:13,059 --> 00:17:19,780

IN THE McDONOGH POOL.

THIS IS A PICTURE THAT BUZZ

266

00:17:19,780 --> 00:17:24,960

ALDRIN TOOK AND HE TWEETED OUT,

QUOTE, THE GREATEST SELFIE EVER,

267

00:17:24,960 --> 00:17:28,590

WITH TYPICAL MODESTY, IT'S

SIGNED SAM MATTINGLY.

268

00:17:28,590 --> 00:17:32,560

IT'S PERSONALLY DEDICATED TO HIM

BECAUSE THE GEMINI 12 WALK IN

269

00:17:32,560 --> 00:17:37,230

SPACE IN NOVEMBER 1966 WAS SUCH

A GREAT SUCCESS.

270

00:17:37,230 --> 00:17:43,000

NEXT?

AND SO YOU SEE HERE THE TANK

271

00:17:43,000 --> 00:17:46,640

THAT HOUSTON ACTUALLY REBUILT.
IT WAS USED FOR WATER TRAIN FOR

272

00:17:46,640 --> 00:17:49,950

GETTING OUT OF THE SPACECRAFT.
THE ASTRONAUTS ARE TRAINED IN

273

00:17:49,950 --> 00:17:53,640

SCUBA.
IT BEGAN WORKING UNDERWATER WITH

274

00:17:53,640 --> 00:17:58,570

THE†-- IN THE APOLLO PROGRAM.
NEXT SLIDE, PLEASE.

275

00:17:58,570 --> 00:18:02,820

DO WE HAVE THE NEXT SLIDE,
PLEASE?

276

00:18:02,820 --> 00:18:05,370

AND WORKING UNDERWATER IN THE
APOLLO PROGRAM IN THE HOUSTON

277

00:18:05,370 --> 00:18:11,260

TANK.
AND MARSHALL ALSO BUILT A HUGE

278

00:18:11,260 --> 00:18:14,750

TANK, 75 FEET ACROSS.
THAT WAS A REALLY IMPORTANT TANK

279

00:18:14,750 --> 00:18:21,830

FOR THE DEVELOPMENT OF SKY LAB.
THIS IS THE SECOND FACILITY

280

00:18:21,830 --> 00:18:26,050

WHICH WE SAW IN THE OPENING
VIDEO WITH THE CALLED WET VEST,

281

00:18:26,050 --> 00:18:31,610

USED FOR THE SHUTTLE TRAINING
AND THEN, FINALLY, IN 1992 NASA

282

00:18:31,610 --> 00:18:37,010

BUILT THE HUGE NEUTRAL BUOYANCY
LABORATORY OUTSIDE HOUSTON.

283

00:18:37,010 --> 00:18:39,630

WE HAVE A LITTLE INTRODUCTORY
VIDEO WHICH JUST TELLS YOU

284

00:18:39,630 --> 00:19:00,850

SOMETHING ABOUT THE NBL.

>> AT A LENGTH OF 202 FEET A

285

00:19:00,850 --> 00:19:16,530

WIDTH OF 102 FEET, AND A DEPTH
OF 40 FEET, THE NEUTRAL BUOYANCY

286

00:19:16,530 --> 00:19:23,680

LABORATORY IS ONE OF THE LARGEST
INDOOR BODIES OF WATER IN THE

287

00:19:23,680 --> 00:19:26,530

WORLD.

AS WORLD CLASS FACILITY NEAR

288

00:19:26,530 --> 00:19:31,350

NASA JOHNSON SPACE CENTER, THE
NBL PLAYS A KEY ROLE IN MEETING

289

00:19:31,350 --> 00:19:35,530

TIME CRITICAL CHALLENGES FOR
ASTRONAUT TRAINING AND REFINING

290

00:19:35,530 --> 00:19:37,610

PROCEDURES FOR SUCCESSFUL
SPACEWALKS.

291

00:19:37,610 --> 00:19:41,670

CONTINUING IN THE SPIRIT OF
ADVANCING TECHNOLOGY AND

292

00:19:41,670 --> 00:19:46,310

SCIENCE, THE POOL'S 6.2 MILLION
GALLONS OF CHLORINATED

293

00:19:46,310 --> 00:19:52,860

FRESHWATER IS 84 TO 86 DEGREES
FAHRENHEIT WITH A SYSTEM CAPABLE

294

00:19:52,860 --> 00:19:56,410

OF TURNING OVER THE ENTIRE POOL
IN 19 HOURS, THE WATER IS

295

00:19:56,410 --> 00:20:00,820

FILTERED AND CLEANED, KEEPING A
HYGIENIC ENVIRONMENT FOR ANY

296

00:20:00,820 --> 00:20:03,660

OPERATION.
LOGISTICAL PLAN FOR MOVING

297

00:20:03,660 --> 00:20:08,040

LARGE-SCALE MODELS FOR TESTING
HAS NEVER BEEN EASIER.

298

00:20:08,040 --> 00:20:13,860

CONVENIENTLY LOCATED NEXT TO
ELLINGTON AIRPORT WITH ACCESS TO

299

00:20:13,860 --> 00:20:14,860

A TAXI WAY, HARDWARE CAN BE
BROUGHT DIRECTLY TO THE

300

00:20:14,860 --> 00:20:17,890

FACILITY.
FROM THERE, THE MBL'S TWO

301

00:20:17,890 --> 00:20:23,560

OVERHEAD CRANES, EACH RATED AT
20 TONS, FOUR JIB CRANE, EACH

302

00:20:23,560 --> 00:20:29,740

RATED AT 4.6 TONS, OR TWO DABIT
CRANES CAN CARRY YOUR WORKLOAD

303

00:20:29,740 --> 00:20:38,220

DIRECTLY TO THE POOL OR THE
POOLSIDE.

304

00:20:38,220 --> 00:20:45,210

>> SO, HERE WE ARE AND I THINK
WE SHOULD NOW HAVE A CONNECTION

305

00:20:45,210 --> 00:20:48,230

TO HOUSTON.
HOUSTON, CAN YOU HEAR ME?

306

00:20:48,230 --> 00:20:54,680

>> EVEN THOUGH IT'S A TEMP, WE
WANT THE FIRST TWO TO HAVE THREE

307

00:20:54,680 --> 00:20:55,680

TWISTS SO WE HAVE THE CABLE
SECURELY DOWN.

308

00:20:55,680 --> 00:20:57,270

>> OKAY.
WE'RE SEEING NOW SIMULATIONS

309

00:20:57,270 --> 00:21:04,370

THAT'S TAKING PLACE ON AIR LOCK
WORK UNDERWATER AT THE NBL.

310

00:21:04,370 --> 00:21:11,620

>> COPY?
SO FOR YOU YOU WILL BE LOOKING

311

00:21:11,620 --> 00:21:16,300

ALONG THE CABLE THAT-- LENGTH
OF THE CABLE FOR THAT WIRE TIE

312

00:21:16,300 --> 00:21:19,810

AND THAT WILL GO ON 2A-6, THE
FORWARD EXPANSION, AND WE MAY

313

00:21:19,810 --> 00:21:25,670

NEED THE DIVERS TO MOVE IT
CLOSER TO YOU TO MAKE THAT

314

00:21:25,670 --> 00:21:27,740

REACH.
SANDY, YOU'RE GOING BACK TO THE

315

00:21:27,740 --> 00:21:31,030

BAG.
YOU'RE GETTING THE AFT COIL OUT.

316

00:21:31,030 --> 00:21:34,860

>> OKAY.
>> I BELIEVE WHAT THEY'RE DOING

317

00:21:34,860 --> 00:21:39,260

HERE IS TRYING TO UNDERSTAND HOW
TO REPAIR A PARTICULAR AIR LOCK

318

00:21:39,260 --> 00:21:40,260

AT THE SPACE STATION.
>> YOU CAN RELEASE THOSE.

319

00:21:40,260 --> 00:21:41,260

I'M SORRY, SANDY.
I MISSED WHAT YOU JUST SAID.

320

00:21:41,260 --> 00:21:55,340

>> A LITTLE TIGHTER THE LAST
TIME OR NOT.

321

00:21:55,340 --> 00:22:05,820

>> I DO NOT.

SO FOR BOTH, SANDY AND FARUQ,

322

00:22:05,820 --> 00:22:08,050

YOU ARE NOW LIVE TO THE
SMITHSONIAN.

323

00:22:08,050 --> 00:22:14,790

THEY ARE OBSERVING YOU AND
LISTENING IN AND PROBABLY IN A

324

00:22:14,790 --> 00:22:30,970

FEW MINUTES WE WILL BEGIN THE
INTERVIEW.

325

00:22:30,970 --> 00:22:33,200

SO KEEP WORKING UNTIL THEN.
>> COPY.

326

00:22:33,200 --> 00:22:35,440

>> SO, YOU KNOW, FIRST†--

327

00:22:35,440 --> 00:22:46,230

>> THREE TWISTS ON THE FORWARD
EXPANSION OF THE HANDRAIL.

328

00:22:46,230 --> 00:22:59,930

>> SHORTLY WE WILL ASK THEM
QUESTIONS.

329

00:22:59,930 --> 00:23:11,350

OKAY.
>> AND, SANDY, I'M HEARING ONE

330

00:23:11,350 --> 00:23:17,750

MINUTE UNTIL YOU START YOUR Q
AND A, SO WE'LL HAVE YOU HOLD

331

00:23:17,750 --> 00:23:23,250
OFF ON PULLING THE CABLE OUT OF
THE BAG.

332
00:23:23,250 --> 00:23:24,700
>> OKAY.
PULL DOWN?

333
00:23:24,700 --> 00:23:27,870
>> YEAH, PUT YOUR LOCAL DOWN.
FOR THE CAMERA, IF WE CAN JUST

334
00:23:27,870 --> 00:23:28,870
GET A NICE VIEW OF SANDY'S FACE
AND TORSO.

335
00:23:28,870 --> 00:23:40,720
AND, FARUQ, WE WILL LET YOU
FINISH WIRE TYING YOUR CABLE.

336
00:23:40,720 --> 00:23:51,890
>> MIGHT HAVE TO HOLD ME
STATIONARY.

337
00:23:51,890 --> 00:23:55,640
>> GENTLEMEN, CAN YOU HEAR ME?
OR NBL, CAN YOU HEAR ME?

338
00:23:55,640 --> 00:23:59,190
>> WE CAN HEAR YOU LOUD AND
CLEAR.

339
00:23:59,190 --> 00:24:02,750
>> IT'S NOT ONLY GENTLEMEN.
I APOLOGIZE HERE.

340
00:24:02,750 --> 00:24:06,790
CAN YOU TELL ME YOUR NAMES AND
WHO YOU ARE AND WHAT YOU'RE

341

00:24:06,790 --> 00:24:27,300
DOING TODAY?
>> MY NAME IS SANDY MOORE, AND I

342
00:24:27,300 --> 00:24:28,300
AM WORKING ON TWO CABLES WITH
POWER, WE WILL PROVIDE POWER.

343
00:24:28,300 --> 00:24:29,300
IT WILL COME UP LATER AT THE END
OF THIS YEAR.

344
00:24:29,300 --> 00:24:30,480
>> SO ARE YOU PIONEERING THE
TECHNIQUE THAT THE ASTRONAUTS

345
00:24:30,480 --> 00:24:32,430
WILL HAVE TO USE?
>> THAT'S CORRECT.

346
00:24:32,430 --> 00:24:35,950
I'M IN CHARGE OF THE
CHOREOGRAPHY FOR THIS TVA AND

347
00:24:35,950 --> 00:24:42,430
I'M ACTUALLY PRACTICING IT TODAY
AND SEEING HOW IT ALL WORKS FOR

348
00:24:42,430 --> 00:24:46,430
MY UPCOMING CREW'S DEVELOPMENT
RUN.

349
00:24:46,430 --> 00:24:49,549
>> SO TELL ME†-- HELLO.
MY NAME IS†--

350
00:24:49,549 --> 00:24:53,550
>> YES.
>> YES, MY NAME IS FURYK SABUR.

351

00:24:53,550 --> 00:24:58,280

I AM THE EV-2 POSITION IN THE
WATER TODAY.

352

00:24:58,280 --> 00:25:02,850

AND I AM HELPING WITH SANDY,
WITH WORKING OUT THE

353

00:25:02,850 --> 00:25:05,070

CHOREOGRAPHY ON THE EV-2 SIDE OF
THE CABLE.

354

00:25:05,070 --> 00:25:09,520

SO THERE ARE A NUMBER OF CABLES
THAT WE HAVE TO LAYOUT RIGHT

355

00:25:09,520 --> 00:25:15,400

NOW.

>> SO YOU'RE†-- IT'S BEING

356

00:25:15,400 --> 00:25:18,670

REFITTED FOR A NEW SPACECRAFT?

>> I'M SORRY.

357

00:25:18,670 --> 00:25:22,890

I DIDN'T HEAR YOU.

>> THE DOCKING ADAPTER THAT

358

00:25:22,890 --> 00:25:26,250

YOU'RE WORKING ON IS GOING TO BE
REFITTED FOR A NEW SPACE STATION

359

00:25:26,250 --> 00:25:29,870

TO DOCK TO THE SPACE STATION?

>> YES, IT IS.

360

00:25:29,870 --> 00:25:36,470

SO THESE CABLES ARE MORE FOR THE
SECOND DOCKING THE DOCKET ON A

361

00:25:36,470 --> 00:25:43,940
PREVIOUS EVA, 29 AND 30, THEY'RE
SETTING UP THE CABLES FOR THE

362

00:25:43,940 --> 00:25:47,880
FIRST DOCKING ADAPTER.

>> SO COULD YOU TWO TELL THE

363

00:25:47,880 --> 00:25:52,060
AUDIENCE HERE AND ONLINE, IN THE
AUDIENCE HERE AT THE MUSEUM UP,

364

00:25:52,060 --> 00:25:57,390
WHO YOU ARE, ENGINEERS WORKING
AT JOHNSON SPACE CENTER?

365

00:25:57,390 --> 00:26:11,390
>> THAT'S CORRECT.
ENGINEERS, ASTRONAUT INSPECTORS

366

00:26:11,390 --> 00:26:20,076
AND FLIGHT CONTROLLERS.
SO WE HELP TEACH EVAs, WE HELP

367

00:26:20,076 --> 00:26:21,076
CERTIFY CREW MEMBERS FOR
SPACEWALK, THEN WE HELP EXECUTE

368

00:26:21,076 --> 00:26:22,076
MISSION CONTROL WHILE THEY ARE
ON ORBIT AND HELP REALTIME

369

00:26:22,076 --> 00:26:23,076
PROBLEM SOLVE WHEN THEY RUN INTO
ISSUES.

370

00:26:23,076 --> 00:26:24,076
>> MUST HAVE HAD A LOT OF
TRAINING BECAUSE CLEARLY YOU

371

00:26:24,076 --> 00:26:25,801
HAVE LEARNED HOW TO USE THE
SPACE SUIT, WORK IN A SPACE SUIT

372
00:26:25,801 --> 00:26:28,600
JUST LIKE AN ASTRONAUT.
MAYBE YOU COULD TELL US ABOUT

373
00:26:28,600 --> 00:26:31,790
WHAT IT TAKES TO ACTUALLY†-- TO
DO WHAT YOU'RE DOING NOW.

374
00:26:31,790 --> 00:26:37,960
>> THAT'S ONE OF THE QUESTIONS I
GET THE MOST, IS HOW CAN YOU

375
00:26:37,960 --> 00:26:41,590
TRAIN ASTRONAUTS IF YOU'RE NOT
AN ASTRONAUT.

376
00:26:41,590 --> 00:26:47,160
SO MOST OF THE TRAINING THAT WE
GIVE IS RIGHT HERE AT JOHNSON

377
00:26:47,160 --> 00:26:52,010
SPACE CENTER WHERE WE TRAIN, WE
DO MANY OF THE SAME THINGS THAT

378
00:26:52,010 --> 00:26:55,350
THE ASTRONAUTS DO, INCLUDING
GETTING INTO SUIT AND RUNNING

379
00:26:55,350 --> 00:26:59,860
THESE†-- THESE CHOREOGRAPHY RUNS
IN THE WATER.

380
00:26:59,860 --> 00:27:02,910
WE ALSO TALK TO A LOT OF OTHER
ASTRONAUTS ABOUT THEIR

381

00:27:02,910 --> 00:27:06,730
EXPERIENCES IN SPACE AND HOW
THEY DIFFER FROM BEING IN THE

382

00:27:06,730 --> 00:27:09,350
WATER.

AND THEN SO A LOT OF THESE

383

00:27:09,350 --> 00:27:17,570
TRAININGS THAT WE GET RIGHT HERE
AT JOHNSON STATION AND THEN WE

384

00:27:17,570 --> 00:27:20,820
USE THE ENGINEERING TRAINING
THAT WE GET FROM SCHOOLING TO

385

00:27:20,820 --> 00:27:27,520
HELP US BE ABLE TO PLAN AND
DEVELOP CHOREOGRAPHIES THAT WILL

386

00:27:27,520 --> 00:27:29,730
WORK BEST FOR THE ASTRONAUTS IN
SPACE.

387

00:27:29,730 --> 00:27:31,980
>> THANK YOU.
WE'D LIKE TO GO TO THE AUDIENCE.

388

00:27:31,980 --> 00:27:35,710
IF ANYBODY IN THE AUDIENCE HERE
WOULD LIKE TO ASK A QUESTION

389

00:27:35,710 --> 00:27:39,500
DIRECTLY TO THE ENGINEERS IN THE
POOL IN HOUSTON, WE'RE HAPPY IF

390

00:27:39,500 --> 00:27:43,800
YOU COULD JUST GO UP AND GO TO
THE MIKE HERE AND COME AROUND

391

00:27:43,800 --> 00:27:49,410
AND GO TO THE MICROPHONE AND
MAYBE YOU CAN TALK DIRECTLY TO

392
00:27:49,410 --> 00:27:54,680
HOUSTON.
A LITTLE PATIENCE HERE, WE HAVE

393
00:27:54,680 --> 00:27:57,930
A YOUNG MAN HERE.
WE HAVE A NUMBER OF SCHOOL

394
00:27:57,930 --> 00:28:02,950
CLASSES HERE.
AND HE WOULD LIKE TO ASK YOU A

395
00:28:02,950 --> 00:28:07,520
QUESTION.
>> MY NAME IS MALACHI.

396
00:28:07,520 --> 00:28:13,010
I'M FROM FRIENDSHIP PUBLIC
CHARTER SCHOOL.

397
00:28:13,010 --> 00:28:23,370
MY QUESTION IS, HOW DO I†-- WHAT
DO Y'ALL GO TO FIX THE LITTLE,

398
00:28:23,370 --> 00:28:28,650
QUIET LITTLE THINGS, LIKE LITTLE
CABLES.

399
00:28:28,650 --> 00:28:31,740
>> I THINK HE'S ASKING HOW DO
YOU FIX THE SPECIFIC CABLE THAT

400
00:28:31,740 --> 00:28:37,480
YOU'RE WORKING ON.
>> HOW DO WE ATTACH THEM?

401

00:28:37,480 --> 00:28:40,800

>> YEAH.

YOU KNOW, DESCRIBE A LITTLE BIT

402

00:28:40,800 --> 00:28:42,920

HOW THAT WORKS AND HOW YOU ARE DOING IT.

403

00:28:42,920 --> 00:28:50,350

>> THESE ARE THE LONGEST AND THEY'RE NOT IN THE POOL BUT IN

404

00:28:50,350 --> 00:28:55,300

THE ORBIT, THE THICKEST CABLES WE'VE EVER INSTALLED.

405

00:28:55,300 --> 00:29:00,690

WE ACTUALLY START AT A CENTER POINT.

406

00:29:00,690 --> 00:29:18,150

WE ATTACH THE WIRE TIE. THEN WE ROUTE PART OF THE CABLE

407

00:29:18,150 --> 00:29:22,670

AFT IN SPACE AND THEN WE WILL ROUTE THE REST FORWARD.

408

00:29:22,670 --> 00:29:23,670

WE KIND OF START IT IN THE MIDDLE SO IT MAKES IT A LITTLE

409

00:29:23,670 --> 00:29:24,670

EASIER THAN HANDLING THE WHOLE CABLE ALL AT ONCE.

410

00:29:24,670 --> 00:29:25,670

WE ATTACH THEM USING A RUSSIAN WIRE TIE.

411

00:29:25,670 --> 00:29:26,670
AND IT'S JUST A PIECE OF COPPER
AND IT ALLOWS US TO TWIST IT AND

412
00:29:26,670 --> 00:29:27,670
BEND IT MUCH LIKE A TWIST TIE.
>> WE'RE TOLD WE HAVE A VIEWER

413
00:29:27,670 --> 00:29:47,810
QUESTION FROM ONLINE OR FROM TV.
>> DOES IT FEEL LIKE YOU'RE IN

414
00:29:47,810 --> 00:29:51,030
SPACE WHEN YOU'RE UNDERWATER OR
IS IT MUCH DIFFERENT, IS THE

415
00:29:51,030 --> 00:29:56,480
QUESTION SENT BY BETTY.
>> SO THERE ARE SIMILARITIES AND

416
00:29:56,480 --> 00:29:59,960
THERE ARE DIFFERENCES.
SO IN THE WATER, THE SUIT IS THE

417
00:29:59,960 --> 00:30:01,150
ONLY THING THAT IS NEUTRAL
BUOYANT.

418
00:30:01,150 --> 00:30:04,850
SO YOUR BODY, YOUR BLOOD PUMPING
AND ALL OF THAT STUFF STILL HAS

419
00:30:04,850 --> 00:30:09,620
VALUE.
AND THE TOOLS AS YOU CAN SEE,

420
00:30:09,620 --> 00:30:11,000
THEY STILL FALL WITH GRAVITY AS
WELL.

421

00:30:11,000 --> 00:30:13,960
SO THE GRAPH GRAVITY OF THE
TOOLS AND WHEN YOU TURN

422
00:30:13,960 --> 00:30:17,710
UPSIDE-DOWN AND YOU FEEL THE
BLOOD RUSHING TO YOUR HEAD THAT

423
00:30:17,710 --> 00:30:21,170
ISN'T ANY DIFFERENT.
BUT THE SENSATION OF BEING ABLE

424
00:30:21,170 --> 00:30:25,000
TO ORIENT YOUR BODY IS OFTEN
SIMILAR.

425
00:30:25,000 --> 00:30:29,550
WE HEAR HOW SIMILAR TRAINING IN
THE POOL IS.

426
00:30:29,550 --> 00:30:32,820
ONE OF THE BIGGEST DIFFERENCES
IS THE DRAG OF WATER.

427
00:30:32,820 --> 00:30:37,480
SO IN SPACE, IT IS REAL EASY TO
GET STARTED MOVING AND REALLY

428
00:30:37,480 --> 00:30:42,740
HARD TO STOP BECAUSE YOU HAVE A
LOT OF MOMENTUM FROM THE MASS OF

429
00:30:42,740 --> 00:30:46,710
THE SUIT.
AND THEN IN THE WATER, IT'S

430
00:30:46,710 --> 00:30:49,890
REALLY HARD TO GET STARTED AS
YOU'RE DISPLACING THE SAME

431

00:30:49,890 --> 00:30:54,810
AMOUNT OF WATER AS THE MASS OF
THE SUIT AND IT'S REAL EASY TO

432
00:30:54,810 --> 00:30:55,910
STOP.
>> OKAY.

433
00:30:55,910 --> 00:30:57,560
NEXT WE HAVE A QUESTION FROM
ANOTHER YOUNG MAN.

434
00:30:57,560 --> 00:30:58,560
HE FORGOT HIS QUESTION.
YOUNG LADY.

435
00:30:58,560 --> 00:31:03,950
WHAT WOULD YOU LIKE TO ASK?
>> MY NAME IS RACHEL AND I'M

436
00:31:03,950 --> 00:31:10,090
FROM FRIENDSHIP PUBLIC SCHOOL
AND MY QUESTION IS, HOW LONG DO

437
00:31:10,090 --> 00:31:18,750
YOU TRAIN BEFORE YOU ACTUALLY GO
UP INTO SPACE?

438
00:31:18,750 --> 00:31:20,510
>> HOW LONG DO YOU TRAIN BEFORE
BEFORE YOU ACTUALLY GO UP INTO

439
00:31:20,510 --> 00:31:28,120
SPACE?
>> REPEAT THE QUESTION, PLEASE?

440
00:31:28,120 --> 00:31:30,530
>> TO GO INTO SPACE, OR THE
ASTRONAUTS, HOW LONG WOULD THEY

441

00:31:30,530 --> 00:31:34,260
HAVE TO WORK TO GO INTO SPACE OR
EXECUTE A PARTICULAR EVA?

442

00:31:34,260 --> 00:31:35,260
>> THEY COME AND DO SEVERAL RUNS
TO BE CERTIFIED AS AN ASTRONAUT.

443

00:31:35,260 --> 00:31:36,260
ONCE THEY'RE CERTIFIED, THEY CAN
BE ASSIGNED AND THEY DO TEN FULL

444

00:31:36,260 --> 00:31:37,260
RUNS.
AND AT THAT POINT THEY HAVE A

445

00:31:37,260 --> 00:31:39,780
SKILL SET THAT THEY TAKE WITH
THEM AND THEY CAN DO ANY EVA.

446

00:31:39,780 --> 00:31:44,450
EVAs IN PARTICULAR ARE DESIGNED
AND TRAINED ABOUT FOUR TIMES IN

447

00:31:44,450 --> 00:31:50,820
THE WATER AND THEN WE SEND IT UP
THE CREW AND THEY EXECUTE IT ON

448

00:31:50,820 --> 00:31:54,210
ORBIT.
THEY MAY ONLY DO THE ACTUAL EVA

449

00:31:54,210 --> 00:31:58,030
IN THE POOL ONCE, MAYBE TWICE.
IF THEY'RE LUCKY.

450

00:31:58,030 --> 00:32:15,740
WE TRAIN QUITE A BIT DIFFERENTLY
THAN WITH SHUTTLE DAYS.

451

00:32:15,740 --> 00:32:19,280

>> OKAY.

THANK YOU.

452

00:32:19,280 --> 00:32:22,940

NOW THE NEXT IS AN ONLINE
QUESTION THAT WE'VE BEEN SENT.

453

00:32:22,940 --> 00:32:28,230

AND DO ASTRONAUTS WEAR THE SAME
EME SUIT IN THE NBL AS THEY DO

454

00:32:28,230 --> 00:32:33,680

IN SPACE?

>> FOR THE MOST PART THERE ARE

455

00:32:33,680 --> 00:32:36,710

AWFUL LOT OF SIMILARITIES.
SO ONE OF THE THINGS THAT

456

00:32:36,710 --> 00:32:39,050

DOESN'T WORK SO WELL IN THE
WATER IS ELECTRONICS.

457

00:32:39,050 --> 00:32:43,390

SO THEY TOOK ALL OF THE
ELECTRONICS OUT OF THE EMU THAT

458

00:32:43,390 --> 00:32:48,420

WE CURRENTLY HAVE ON AS OPPOSED
TO THE ONE IN SPACE.

459

00:32:48,420 --> 00:32:52,090

SO WITH THAT, THE ENTIRE
BACKPACK FOR IN THE WATER IS

460

00:32:52,090 --> 00:32:59,250

JUST A VOLUME METRIC SIMULATION.
WE GET OUR WATER AND OXYGEN FROM

461

00:32:59,250 --> 00:33:04,540
AN UMBILICAL CABLE AS OPPOSED TO
THE BACKPACK THAT WOULD HAVE ALL

462
00:33:04,540 --> 00:33:07,899
THE ELECTRONICS AS THE EMU IN
SPACE.

463
00:33:07,899 --> 00:33:09,020
>> OKAY.
THANK YOU.

464
00:33:09,020 --> 00:33:53,730
NEXT WE HAVE AN AUDIENCE
QUESTION.

465
00:33:53,730 --> 00:33:58,700
>> HOW DO THE SPACE ASTRONAUTS
BREATHE UNDERWATER?

466
00:33:58,700 --> 00:34:04,320
>> HOW DO YOU BREATHE IN THE
SPACE SUITS UNDERWATER?

467
00:34:04,320 --> 00:34:12,780
>> THEY ARE PRESSURIZED SUITS
AND THERE IS OXYGEN THAT IS FED

468
00:34:12,780 --> 00:34:21,359
INTO OUR PRESSURIZED SUIT.
BASICALLY WE'RE A BIG BALLOON

469
00:34:21,359 --> 00:34:37,870
RIGHT NOW AND WE BREATHE THAT
OXYGEN AND THEN WE RELEASE OUR

470
00:34:37,870 --> 00:34:43,660
CO2 AND THEY ARE FLUSHING NEW
OXYGEN IN AND THAT'S HOW WE

471

00:34:43,660 --> 00:34:48,429

BREATHE IN THE SUIT.

>> YOUNG MAN.

472

00:34:48,429 --> 00:34:57,960

>> HOW DO YOU†-- HOW DO YOU MOVE
AROUND WITH A HEAVY SUIT?

473

00:34:57,960 --> 00:34:59,721

>> HOW DO YOU MOVE AROUND WITH
SUCH A HEAVY SUIT?

474

00:34:59,721 --> 00:35:00,721

>> HOW DO YOU MOVE AROUND IN A
PRESSURIZED SUIT?

475

00:35:00,721 --> 00:35:01,721

>> GOOD QUESTION.
>> YES.

476

00:35:01,721 --> 00:35:02,721

>> SO LARGELY IT'S SIMILAR TO
HOW YOU WOULD MOVE AROUND

477

00:35:02,721 --> 00:35:03,721

ANYWHERE EXCEPT FOR THE SUIT IS
A LITTLE STIFF AROUND YOU

478

00:35:03,721 --> 00:35:10,020

BECAUSE IT KIND OF EXPANDS LIKE
A LITTLE BIT OF BALLOON BUT IT

479

00:35:10,020 --> 00:35:11,020

IS CONSTRAINED BY ALL OF THE
RINGS INSIDE OF IT.

480

00:35:11,020 --> 00:35:12,020

SO YOU CAN MOVE RIGHT HERE WHERE
YOU CAN MOVE YOUR ENTIRE WRIST

481

00:35:12,020 --> 00:35:13,020
AROUND AND THEN THE SHOULDER
JOINTS ARE NOT LIKE OUR SHOULDER

482
00:35:13,020 --> 00:35:14,020
JOINTS.
OUTSIDE OF THE SUIT, YOU HAVE TO

483
00:35:14,020 --> 00:35:15,020
ROLL THEM AND THEN SO ONCE YOU
GET USED TO THIS SORT OF ACTION,

484
00:35:15,020 --> 00:35:16,020
YOU CAN USE THIS TO TRANSLATE
ACROSS THE STATION OR DO ANY

485
00:35:16,020 --> 00:35:17,020
ACTIONS WITHIN THIS WORK
ENVELOPE RIGHT HERE.

486
00:35:17,020 --> 00:35:18,020
THEN YOU HAVE TO USE YOUR ARMS
TO REACT AGAINST DIFFERENT

487
00:35:18,020 --> 00:35:19,020
FORCES IN ORDER TO MOVE AROUND.
>> QUESTION FROM A YOUNG MAN.

488
00:35:19,020 --> 00:35:20,020
>> HOW DO YOU TALK?
>> HOW ARE YOU ABLE TO TALK

489
00:35:20,020 --> 00:35:21,020
UNDERWATER, IS THE QUESTION.
>> ONE MORE TIME?

490
00:35:21,020 --> 00:35:22,020
>> THE QUESTION WAS, HOW YOU
WERE ABLE TO TALK TO US FROM

491

00:35:22,020 --> 00:35:23,020

UNDERWATER.

>> GOOD QUESTION.

492

00:35:23,020 --> 00:35:30,030

WE ACTUALLY WEAR A COM CAP AND
WITHIN THE COMMUNICATIONS CAP

493

00:35:30,030 --> 00:35:47,540

THE ABILITY FOR US TO
COMMUNICATE USING COMMUNICATION

494

00:35:47,540 --> 00:35:55,081

ELECTRONICS UP TO THE TEST
CONNECTOR ROOM AND THE TEST

495

00:35:55,081 --> 00:35:56,081

DIRECTOR ROOM AND THEY CAN TALK
BACK TO US VIA WITHIN OUR COM

496

00:35:56,081 --> 00:35:57,081

CAP.
SOMETIMES IT'S REFERRED TO AS A

497

00:35:57,081 --> 00:35:58,081

STUPID CAP.
IT'S LIKE THE ONES YOU WOULD

498

00:35:58,081 --> 00:35:59,081

WEAR ON THE COMMERCIALS WHEN
YOU'RE FLYING THE AIRPLANES.

499

00:35:59,081 --> 00:36:00,081

THEY'RE BASED OFF THE APOLLO
DAYS AND THE DESIGN HAS NOT

500

00:36:00,081 --> 00:36:01,081

CHANGED VERY MUCH.
>> YEAH.

501

00:36:01,081 --> 00:36:02,081
SO THEY HAVE A LITTLE CAP WITH A
MICROPHONE AND HEADPHONES INSIDE

502
00:36:02,081 --> 00:36:03,980
OF IT AND A WIRE TO THE OUTSIDE.
SO WE HAVE ANOTHER QUESTION.

503
00:36:03,980 --> 00:36:15,280
>> PUBLIC CHARTER SCHOOLS.
AND MY QUESTION IS, HOW MUCH

504
00:36:15,280 --> 00:36:17,990
DOES THE SUIT WEIGH?
>> HOW MUCH DOES THE SUIT WEIGH?

505
00:36:17,990 --> 00:36:26,600
>> SO FROM MY UNDERSTANDING WHEN
THE SUIT IS ON THE DRY, IT'S

506
00:36:26,600 --> 00:36:30,730
ABOUT 300 POUNDS.
SO IT WOULD BE REALLY DIFFICULT

507
00:36:30,730 --> 00:36:34,910
TO WALK IN THIS SUIT.
BUT WHEN YOU'RE IN SPACE, 300

508
00:36:34,910 --> 00:36:38,880
POUNDS HAS NO WEIGHT.
IT JUST HAS THE MASS OF 300

509
00:36:38,880 --> 00:36:42,830
POUNDS.
SO IT'S REAL EASY TO MOVE IN

510
00:36:42,830 --> 00:36:43,830
SPACE.
>> OKAY.

511

00:36:43,830 --> 00:36:46,050
THANK YOU.
AND I'M TOLD THAT WE HAVE ONE

512
00:36:46,050 --> 00:36:53,790
MORE ONLINE QUESTION.
CAN YOU DRINK WATER IN THE SUIT

513
00:36:53,790 --> 00:36:59,430
IN SPACE AND UNDERWATER, SAYS
JOE?

514
00:36:59,430 --> 00:37:07,820
>> YOU CAN.
ACTUALLY WE HAVE A DRINK BAG

515
00:37:07,820 --> 00:37:15,880
WITH ABOUT 32 OUNCES OF WATER.
THIS BLUE THING HERE BY MY MOUTH

516
00:37:15,880 --> 00:37:17,590
IS HOW WE DRINK.
IT OPENS AND CLOSES WITH BY

517
00:37:17,590 --> 00:37:18,590
BITING IT.
>> SO DO WE HAVE ONE MORE

518
00:37:18,590 --> 00:37:20,880
QUESTION FROM THE AUDIENCE?
>> HI.

519
00:37:20,880 --> 00:37:29,119
MY NAME IS McCAIN.
I'M FROM A CHARTER SCHOOL.

520
00:37:29,119 --> 00:37:32,361
MY QUESTION IS, WHO BUILT THE
SUIT?

521

00:37:32,361 --> 00:37:42,020
>> WHO BUILT THE SPACE SUITS?
>> WHO BUILT THE SPACE SUIT?

522
00:37:42,020 --> 00:37:48,400
>> YES.
>> I THINK IT WAS HAMILTON, IS

523
00:37:48,400 --> 00:37:51,049
THAT CORRECT?
>> NO.

524
00:37:51,049 --> 00:37:53,720
>> AND THEN SO THERE ARE SEVERAL
DIFFERENT SPACE SUITS RIGHT NOW

525
00:37:53,720 --> 00:37:57,130
THAT ARE IN THE PROCESS OF BEING
DESIGNED BUT THE ONE THAT WE

526
00:37:57,130 --> 00:38:04,410
HAVE NOW, IT'S BEEN AROUND FOR
LIKE ALMOST AROUND 30 YEARS.

527
00:38:04,410 --> 00:38:07,530
>> OKAY.
WELL, THANK YOU VERY MUCH.

528
00:38:07,530 --> 00:38:10,990
THANK YOU FOR COMING ONLINE WITH
US AND TALKING TO US.

529
00:38:10,990 --> 00:38:12,990
WE DON'T WANT TO HOLD YOU UP ANY
LONGER.

530
00:38:12,990 --> 00:38:15,810
WE'RE GOING TO WATCH YOU FOR A
LITTLE WHILE LONGER.

531

00:38:15,810 --> 00:38:17,971
WHILE YOU WORK UNDERWATER,
THANK YOU.

532
00:38:17,971 --> 00:39:00,800
YOU CAN SORT OF SEE THEY'RE
WORKING OF SIDE.

533
00:39:00,800 --> 00:39:08,369
WITH THE INTERNATIONAL SPACE
STATION IT'S BEING USELY BEING

534
00:39:08,369 --> 00:39:13,110
REMODELLED IN ORDER TO KEEP IT
IN OPERATION.

535
00:39:13,110 --> 00:39:15,780
IT REQUIRES CONTINUOUS
MAINTENANCE.

536
00:39:15,780 --> 00:39:19,970
SO WE HAVE THE PEOPLE IN
HOUSTON, DOWN HERE.

537
00:39:19,970 --> 00:39:24,640
THESE GUYS ARE ENGINEERS BUT
THEY TRAIN THE ASTRONAUTS, SO

538
00:39:24,640 --> 00:39:30,030
THEY FIRST FIGURE OUT HOW TO DO
IT AND THEN THE ASTRONAUT CREWS

539
00:39:30,030 --> 00:39:36,200
COME IN AND THEY†-- THEY DO THE
SAME THING, AT LEAST TRY TO

540
00:39:36,200 --> 00:39:41,270
UNDERSTAND IT.
ONE OF THE DIFFERENCES IS THAT

541

00:39:41,270 --> 00:39:44,470
ON THE SPACE SHUTTLE THEY WOULD
TRAIN VERY SPECIFICALLY.

542
00:39:44,470 --> 00:39:48,240
LIKE THE HUBBLE SPACE TELESCOPE
FOR A SPECIFIC MISSION AND THEY

543
00:39:48,240 --> 00:39:52,360
TRAIN OVER AND OVER AND OVER
AGAIN TO DO THAT MISSION UNTIL

544
00:39:52,360 --> 00:39:55,790
THEY HAD IT PERFECT.
BUT ON THE SPACE STATION, THEIR

545
00:39:55,790 --> 00:39:58,690
GUYS ARE UP THERE FOR SIX MONTHS
OR WOMEN ARE UP THERE FOR SIX

546
00:39:58,690 --> 00:40:01,830
MONTHS AT A TIME AND THEY HAVE
TO BE FLEXIBLE.

547
00:40:01,830 --> 00:40:05,310
SO THEY HAVE TO BE ABLE TO GO
OUTSIDE AND DO SOMETHING,

548
00:40:05,310 --> 00:40:09,460
SOMETIMES THEY'VE ACTUALLY GONE
OUTSIDE AND FIXED THINGS ON THE

549
00:40:09,460 --> 00:40:15,060
SPACE STATION AND SO THEY
WEREN'T ABLE TO GET THE ABSOLUTE

550
00:40:15,060 --> 00:40:20,141
CHOREOGRAPHED PERFECT SPACEWALK
BEFOREHAND, THEY HAD TO GET

551

00:40:20,141 --> 00:40:23,310
GENERAL TRAINING FROM THESE
PEOPLE WHO ARE IN THE POOL TODAY

552
00:40:23,310 --> 00:40:26,369
AND FROM OTHERS LIKE THEM.
THEN THEY HAD TO WORK A BIT ON

553
00:40:26,369 --> 00:40:30,590
THE POOL ON VARIOUS PROCEDURES.
SO IN AN EMERGENCY THEY COULD GO

554
00:40:30,590 --> 00:40:34,520
OUTSIDE TO FIX SOMETHING AND
THEY WOULD BE READY†-- OR

555
00:40:34,520 --> 00:40:37,600
SOMETIMES JUST FOR ROUTINE
ACTIVITIES THAT THEY NEED TO GO

556
00:40:37,600 --> 00:40:40,080
OUTSIDE.
SO THE SPACE STATION NEEDS

557
00:40:40,080 --> 00:40:46,670
CONSTANT UPKEEP AND MAINTENANCE
DURING ITS STAYING IN ORBIT.

558
00:40:46,670 --> 00:40:51,090
AND, YOU KNOW, ALTHOUGH WE DON'T
HAVE A SPACECRAFT THAT CAN WATCH

559
00:40:51,090 --> 00:40:54,560
ASTRONAUTS AT THE SPACE STATION,
I SHOULD UNDERLINE THE FACT THAT

560
00:40:54,560 --> 00:40:58,920
AMERICANS ARE IN SPACE NOW, ON
THE SPACE STATION.

561

00:40:58,920 --> 00:41:00,480
NEW CREWS ARE ALWAYS BEING
LAUNCHED.

562
00:41:00,480 --> 00:41:03,790
RIGHT NOW WE'RE ONLY USING A
RUSSIAN SPACECRAFT TO GET THERE.

563
00:41:03,790 --> 00:41:08,010
BUT BY 2017 WE'RE AGAIN SUPPOSED
TO HAVE THIS TIME COMMERCIALY

564
00:41:08,010 --> 00:41:12,100
OPERATED SPACECRAFT TO TAKE
CREWS UP TO THE SPACE STATION.

565
00:41:12,100 --> 00:41:15,609
SO THAT THEY WILL BE KEEPING THE
SPACE STATION GOING AT LEAST

566
00:41:15,609 --> 00:41:20,070
UNTIL THE 2020s, AND RIGHT
BEHIND ME HERE IS A MODEL OF THE

567
00:41:20,070 --> 00:41:23,680
FULL INTERNATIONAL SPACE STATION
WHICH IS A HUGE THING.

568
00:41:23,680 --> 00:41:28,390
IT WAS THE SIZE OF MANY FOOTBALL
FIELDS.

569
00:41:28,390 --> 00:41:31,460
AT SOME POINT HERE WE'RE GOING
TO OPEN IT UP AGAIN FOR Q AND A

570
00:41:31,460 --> 00:41:36,850
FOR ME PERSONALLY SINCE WE HAD
TO LET THOSE GUYS GO BACK†--

571

00:41:36,850 --> 00:41:41,190
LADY AND MAN TO GO BACK TO THEIR
JOBS WORKING IN THE POOL.

572
00:41:41,190 --> 00:41:45,760
BUT WHENEVER WE'RE READY, WE CAN
HAVE A Q AND A SESSION.

573
00:41:45,760 --> 00:41:47,920
YES, GO AHEAD.
>> I HAD A QUESTION.

574
00:41:47,920 --> 00:41:56,329
WHEN DID†-- WHERE DO THEY GO TO
THE BATHROOM AT?

575
00:41:56,329 --> 00:41:58,040
>> HOW DO THEY GO TO THE
BATHROOM?

576
00:41:58,040 --> 00:42:03,369
>> IN THE SUIT OR†-- THESE DAYS
THEY WEAR DIAPERS, BASICALLY, IS

577
00:42:03,369 --> 00:42:05,490
THE ANSWER.
YEAH.

578
00:42:05,490 --> 00:42:09,250
BUT IN THE SPACE STATION THEY
HAVE REAL TOILETS.

579
00:42:09,250 --> 00:42:13,420
IN THE SPACE STATION THEY
ACTUALLY HAVE A ZERO G TOILET.

580
00:42:13,420 --> 00:42:16,160
I THINK ONE IN THE RUSSIAN PART,
ONE IN THE AMERICAN PART OF THE

581

00:42:16,160 --> 00:42:18,470
SPACE STATION.
BUT, YOU KNOW, WHEN YOU'RE

582
00:42:18,470 --> 00:42:21,720
INSIDE A SPACE SUIT FOR EIGHT
HOURS YOU OBVIOUSLY HAVE TO HAVE

583
00:42:21,720 --> 00:42:25,590
SOME BACKUP PLAN.
AND THAT'S THE KIND OF TIME

584
00:42:25,590 --> 00:42:30,270
WE'RE TALKING ABOUT WHEN YOU'RE
INSIDE THAT SUIT FOR LONG

585
00:42:30,270 --> 00:42:32,540
PERIODS.
SIX, SEVEN, EIGHT HOURS.

586
00:42:32,540 --> 00:42:36,461
THEY HAVE THE DRINK BAG THAT
THEY AT LEAST HAVE CANNOT BE

587
00:42:36,461 --> 00:42:42,420
THIRSTY AND HAVE TO HAVE SOME
WAY TO GO TO THE BATHROOM.

588
00:42:42,420 --> 00:42:46,060
ANOTHER QUESTION?
>> HI, MY NAME IS KENYA FROM

589
00:42:46,060 --> 00:42:50,480
FRIENDSHIP PUBLIC CHARTER
SCHOOL.

590
00:42:50,480 --> 00:42:58,220
AND MY QUESTION IS, HOW DO
YOU†--

591

00:42:58,220 --> 00:43:03,100
>> ESSENTIALLY WHAT THEY'RE
DOING IS FIGURING OUT HOW TO TIE

592
00:43:03,100 --> 00:43:04,820
THESE CABLES TO THE SPACE
STATION.

593
00:43:04,820 --> 00:43:08,430
SO WHAT DO YOU NEED TO DO, HOW
DO YOU NEED TO MOVE THEM, HOW DO

594
00:43:08,430 --> 00:43:12,070
YOU DIVIDE UP THE TASK TO DO
THAT SO THAT THEY HAVE, YOU

595
00:43:12,070 --> 00:43:15,290
KNOW, TIES AN THINGS THAT ENABLE
THEM TO PIN IT DOWN TO THE

596
00:43:15,290 --> 00:43:17,230
SPACECRAFT.
THAT'S WHAT THEY'RE DOING,

597
00:43:17,230 --> 00:43:19,090
THEY'RE LEARNING HOW TO DO THAT.
THEN THEY CAN TELL THE

598
00:43:19,090 --> 00:43:23,040
ASTRONAUTS HOW TO DO IT AND THE
ASTRONAUTS CAN DO IT IN SPACE.

599
00:43:23,040 --> 00:43:25,170
YES.
NEXT QUESTION?

600
00:43:25,170 --> 00:43:38,700
>> MY QUESTION IS, HOW DO THEY
MAKE SPACE SHIPS, WHAT TOOLS DO

601

00:43:38,700 --> 00:43:47,690
THEY USE WHEN THEY MAKE SPACE
SHIPS?

602
00:43:47,690 --> 00:43:51,000
>> WHAT TOOLS DID THEY USE WHEN
THEY WORKED ON THE SPACE

603
00:43:51,000 --> 00:43:52,660
STATION.
>> WHAT TOOLS?

604
00:43:52,660 --> 00:43:57,850
THEY HAVE A WHOLE LOT OF SPECIAL
TOOLS THEY HAVE TO BUILD FOR

605
00:43:57,850 --> 00:44:00,630
SPACE.
THEY'RE BOTH LIGHT WEIGHT AND

606
00:44:00,630 --> 00:44:02,900
YOU SEE SOME OF THEM OVER HERE
IF YOU WANT TO GO AFTER THE

607
00:44:02,900 --> 00:44:06,770
SHOW'S OVER AND LOOK AT SOME OF
THE EXHIBITS IN HERE THAT THEY

608
00:44:06,770 --> 00:44:10,710
HAVE TO HAVE SPECIAL TOOLS.
SOMETIMES THEY HAVE LIKE DRILLS

609
00:44:10,710 --> 00:44:12,640
AND THINGS THAT ARE ZERO
REACTION TOOL.

610
00:44:12,640 --> 00:44:19,109
THAT MEANS WHEN YOU TRY TO TAKE
A BOLT OUT OR SCREW A BOLT IN,

611

00:44:19,109 --> 00:44:23,120
IT DOESN'T CREATE A FORCE THAT
TURNS YOU ON YOUR OWN AXIS

612
00:44:23,120 --> 00:44:25,090
BECAUSE HERE'S ONE OF THE
REALITIES I MENTIONED THIS IN

613
00:44:25,090 --> 00:44:29,080
PASSING IN MY TALK.
IN SPACE, YOU DON'T HAVE THE

614
00:44:29,080 --> 00:44:33,020
GROUND AND THE GRAVITY HOLDING
YOU THERE, SO IF YOU TURN A

615
00:44:33,020 --> 00:44:36,700
SCREW YOUR BODY WANTS TO GO IN
THE OPPOSITE DIRECTION.

616
00:44:36,700 --> 00:44:43,170
ISAAC NEWTON, MOTION, ONE OF THE
GOOD THINGS ABOUT THIS KIND OF

617
00:44:43,170 --> 00:44:45,970
NEUTRAL BUOYANCY OR UNDERWATER
TRAINING IS IT GIVES YOU SOME

618
00:44:45,970 --> 00:44:48,550
SENSE OF THAT.
IF YOU'RE NOT ANCHORED PROPERLY

619
00:44:48,550 --> 00:44:52,910
OR IF YOU DON'T HAVE A SPECIAL
TOOL, YOU'RE GOING TO TURN.

620
00:44:52,910 --> 00:44:56,880
AND SO UNDERSTANDING THAT
PROCESS AND HOW YOU CAN WORK IN

621

00:44:56,880 --> 00:44:58,530

SPACE.

IT TURNS OUT YOU HAVE TO DO

622

00:44:58,530 --> 00:45:03,070

EVERYTHING SLOW AND CAREFULLY
RATHER THAN RUSHING.

623

00:45:03,070 --> 00:45:04,950

ONE MORE QUESTION?
THAT WAS AN ONLINE QUESTION,

624

00:45:04,950 --> 00:45:08,680

I'VE BEEN TOLD, FIRST.
DO OTHER COUNTRIES HAVE SIMILAR

625

00:45:08,680 --> 00:45:11,830

TRAINING FACILITIES FOR THEIR
ASTRONAUTS?

626

00:45:11,830 --> 00:45:13,530

ONLINE.
ABSOLUTELY.

627

00:45:13,530 --> 00:45:18,770

IN FACT, IN 1980 THE RUSSIANS
BUILT THEIR OWN SO-CALLED HYDRO

628

00:45:18,770 --> 00:45:23,410

LAB WHICH THEY USED TO TRAIN FOR
THEIR SPACE STATIONS AND NOW

629

00:45:23,410 --> 00:45:28,030

TRAIN FOR THE RUSSIAN COSMONAUTS
TO WORK ON ISS AND IN MORE

630

00:45:28,030 --> 00:45:30,860

RECENT TIMES THE JAPANESE BUILT
A TANK.

631

00:45:30,860 --> 00:45:34,520
THE EUROPEANS BUILT A TANK.
AND NOW THE CHINESE BUILT A

632
00:45:34,520 --> 00:45:36,030
TANK.
AND SO THE CHINESE ACTUALLY HAVE

633
00:45:36,030 --> 00:45:38,590
THEIR OWN MANNED SPACE PROGRAM,
THEY HAVE THEIR OWN SMALL

634
00:45:38,590 --> 00:45:42,540
STATION THEY'VE BEEN WATCHING
AND HAVE ACTUALLY ALREADY HAD†--

635
00:45:42,540 --> 00:45:47,340
CHINESE ASTRONAUT GOING OUTSIDE.
SO, YES, THAT'S BECOME A NASA

636
00:45:47,340 --> 00:45:51,020
REALLY IS THE PIONEER OF THIS
BUT IT'S GOING AROUND THE WORLD

637
00:45:51,020 --> 00:45:56,070
OR HAS GONE AROUND THE WORLD.
>> HI, MY NAME IS QUINTON MORROW

638
00:45:56,070 --> 00:45:59,990
AND I GO TO FRIENDSHIP CART
CHARTER SCHOOL.

639
00:45:59,990 --> 00:46:07,119
MY QUESTION IS DO THEY PRACTICE
THE SAME THINGS OVER AND OVER

640
00:46:07,119 --> 00:46:09,570
AGAIN OR NEW THINGS EVERY DAY?
>> WELL, SORT OF BOTH.

641

00:46:09,570 --> 00:46:12,320
IT'S A GOOD QUESTION.
I MEAN, TO DO A LOT OF THINGS

642
00:46:12,320 --> 00:46:17,030
THEY HAVE TO REPEAT AND REPEAT
AND REPEAT IN ORDER TO BE

643
00:46:17,030 --> 00:46:19,960
COMFORTABLE THAT WE HAVE THE
TECHNIQUE DOWN AND WE NEED TO DO

644
00:46:19,960 --> 00:46:26,000
SOMETHING.
AND SO, ANYWAY, THANK YOU VERY

645
00:46:26,000 --> 00:46:28,130
MUCH FOR COMING.
I WANT TO THANK THE BOEING

646
00:46:28,130 --> 00:46:30,970
COMPANY FOR SPONSORING WHAT'S
NEW IN AEROSPACE AND FOR

647
00:46:30,970 --> 00:46:35,030
SPONSORING THIS SHOW.
I WANT TO THANK NASA AND FOR THE

648
00:46:35,030 --> 00:46:38,400
NBL FOR WORKING ALONG WITH US
AND TALKING TO US TODAY.

649
00:46:38,400 --> 00:46:43,070
SO MAYBE WE SHOULD GIVE THEM
ANOTHER HAND.

650
00:46:43,070 --> 00:46:48,000
AND I WANTED TO THANK THE CREW
HERE IN THE SPACE MUSEUM FOR