WHAT'S ON BOARD

NORTHROP GRUMMAN'S CRS-14 MISSION TO THE INTERNATIONAL SPACE STATION

1
00:00:16,980 --> 00:00:19,680
WE'VE BEEN DEVELOPING
CANCER CELLS TO SPECIFIC

2
00:00:19,780 --> 00:00:23,340
BIOLOGICAL DRUGS THAT CAN
SELECTIVELY AND EFFECTIVELY

3
00:00:23,340 --> 00:00:24,810
GO AFTER CANCER CELLS.

4
00:00:25,080 --> 00:00:27,460
AND WE UNCOVERED THAT
CANCER CELLS HAVE A

5
00:00:27,830 --> 00:00:30,510
FOREIGN LANGUAGE THAT THEY
ONLY SPEAK IN THE BODY.

6
00:00:30,750 --> 00:00:33,810
THIS ALLOWS US TO
EXPLOIT THIS LANGUAGE,

7
00:00:34,230 --> 00:00:36,840
TO ENCRYPT OUR BIOLOGICAL
DRUGS IN THAT FOREIGN

8
00:00:36,840 --> 00:00:39,690
LANGUAGE SO ONLY CANCER
CELLS CAN UNDERSTAND US.

9
00:00:39,920 --> 00:00:41,960
SO WE'RE DOING THIS
EXTREME FORM OF STRESS

10
00:00:41,960 --> 00:00:43,370
TESTING UNDER MICROGRAVITY.

11
00:00:43,370 --> 00:00:45,150

THAT IS OUR FIRST ACHIEVEMENT.

12
00:00:45,170 --> 00:00:48,410
IF WE CAN IDENTIFY AT
LEAST ONE CANDIDATE THAT IS

13
00:00:48,410 --> 00:00:51,260
RESISTANT TO LEAKINESS AND
NORMAL CELLS, DESPITE BEING

14
00:00:51,290 --> 00:00:53,870
PUSHED TO THIS MICROGRAVITY
CONDITIONS, THEN THERE'S

15
00:00:53,870 --> 00:00:55,790
A GOOD CHANCE THAT WHEN
WE GO INTO THE CLINIC WITH

16
00:00:56,080 --> 00:00:58,904
HUNDREDS OF DIFFERENT TYPES
OF CANCER CELL RIBOSOMES,

17
00:00:59,175 --> 00:01:01,845
CANCER CELL BIOMARKERS,
THEN WE WILL BE ABLE TO

18
00:01:01,845 --> 00:01:05,375
STILL RELY ON THIS ASSET
FOR CLINICAL DEVELOPMENT.

19
00:01:05,725 --> 00:01:10,095
ASTRONAUTS WILL TAKE OUR
CELLS AND PUT THEM INTO, BACK

20
00:01:10,115 --> 00:01:13,955
INTO THE PROPER 37 DEGREE
CELL CULTURE INCUBATOR,

21
00:01:14,255 --> 00:01:16,925
AND THEN WITH SYRINGES,

THEY ARE GOING TO APPLY OUR

22
00:01:16,925 --> 00:01:20,975
REAGENTS INTO THE CANCER
CELLS AND THE HEALTHY CELLS.

23
00:01:21,435 --> 00:01:24,615
AND THEN THE NEXT DAY THEY
ARE GONNA DO THE READOUT AND

24
00:01:25,325 --> 00:01:30,325
SEE WHETHER THIS DIFFERENTIAL
BEHAVIOR IS RECAPITULATED

25
00:01:30,345 --> 00:01:32,595
IN MICROGRAVITY CONDITIONS.

26
00:01:32,855 --> 00:01:35,135
THIS IS ALL ABOUT BETTING
ON THE RIGHT ASSETS

27
00:01:35,195 --> 00:01:37,385
FOR FUTURE DEVELOPMENT
BECAUSE DRUG DEVELOPMENT

28
00:01:37,415 --> 00:01:39,215
IS COSTLY AND TAKES TIME.

29
00:01:39,635 --> 00:01:42,395
AND WE'RE ALSO, WE'RE ALSO
BUILDING HOPE WITH PATIENTS.

30
00:01:42,395 --> 00:01:45,245
WE WANT TO IDENTIFY THE
BEST CANDIDATES FOR THEM.

31
00:01:47,039 --> 00:01:48,990
I KNOW IT'S A TOILET AND
I GET A BIG LAUGH FROM

32
00:01:48,990 --> 00:01:50,100
MY FRIENDS ALL THE TIME.

33
00:01:50,100 --> 00:01:53,190
LIKE, OH, HE'S, YOU KNOW,
HE'S BUILDING A TOILET.

34
00:01:53,220 --> 00:01:55,199
AND YOU'RE LIKE, HUH, NOT
JUST A TOILET, YOU KNOW,

35
00:01:55,199 --> 00:01:56,640
A TITANIUM SPACE TOILET.

36
00:01:56,729 --> 00:01:59,880
SO IT'S PRETTY NIFTY,
ESPECIALLY WHEN YOU GET

37
00:01:59,880 --> 00:02:01,320
INTO THE COMPLEXITIES OF IT.

38
00:02:01,610 --> 00:02:06,169
THE UWMS IS 65% SMALLER
AND 40% LIGHTER THAN THE

39
00:02:06,169 --> 00:02:08,210
CURRENT TOILET USED ON ISS.

40
00:02:08,745 --> 00:02:12,045
OUR TOILET WILL BE INSTALLED
JUST ADJACENT TO THAT TOILET

41
00:02:12,255 --> 00:02:15,435
AND WILL UNDERGO A CONCURRENT
USE WITH THAT TOILET AS

42
00:02:15,435 --> 00:02:16,755
WE DO THE DEMONSTRATION.

43
00:02:17,735 --> 00:02:20,465
ONE OF THE THINGS THAT UWMS
HAS TO DO IS IT ACTUALLY HAS

44
00:02:20,465 --> 00:02:23,645
TO INJECT PRETREAT INTO THE
URINE BEFORE IT SENDS IT TO

45
00:02:23,645 --> 00:02:25,145
THE URINE PROCESSOR ASSEMBLY.

46
00:02:25,835 --> 00:02:30,335
THE PRETREAT IS A VERY
STRONG ACID AND IT IS

47
00:02:30,335 --> 00:02:32,345
NOT VERY COMPATIBLE
WITH A LOT OF MATERIALS.

48
00:02:32,345 --> 00:02:34,415
SO THAT FORCED US TO
HAVE TO USE A LOT OF

49
00:02:34,415 --> 00:02:39,375
EXOTIC MATERIALS SUCH AS
INCONEL, ELGILOY, TITANIUM.

50
00:02:39,644 --> 00:02:41,265
SO ONE OF THE COOLEST
THINGS THAT WE ACTUALLY

51
00:02:41,265 --> 00:02:44,745
DID ON THIS PROJECT, IS WE
IMPLEMENTED A PROCESS CALLED

52
00:02:44,775 --> 00:02:48,165
ELECTRON BEAM POWDER BED
FUSION, THAT'S JUST A BIG,

53

00:02:48,195 --> 00:02:51,105
FANCY WORD FOR 3D PRINTING.

54
00:02:51,525 --> 00:02:53,265
YOU KNOW, WHEN WE GO
TO THE BATHROOM HERE,

55
00:02:53,265 --> 00:02:55,755
GRAVITY PULLS EVERYTHING
TO THE GROUND, ESSENTIALLY

56
00:02:55,755 --> 00:02:56,775
AWAY FROM THE BODY.

57
00:02:57,255 --> 00:02:59,565
WELL, IN MICROGRAVITY,
WHEN YOU GO INTO SPACE,

58
00:02:59,595 --> 00:03:01,275
YOU DON'T HAVE THAT LUXURY.

59
00:03:01,530 --> 00:03:03,540
SO WE HAVE TO
ESSENTIALLY CREATE OUR

60
00:03:03,540 --> 00:03:05,340
OWN ARTIFICIAL GRAVITY.

61
00:03:05,340 --> 00:03:09,180
SO AT THE HEART OF THE
UWMS IS CALLED, IS THE

62
00:03:09,180 --> 00:03:10,230
DUAL FAN SEPARATOR.

63
00:03:10,230 --> 00:03:12,000
AND THAT'S ACTUALLY THE PART
THAT'S ACTUALLY MADE OUT

64

00:03:12,000 --> 00:03:13,500
OF THE 3D PRINTED TITANIUM.

65
00:03:13,880 --> 00:03:16,250
EXPLORATION IS, IS
A HARD BUSINESS.

66
00:03:16,250 --> 00:03:17,269
IT'S, IT'S UNCOMFORTABLE.

67
00:03:17,269 --> 00:03:19,160
THERE'S A LOT OF THINGS
THAT THE CREW HAS TO

68
00:03:19,160 --> 00:03:22,160
DO JUST TO EXPLORE.

69
00:03:22,519 --> 00:03:27,170
AND THE GOAL WITH THE UWMS
IS TO MEET THE CHALLENGES OF

70
00:03:27,170 --> 00:03:32,300
SPACE FLIGHT IN TERMS OF MASS
AND VOLUME AND POWER USAGE AND

71
00:03:32,340 --> 00:03:36,510
KEEP WITHIN THOSE CONSTRAINTS,
BUT ALSO MAKE IT A SYSTEM THAT

72
00:03:36,510 --> 00:03:40,530
THE CREW HAS A MORE LIKELIHOOD
TO BE COMFORTABLE WITH.

73
00:03:43,310 --> 00:03:45,859
THE OBJECTIVE OF
THE EXPERIMENT SEEMS

74
00:03:45,859 --> 00:03:49,310
VERY SIMPLE AND IT IS
GROWING THE RADISHES.

75
00:03:50,010 --> 00:03:51,690
ON THE ISS.

76
00:03:52,109 --> 00:03:56,070
I KNOW THAT RADISHES HAVE
BEEN GROWN SEVERAL TIMES,

77
00:03:56,070 --> 00:04:00,210
BUT NEVER IN THE ADVANCED
PLANT HABITAT THAT WE HAVE

78
00:04:00,210 --> 00:04:06,150
ACTUALLY ENOUGH SPACE TO GROW
A NUMBER OF PLANTS THAT ALLOW

79
00:04:06,150 --> 00:04:07,709
US TO DO SOME STATISTICS.

80
00:04:08,209 --> 00:04:12,829
PLANT HABITAT IS CURRENTLY
THE LARGEST, MOST COMPLEX

81
00:04:12,920 --> 00:04:15,079
PLANT GROWTH SYSTEM
ON THE SPACE STATION.

82
00:04:15,615 --> 00:04:19,635
THE ACTUAL GROWTH
VOLUME ITSELF FOR PLANTS

83
00:04:19,665 --> 00:04:23,625
MEASURES ABOUT 20 BY
20 BY 20 INCHES CUBE.

84
00:04:23,925 --> 00:04:27,725
SO ALL THE REST OF THE VOLUME
OF PLANT HABITAT IS ALL OF THE

85

00:04:27,725 --> 00:04:31,650
STUFF THAT IT TAKES TO PROVIDE
A CONTROLLED ENVIRONMENT FOR

86
00:04:31,650 --> 00:04:35,039
THE PLANTS THAT ARE GROWING
INSIDE OF THE GROWTH CHAMBER.

87
00:04:35,420 --> 00:04:40,940
RADISHES GROW TO A SIZABLE
VOLUME AND A BIG PIECE OF

88
00:04:40,940 --> 00:04:45,469
THAT MASS IS THE RADISH ITSELF
THAT BULBOUS TISSUE AND THE

89
00:04:45,469 --> 00:04:49,610
PROCESS OF DEVELOPING THIS
SECONDARY TISSUE IS COMPLETELY

90
00:04:50,055 --> 00:04:54,405
UNRESEARCHED IN SPACE, BUT
IT IS RELEVANT BECAUSE IT IS

91
00:04:54,405 --> 00:04:59,594
SENSITIVE TO ALL THESE THINGS
THAT WE HAVE ON STATION.

92
00:04:59,625 --> 00:05:04,965
SO IT ADDS TO THIS RATHER
COMPLEX SET OF DATA THAT

93
00:05:04,965 --> 00:05:09,015
WE NEED TO GET A HANDLE
ON, TO PROPERLY GROW AND

94
00:05:09,015 --> 00:05:12,075
UNDERSTAND THE CULTIVATION
OF PLANTS IN SPACE.

95

00:05:12,325 --> 00:05:15,335
TO GO TO MARS IS A LONG
HAUL AND TO GO ANY FURTHER

96
00:05:15,335 --> 00:05:16,625
THAN MARS IS LONGER YET.

97
00:05:16,685 --> 00:05:19,965
SO WITHOUT A DOUBT, UNLESS
WE ARE GOING TO HAVE

98
00:05:20,174 --> 00:05:23,445
SPACE VEHICLES THAT HAVE
ROTATING ELEMENTS THAT CAN

99
00:05:23,445 --> 00:05:26,385
PROVIDE SOME FRACTIONAL
GRAVITY, THERE'S GOING TO

100
00:05:26,385 --> 00:05:28,065
BE A MICROGRAVITY AREA.

101
00:05:28,125 --> 00:05:32,445
AND IN ORDER TO GROW A
REASONABLE AMOUNT OF PLANTS,

102
00:05:32,805 --> 00:05:35,505
WE ARE TALKING ABOUT THEM
ABOUT MUCH LARGER SYSTEM.

103
00:05:35,974 --> 00:05:39,544
AND SO THIS EXPERIMENT
IS, IS ONE WAY OF TRYING

104
00:05:39,544 --> 00:05:41,255
TO GET A LITTLE CLOSER.

105
00:05:48,195 --> 00:05:51,765
FOR THE PAST TWO YEARS,
WE HAVE BEEN IN INTENSIVE

106
00:05:51,765 --> 00:05:54,945
PRODUCTION ON A PROJECT
CALLED SPACE EXPLORERS

107
00:05:54,945 --> 00:05:59,400
THE ISS EXPERIENCE THAT IS
FILMING INSIDE AND OUTSIDE

108
00:05:59,400 --> 00:06:02,630
OF THE INTERNATIONAL SPACE
STATION THROUGH THE IMMERSIVE

109
00:06:02,659 --> 00:06:04,340
POWER OF VIRTUAL REALITY.

110
00:06:04,460 --> 00:06:07,430
AND IN A FEW MONTHS, WE'RE
GOING TO TAKE THE CAMERA

111
00:06:07,520 --> 00:06:11,659
OUTSIDE TO A DOCUMENT A
FULL SPACE WALK AND TO

112
00:06:11,659 --> 00:06:14,630
FILM EXTERIOR SHOTS OF
THE SPACE STATION AS WELL

113
00:06:14,630 --> 00:06:16,310
AS SHOTS OF PLANET EARTH.

114
00:06:16,490 --> 00:06:19,490
WHAT WE ARE DOING NOW IS
GETTING READY TO LAUNCH

115
00:06:19,520 --> 00:06:23,825
OUR EVA VIRTUAL REALITY
CAMERA, WHICH IS A SLIGHTLY

116

00:06:23,825 --> 00:06:27,335
DIFFERENT SYSTEM TO THE
IVA CAMERA THAT WE'VE BEEN

117
00:06:27,335 --> 00:06:30,355
USING FOR THE PAST TWO YEARS
INSIDE OF THE SPACE STATION.

118
00:06:30,595 --> 00:06:33,985
WE WORKED IN COLLABORATION
WITH NANORACKS TO MAKE

119
00:06:33,985 --> 00:06:38,245
IT BASICALLY RESISTANCE
TO THE PRESSURE OF SPACE,

120
00:06:38,805 --> 00:06:42,415
THE, UH, EXTREME VARIATIONS
IN TEMPERATURES AND WE

121
00:06:42,415 --> 00:06:45,135
HAD TO MAKE SURE THAT
THE LENSES WERE ALSO

122
00:06:45,135 --> 00:06:47,295
CERTIFIED FOR USE OUTSIDE.

123
00:06:47,745 --> 00:06:52,115
AND WE'RE BASICALLY GOING TO
USE DEXTRE AND THE CANADARM AS

124
00:06:52,145 --> 00:06:56,615
KIND OF A CELESTIAL CRANE AS
YOU WOULD IN THE MIDDLE MOVIES

125
00:06:56,685 --> 00:06:59,695
TO SHOOT OUTSIDE OF THE ISS.

126
00:06:59,784 --> 00:07:04,184
BEYOND THE ISS OF COURSE, ARE

A LOT MORE PLACES TO EXPLORE.

127
00:07:04,244 --> 00:07:07,724
SO THIS HAS REALLY BEEN, YOU
KNOW, INVALUABLE KNOWLEDGE

128
00:07:07,755 --> 00:07:10,544
TO HELP US DESIGN FUTURE
CAMERAS THAT ARE GOING

129
00:07:10,544 --> 00:07:12,315
TO GO DEEPER INTO SPACE.

130
00:07:12,505 --> 00:07:16,054
ONCE AUDIENCES EXPERIENCE IT
I BELIEVE THEY WILL NOT WANT

131
00:07:16,054 --> 00:07:19,984
TO GO BACK TO TRADITIONAL
MEDIA TO EXPERIENCE

132
00:07:19,984 --> 00:07:21,135
SPACE CONTENT, YOU KNOW.

133
00:07:21,135 --> 00:07:24,115
IT'S GOING TO BE THE SORT
OF DEFAULT FAST TRACK.

134
00:07:24,424 --> 00:07:26,434
SPACE EQUALS IMMERSIVE MEDIA.

135
00:07:26,765 --> 00:07:29,284
AND BECAUSE OF THAT I
THINK THAT WE'RE GOING TO

136
00:07:29,284 --> 00:07:32,284
BE BUSY IN THE NEXT FEW
YEARS, DOING MORE AND MORE

137

00:07:32,284 --> 00:07:33,424
AND MORE OF THOSE PROJECTS.

138
00:07:36,745 --> 00:07:41,245
NASA IS LOOKING FOR STRATEGIES
TO TAKE ADVANTAGE OF THE

139
00:07:41,304 --> 00:07:45,025
WASTE GENERATED IN THE
INTERNATIONAL SPACE STATION.

140
00:07:45,599 --> 00:07:50,270
AND ONE OF THE WAYS OF
THOSE WASTES IS URINE.

141
00:07:50,539 --> 00:07:55,969
AFTER CERTAIN PROCESSES THAT
URINE CAN BE CONVERTED TO

142
00:07:55,969 --> 00:08:03,280
AMMONIA AND AMMONIA CAN BE
USED AS A FUEL IN A FUEL CELL.

143
00:08:04,300 --> 00:08:10,140
THE PROJECT INTENDS
TO HELP WITH THE WATER

144
00:08:10,140 --> 00:08:14,679
RECYCLING AND ALSO GENERATE
ELECTRICAL CURRENT.

145
00:08:15,079 --> 00:08:19,250
AMMONIA OXIDATION IS JUST ONE
COMPONENT OF A PROCESS THAT

146
00:08:19,250 --> 00:08:23,630
HAS BEEN DEVELOPED IN THE LAB
FOR THE SEVERAL YEARS NOW THAT

147
00:08:23,630 --> 00:08:25,760

CAN BE USED TO PURIFY URINE.

148
00:08:26,150 --> 00:08:28,450
THIS WILL CREATE A SYSTEM
THAT CAN BE USED FOR THAT.

149
00:08:29,059 --> 00:08:31,409
THIS IS THE MODULE.

150
00:08:31,469 --> 00:08:32,689
LIKE IT'S OPEN.

151
00:08:32,939 --> 00:08:36,270
EVERYTHING WILL BE
INSIDE NOW IT'S OUT

152
00:08:36,270 --> 00:08:37,349
BECAUSE I'M TESTING IT.

153
00:08:37,739 --> 00:08:38,069
RIGHT.

154
00:08:38,520 --> 00:08:44,500
BUT IF YOU SEE THE TUBINGS,
THE WIRES, THE PUMPS, AND

155
00:08:44,530 --> 00:08:49,969
ALSO THIS WHITE BOX IS THE
AUTONOMOUS POTENTIAL STEP.

156
00:08:50,510 --> 00:08:53,719
SO THIS IS MORE THAN
AN APPLICATION FOR

157
00:08:53,719 --> 00:08:54,770
THE SPACE STATION.

158
00:08:54,979 --> 00:08:57,920
IF IT'S EFFICIENT IN

THE SPACE STATION, IT'S

159
00:08:57,920 --> 00:09:00,160
MORE EFFICIENT ON EARTH.

160
00:09:00,435 --> 00:09:02,575
SO THAT'S SORT OF WHY
WE WANT TO DEMONSTRATE

161
00:09:02,595 --> 00:09:03,645
THAT IT CAN WORK.

162
00:09:06,645 --> 00:09:08,585
SO IF YOU THINK BACK TO
THE HISTORY, WE STARTED

163
00:09:08,585 --> 00:09:11,495
WITH COMMERCIAL CARGO
TO GET CARGO UP AND DOWN

164
00:09:11,495 --> 00:09:12,245
THE LOW-EARTH ORBIT.

165
00:09:12,395 --> 00:09:16,230
THEN WE MOVED TO COMMERCIAL
CREW TO GET PEOPLE UP AND

166
00:09:16,230 --> 00:09:17,280
DOWN TO LOW-EARTH ORBIT.

167
00:09:17,600 --> 00:09:20,540
BUT WE ALSO THOUGHT THAT
IT WOULD BE KEY TO SORT OF

168
00:09:20,540 --> 00:09:23,600
HELP STIMULATE COMMERCIAL
DEMANDS SO THAT WE WOULD

169
00:09:23,600 --> 00:09:27,020

NOT BE THE ONLY CUSTOMER
FOR MICROGRAVITY RESEARCH

170
00:09:27,050 --> 00:09:28,670
CAPABILITY IN LOW-EARTH ORBIT.

171
00:09:28,829 --> 00:09:31,520
LET'S EXPAND IT AND SEE WHAT
PRIVATE INDUSTRY WOULD WANT

172
00:09:31,520 --> 00:09:34,520
TO DO AND LET THEM COME UP
WITH THESE INNOVATIVE IDEAS

173
00:09:34,520 --> 00:09:37,550
ON HOW THEY COULD MAYBE
MAKE MONEY AND STIMULATE

174
00:09:37,550 --> 00:09:40,670
THIS LEO ECONOMY WITH IDEAS
THAT THEY CAME UP WITH.

175
00:09:40,670 --> 00:09:41,600
SO THAT'S WHAT WE DID.

176
00:09:41,600 --> 00:09:42,380
WE CARVED OUT.

177
00:09:42,720 --> 00:09:46,800
A CERTAIN AMOUNT OF RESOURCES,
CREW TIME, AND UPMASS TO JUST

178
00:09:46,800 --> 00:09:50,430
SUPPORT COMMERCIAL MARKETING
AND PROMOTION ACTIVITIES.

179
00:09:50,460 --> 00:09:53,640
WE DID THE VERY FIRST MISSION
ON A SPACEX CARGO FLIGHT

180
00:09:53,640 --> 00:09:55,770
THAT WENT UP THERE AND IS
ON SPACE STATION TODAY.

181
00:09:56,040 --> 00:09:57,780
AND ESTÉE LAUDER
IS COMING UP NEXT.

182
00:09:58,440 --> 00:10:01,230
SO FOR THIS PARTICULAR
PAYLOAD, ESTÉE LAUDER HAS

183
00:10:01,230 --> 00:10:06,090
PROPOSED TO FLY THEIR ADVANCED
NIGHT REPAIR PRODUCT TO THE