
SPACEX CRS-17
WHAT'S ON BOARD

1
00:00:00,700 --> 00:00:15,248
[MUSIC]

2
00:00:20,987 --> 00:00:21,955
>> THIS IS A PAYLOAD

3
00:00:21,955 --> 00:00:22,789
THAT'S GONNA BE ON

4
00:00:22,789 --> 00:00:24,524
THE JEM XPOSED MODULE,

5
00:00:24,524 --> 00:00:25,625
SO IT'S HANGIN' ON THE OUTSIDE

6
00:00:25,625 --> 00:00:26,960
OF THE ISS LOOKIN' DOWN

7
00:00:26,960 --> 00:00:28,027
AT THE EARTH.

8
00:00:28,027 --> 00:00:28,928
AND WHAT ARE WE DOING?

9
00:00:28,928 --> 00:00:29,796
WE'RE TRYING TO MEASURE

10
00:00:29,796 --> 00:00:31,464
ATMOSPHERIC CARBON DIOXIDE.

11
00:00:31,464 --> 00:00:32,298
PLANTS ARE ACTUALLY

12
00:00:32,298 --> 00:00:33,700
DOING US A HUGE FAVOR.

13
00:00:33,700 --> 00:00:35,101

THOSE PLANTS IN THE OCEAN

14
00:00:35,101 --> 00:00:36,169
TAKE ABOUT HALF OF

15
00:00:36,169 --> 00:00:37,370
THE ATMOSPHERIC CARBON DIOXIDE

16
00:00:37,370 --> 00:00:39,439
THAT HUMANS EMIT OUT EVERY YEAR.

17
00:00:39,439 --> 00:00:41,007
BUT SOME YEARS IT'S 20%.

18
00:00:41,007 --> 00:00:42,776
SOME YEARS IT'S 80%,

19
00:00:42,776 --> 00:00:43,710
AND WE'VE GOTTA FIGURE OUT

20
00:00:43,710 --> 00:00:44,677
WHY THAT IS.

21
00:00:44,677 --> 00:00:46,746
SO OCO-2 HAS STARTED COLLECTING

22
00:00:46,746 --> 00:00:48,915
ATMOSPHERIC CARBON DIOXIDE DATA.

23
00:00:48,915 --> 00:00:49,916
WE'VE BEEN DOING THAT

24
00:00:49,916 --> 00:00:51,451
SINCE 2014.

25
00:00:51,451 --> 00:00:53,186
OCO-3 IS MEANT TO CONTINUE

26
00:00:53,186 --> 00:00:55,088
THAT RECORD OF CARBON DIOXIDE,

27
00:00:55,088 --> 00:00:56,256
AND BUILD ONTO WHAT

28
00:00:56,256 --> 00:00:57,824
OCO-2 STARTED.

29
00:00:57,824 --> 00:00:59,159
BUT BEING ON THE SPACE STATION

30
00:00:59,159 --> 00:01:00,393
IS A LITTLE BIT DIFFERENT.

31
00:01:00,393 --> 00:01:01,428
YOU KNOW IT'S IN

32
00:01:01,428 --> 00:01:03,430
THIS PRECESSING ORBIT.

33
00:01:03,430 --> 00:01:04,864
EVERY DAY IT GOES OVER YOUR HEAD

34
00:01:04,864 --> 00:01:06,599
A LITTLE BIT EARLIER IN THE DAY.

35
00:01:06,599 --> 00:01:07,700
WE'LL HAVE THESE DETAILED

36
00:01:07,700 --> 00:01:08,835
LITTLE SNAPSHOT MAPS

37
00:01:08,835 --> 00:01:10,236
OF CARBON DIOXIDE AND SIF

38
00:01:10,236 --> 00:01:11,204

THAT ARE UNLIKE DATA

39
00:01:11,204 --> 00:01:12,472
WE'VE COLLECTED BEFORE.

40
00:01:12,472 --> 00:01:13,540
LET US SEE NEW THINGS

41
00:01:13,540 --> 00:01:15,608
ABOUT FORESTS, CROP AREAS,

42
00:01:15,608 --> 00:01:17,010
AND OF COURSE THERE'S FOLKS

43
00:01:17,010 --> 00:01:18,144
WANNA LOOK AT CITIES

44
00:01:18,144 --> 00:01:19,379
AND POWER PLANTS.

45
00:01:19,379 --> 00:01:20,346
SO THE SNAPSHOT MAP'S

46
00:01:20,346 --> 00:01:21,448
GONNA BE A GREAT NEW WAY

47
00:01:21,448 --> 00:01:22,449
TO GET A DETAILED PICTURE

48
00:01:22,449 --> 00:01:23,650
OF CARBON DIOXIDE.

49
00:01:23,650 --> 00:01:24,851
>> WE'RE INTERESTED IN

50
00:01:24,851 --> 00:01:26,052
STUDYING PLANETARY BODIES.

51
00:01:26,052 --> 00:01:27,120
SO IN PARTICULAR,

52
00:01:27,120 --> 00:01:28,321
MY RESEARCH OF FOCUS IS ON

53
00:01:28,321 --> 00:01:29,389
STUDYING ASTEROIDS.

54
00:01:29,389 --> 00:01:30,323
THE GOAL OF HERMES IS

55
00:01:30,323 --> 00:01:31,524
TO STUDY THE SURFACE MATERIAL

56
00:01:31,524 --> 00:01:32,659
OF ASTEROIDS, AND THIS IS

57
00:01:32,659 --> 00:01:33,993
SOMETHING THAT WE CALL REGOLITH,

58
00:01:33,993 --> 00:01:35,862
THIS FINE PARTICLE, FINE DUST

59
00:01:35,862 --> 00:01:37,630
THAT COVERS THE ENTIRE SURFACE.

60
00:01:37,630 --> 00:01:39,098
THERE'S A LOT OF INTEREST

61
00:01:39,098 --> 00:01:41,034
IN ONE DAY SENDING ASTRONAUTS

62
00:01:41,034 --> 00:01:42,368
TO ASTEROIDS, FOR INSTANCE,

63
00:01:42,368 --> 00:01:43,369

UM, AND WE HAVE ALREADY

64
00:01:43,369 --> 00:01:44,504
SENT A LOT OF ROBOTIC MISSIONS

65
00:01:44,504 --> 00:01:45,338
TO ASTEROIDS,

66
00:01:45,338 --> 00:01:46,272
AND PLAN TO SEND MORE.

67
00:01:46,272 --> 00:01:47,073
AND SO WE WOULD NEED TO

68
00:01:47,073 --> 00:01:48,107
UNDERSTAND HOW TO INTERACT

69
00:01:48,107 --> 00:01:49,876
WITH THE ASTEROID SURFACE.

70
00:01:49,876 --> 00:01:51,277
SO IF YOU WERE GOING TO ANCHOR

71
00:01:51,277 --> 00:01:52,245
TO THE SURFACE OF THE ASTEROID,

72
00:01:52,245 --> 00:01:53,379
FOR INSTANCE, UM, YOU NEED

73
00:01:53,379 --> 00:01:54,314
TO UNDERSTAND HOW TO INTERACT

74
00:01:54,314 --> 00:01:55,181
WITH THE REGOLITH.

75
00:01:55,181 --> 00:01:55,915
WHY DO WE WANNA STUDY THIS

76
00:01:55,915 --> 00:01:56,649
ON THE ISS?

77
00:01:56,649 --> 00:01:57,517
SO IT'S NOT JUST THE LONG

78
00:01:57,517 --> 00:01:58,518
DURATION EXPOSURE MICROGRAVITY.

79
00:01:58,518 --> 00:02:00,520
UM, IT'S ALSO-- SOMETHING

80
00:02:00,520 --> 00:02:01,588
THAT WE HAVE ON ASTEROIDS

81
00:02:01,588 --> 00:02:02,722
IS VACUUM, RIGHT?

82
00:02:02,722 --> 00:02:03,890
SO WE WANNA EXPOSE

83
00:02:03,890 --> 00:02:05,191
OUR EXPERIMENTS TO THE VACUUM

84
00:02:05,191 --> 00:02:06,459
OF SPACE, SO WE ACTUALLY HAVE

85
00:02:06,459 --> 00:02:07,627
OUR FACILITY HOOKED UP

86
00:02:07,627 --> 00:02:09,629
ESSENTIALLY TO A PORT TO SPACE.

87
00:02:09,629 --> 00:02:10,430
SO THIS WILL BE

88
00:02:10,430 --> 00:02:11,264

A PERMANENT FACILITY

89
00:02:11,264 --> 00:02:12,098
ON THE SPACE STATION.

90
00:02:12,098 --> 00:02:12,932
AND THE IDEA IS THAT WE'LL

91
00:02:12,932 --> 00:02:14,067
SEND DIFFERENT SCIENCE PACKAGES

92
00:02:14,067 --> 00:02:15,869
THAT ARE CALLED CASSETTES THAT

93
00:02:15,869 --> 00:02:17,370
WILL GO INSIDE THE FACILITY.

94
00:02:17,370 --> 00:02:18,738
UM, SO WE DID CASSETTE-1,

95
00:02:18,738 --> 00:02:19,706
BUT THE IDEA IS THAT

96
00:02:19,706 --> 00:02:20,673
HERMES WILL BE OPEN TO

97
00:02:20,673 --> 00:02:21,474
OTHER INVESTIGATORS,

98
00:02:21,474 --> 00:02:22,609
SO CASSETTE-2, CASSETTE-3,

99
00:02:22,609 --> 00:02:23,843
CASSETTE-7, THESE WILL BE

100
00:02:23,843 --> 00:02:24,911
OTHER RESEARCHERS THAT WILL

101
00:02:24,911 --> 00:02:26,012
APPLY TO USE HERMES TO DO

102
00:02:26,012 --> 00:02:27,213
RESEARCH ON ASTEROID REGOLITH

103
00:02:27,213 --> 00:02:28,114
AND GRANULAR MATERIAL

104
00:02:28,114 --> 00:02:29,215
INVESTIGATIONS.

105
00:02:29,215 --> 00:02:31,918
>> THIS IS A TINY BIOENGINEERED

106
00:02:31,918 --> 00:02:32,986
DEVICE THAT CONTAINS

107
00:02:32,986 --> 00:02:34,387
LIVING HUMAN CELLS

108
00:02:34,387 --> 00:02:36,322
THAT ARE DESIGNED TO RECREATE

109
00:02:36,322 --> 00:02:37,557
THE STRUCTURE AND FUNCTION

110
00:02:37,557 --> 00:02:39,626
OF YOUR TISSUES IN YOUR BODY.

111
00:02:39,626 --> 00:02:40,860
SO WE SEE TISSUE CHIPS

112
00:02:40,860 --> 00:02:42,395
AS A TOOL TO HELP UNDERSTAND

113
00:02:42,395 --> 00:02:44,230

DISEASES AND SPEED THE PROCESS

114
00:02:44,230 --> 00:02:45,198
OF DRUG DISCOVERY,

115
00:02:45,198 --> 00:02:46,165
WHICH DOWN HERE ON EARTH

116
00:02:46,165 --> 00:02:47,834
RIGHT NOW IS EXTREMELY EXPENSIVE

117
00:02:47,834 --> 00:02:48,635
AND TAKES A REALLY,

118
00:02:48,635 --> 00:02:49,435
REALLY LONG TIME.

119
00:02:49,435 --> 00:02:51,037
WE'RE USING MICROGRAVITY ALSO

120
00:02:51,037 --> 00:02:52,372
AS A TOOL, BECAUSE AS YOU KNOW,

121
00:02:52,372 --> 00:02:54,007
MICROGRAVITY CAUSES CHANGES

122
00:02:54,007 --> 00:02:55,808
IN PHYSIOLOGY IN ASTRONAUTS

123
00:02:55,808 --> 00:02:57,477
THAT OFTEN SEEM TO MIMIC

124
00:02:57,477 --> 00:02:58,511
WHAT'S QUITE SIMILAR TO

125
00:02:58,511 --> 00:02:59,412
SOME DISEASE STATES

126
00:02:59,412 --> 00:03:00,480
OR AGING HERE ON EARTH.

127
00:03:00,480 --> 00:03:01,481
THAT HAPPENS ON A REALLY

128
00:03:01,481 --> 00:03:02,749
SHORT TIME SCALE, SO WE'RE

129
00:03:02,749 --> 00:03:04,384
ESSENTIALLY ABLE TO SPEED UP

130
00:03:04,384 --> 00:03:05,618
THE WHOLE PROCESS OF

131
00:03:05,618 --> 00:03:06,586
DISEASE MODELING

132
00:03:06,586 --> 00:03:07,520
AND TESTING OF DRUGS

133
00:03:07,520 --> 00:03:08,788
BY USING THESE TISSUE CHIPS

134
00:03:08,788 --> 00:03:10,356
UP ON THE SPACE STATION.

135
00:03:10,356 --> 00:03:11,291
SO THAT'S A BIG WIN

136
00:03:11,291 --> 00:03:12,759
DOWN FOR US HERE ON EARTH.

137
00:03:12,759 --> 00:03:13,793
ALL OF THESE TECHNOLOGICAL

138
00:03:13,793 --> 00:03:15,929

ADVANCES AND THE-THE PROBLEMS

139
00:03:15,929 --> 00:03:16,796
THAT THE TEAMS HAVE HAD

140
00:03:16,796 --> 00:03:17,730
TO ENCOUNTER TO SHRINK

141
00:03:17,730 --> 00:03:18,865
THEIR TECHNOLOGY AND MAKE IT

142
00:03:18,865 --> 00:03:20,733
REALLY ROBUST IS GONNA BE

143
00:03:20,733 --> 00:03:21,801
TRANSFORMATIONAL FOR

144
00:03:21,801 --> 00:03:22,902
THE TECHNOLOGY BACK DOWN HERE

145
00:03:22,902 --> 00:03:24,070
ON EARTH, BECAUSE IT'S GONNA

146
00:03:24,070 --> 00:03:24,971
MAKE THIS TECHNOLOGY

147
00:03:24,971 --> 00:03:26,239
MUCH MORE BROADLY ACCESSIBLE

148
00:03:26,239 --> 00:03:27,607
TO A WIDER AUDIENCE WHO CAN

149
00:03:27,607 --> 00:03:28,875
USE IT DOWN HERE ON EARTH.

150
00:03:28,875 --> 00:03:30,076
SO WE HAVE FOUR PROJECTS

151
00:03:30,076 --> 00:03:31,044
THAT ARE LAUNCHING.

152
00:03:31,044 --> 00:03:31,844
WE HAVE A TEAM FROM

153
00:03:31,844 --> 00:03:32,946
THE UNIVERSITY OF WASHINGTON,

154
00:03:32,946 --> 00:03:33,980
WHO IS GOING TO BE SENDING UP

155
00:03:33,980 --> 00:03:34,814
A KIDNEY CHIP.

156
00:03:34,814 --> 00:03:35,782
>> WE'RE ACTUALLY SENDING UP

157
00:03:35,782 --> 00:03:37,684
24 OF THESE CHIPS TO

158
00:03:37,684 --> 00:03:39,252
THE INTERNATIONAL SPACE STATION,

159
00:03:39,252 --> 00:03:41,688
SO THAT'S 72 INDIVIDUAL TUBULES.

160
00:03:41,688 --> 00:03:42,822
NOT ONLY IS A KIDNEY

161
00:03:42,822 --> 00:03:44,424
VERY IMPORTANT FOR FILTERING

162
00:03:44,424 --> 00:03:45,692
OUR BLOOD AND REMOVING

163
00:03:45,692 --> 00:03:47,126

WASTE PRODUCTS VIA URINE,

164
00:03:47,126 --> 00:03:48,394
BUT IT'S ALSO A KEY ORGAN

165
00:03:48,394 --> 00:03:49,529
INVOLVED IN THE SYNTHESIS

166
00:03:49,529 --> 00:03:50,630
OF A NUMBER OF DIFFERENT

167
00:03:50,630 --> 00:03:51,965
HORMONES AND VITAMINS.

168
00:03:51,965 --> 00:03:52,966
ONE OF THOSE VITAMINS

169
00:03:52,966 --> 00:03:54,100
IS VITAMIN D.

170
00:03:54,100 --> 00:03:54,968
AND SO WE ACTUALLY HOPE

171
00:03:54,968 --> 00:03:55,902
TO LEARN IN A MATTER OF

172
00:03:55,902 --> 00:03:56,970
A COURSE OF WEEKS IS

173
00:03:56,970 --> 00:03:58,304
HOW DOES OSTEOPOROSIS,

174
00:03:58,304 --> 00:04:00,106
VI-VITAMIN D METABOLISM OCCUR

175
00:04:00,106 --> 00:04:01,708
IN A DISEASE WHICH TYPICALLY

176
00:04:01,708 --> 00:04:02,875
TAKES PLACE OVER THE COURSE

177
00:04:02,875 --> 00:04:04,577
OF YEARS IF NOT DECADES.

178
00:04:04,577 --> 00:04:05,678
>> WE ARE THE 2018

179
00:04:05,678 --> 00:04:07,180
GENES IN SPACE WINNING TEAM.

180
00:04:07,180 --> 00:04:08,214
SO IF YOU'RE UNFAMILIAR WITH

181
00:04:08,214 --> 00:04:09,649
GENES IN SPACE, UM,

182
00:04:09,649 --> 00:04:11,050
IT'S A 7TH TO 12TH GRADE

183
00:04:11,050 --> 00:04:12,685
DNA COMPETITION WHERE YOU

184
00:04:12,685 --> 00:04:13,686
DESIGN AN EXPERIMENT

185
00:04:13,686 --> 00:04:14,520
TO TAKE PLACE ON

186
00:04:14,520 --> 00:04:15,888
THE INTERNATIONAL SPACE STATION.

187
00:04:15,888 --> 00:04:17,156
>> DNA IS THE BLUEPRINT

188
00:04:17,156 --> 00:04:18,024

OF LIFE, RIGHT?

189
00:04:18,024 --> 00:04:18,825
SO IT ENCODES ALL

190
00:04:18,825 --> 00:04:20,426
OUR GENETIC INFORMATION, UM,

191
00:04:20,426 --> 00:04:22,061
AND IT GETS TRANSCRIBED TO RNA,

192
00:04:22,061 --> 00:04:23,363
WHICH IS TRANSLATED TO PROTEINS,

193
00:04:23,363 --> 00:04:24,330
WHICH OF COURSE HELP

194
00:04:24,330 --> 00:04:25,565
ALL OF OUR CELLS FUNCTION.

195
00:04:25,565 --> 00:04:26,599
ASTRONAUTS UNDERGO

196
00:04:26,599 --> 00:04:28,835
HIGH RADIATION FROM HZE IONS

197
00:04:28,835 --> 00:04:30,470
OR GALACTIC COSMIC RAYS,

198
00:04:30,470 --> 00:04:31,371
WHICH CAN LEAD TO THESE

199
00:04:31,371 --> 00:04:32,505
DOUBLE STRANDED BREAKS.

200
00:04:32,505 --> 00:04:33,806
SO OUR OBJECTIVE IN THIS,

201
00:04:33,806 --> 00:04:35,441
UH, EXPERIMENT WAS TO EXAMINE

202
00:04:35,441 --> 00:04:37,210
HOW REPAIR PATHWAY FREQUENCIES

203
00:04:37,210 --> 00:04:38,578
AND DOUBLE STRANDED BREAK REPAIR

204
00:04:38,578 --> 00:04:39,512
AS A WHOLE ARE AFFECTED

205
00:04:39,512 --> 00:04:40,480
BY MICROGRAVITY.

206
00:04:40,480 --> 00:04:42,115
SO TO-TO TEST OUR HYPOTHESIS,

207
00:04:42,115 --> 00:04:42,915
WE'RE GONNA BE USING

208
00:04:42,915 --> 00:04:44,150
THE CRISPR-CAS9 SYSTEM.

209
00:04:44,150 --> 00:04:45,385
>> WE WANT TO VERIFY THAT

210
00:04:45,385 --> 00:04:46,953
CAS9 CAN CUT IN SPACE,

211
00:04:46,953 --> 00:04:48,588
AND THAT WE CAN DEDUCE

212
00:04:48,588 --> 00:04:50,556
REPAIR PATHWAY FREQUENCIES BASED

213
00:04:50,556 --> 00:04:52,058

ON THE RESULTING SEQUENCES.

214
00:04:52,058 --> 00:04:53,226
SO THE RESULTS OF

215
00:04:53,226 --> 00:04:54,861
THESE EXPERIMENTS COULD HELP

216
00:04:54,861 --> 00:04:55,828
SET THE STAGE FOR

217
00:04:55,828 --> 00:04:57,130
GENOMIC EDITING IN SPACE

218
00:04:57,130 --> 00:04:58,197
AND PROTECT ASTRONAUTS

219
00:04:58,197 --> 00:04:59,432
FROM INTENSE RADIATION