



1
00:00:00,770 --> 00:00:02,560
>>> HI, MY NAME IS MATT DAMON.

2
00:00:02,560 --> 00:00:11,150
I PLAY ASTRONAUT MARK WATNEY IN
"THE MARTIAN" SENDING PEOPLE

3
00:00:11,150 --> 00:00:15,049
MARS AND RETURNING SAFELY IS THE
CHALLENGE OF A GENERATION.

4
00:00:15,049 --> 00:00:18,980
THE WHOLE WORLD HELD ITS BREATH
WHEN THE CURIOSITY LANDED IN

5
00:00:18,980 --> 00:00:21,830
2012.
THE BOOTS OF THAT WILL FOLLOW

6
00:00:21,830 --> 00:00:25,880
THAT THANKS TO INNOVATION
HAPPENING TODAY.

7
00:00:25,880 --> 00:00:31,160
THE JOURNEY TO MARS BEGINNING ON
THE INTERNATIONAL SPACE STATION

8
00:00:31,160 --> 00:00:39,040
SOME 250 MILES OVERHEAD.
FUTURE ROUND TRIPS TO MARS COULD

9
00:00:39,040 --> 00:00:43,010
TAKE 500 DAYS OR LONGER.
THIS YEAR, NASA LAUNCHED THE

10
00:00:43,010 --> 00:00:46,120
FIRST ONE-YEAR MISSION TO THE
INTERNATIONAL SPACE STATION TO

11

00:00:46,120 --> 00:00:47,840
HELP PREPARE FOR THOSE FUTURE
JOURNEYS.

12
00:00:47,840 --> 00:00:51,870
HERE AT HOME, PEOPLE ARE WORKING
ACROSS THE COUNTRY ON THE NEW

13
00:00:51,870 --> 00:00:57,000
ORION SPACECRAFT THAT WILL CARRY
ASTRONAUTS FARTHER THAN EVER

14
00:00:57,000 --> 00:00:59,920
BEFORE.
WHEN WE INVENT NEW TECHNOLOGIES

15
00:00:59,920 --> 00:01:04,199
FOR EXPLORATION, IT BENEFITS ALL
OF HUMANITY, BUT MORE THAN THAT

16
00:01:04,199 --> 00:01:07,740
THE JOURNEY TO MARS WILL FOREVER
CHANGE OUR HISTORY BOOK.

17
00:01:07,740 --> 00:01:11,709
REWRITING WHAT WE KNOW ABOUT THE
RED PLANET AND EXPANDING DEEPER

18
00:01:11,709 --> 00:01:17,539
INTO THE SOLAR SYSTEM.
FOLLOW NASA'S JOURNEY TO MARS AT

19
00:01:17,539 --> 00:01:27,529
WWW.NASA.GOV.
>>> WELL, HELLO, EVERYONE.

20
00:01:27,529 --> 00:01:29,619
WELCOME TO NASA'S DIGITAL
LEARNING NETWORK.

21

00:01:29,619 --> 00:01:32,469
MY NAME IS MICHAEL HARE.
I'M GOING TO BE YOUR HOST FOR

22
00:01:32,469 --> 00:01:38,149
SURVIVING AND THRIVING ON MARS.
AN INTERACTIVE EVENT WHERE WE'LL

23
00:01:38,149 --> 00:01:43,049
BRING MULTIPLE SCHOOLS IN
TALKING TO HERE AT NASA AND

24
00:01:43,049 --> 00:01:47,119
JOHNSON SPACE CENTER AND AMES
RESEARCH CENTER.

25
00:01:47,119 --> 00:01:53,079
A GREAT EVENT, HOW WE'RE GOING
TO LIVE ON THE SURFACE AND

26
00:01:53,079 --> 00:01:56,899
RETURN THEM SAFELY TO EARTH.
AS YOU KNOW, NASA IS CURRENTLY

27
00:01:56,899 --> 00:02:00,859
WORKING BUILDING THE FOUNDATION
OF ACTUALLY MAKING THIS AMAZING

28
00:02:00,859 --> 00:02:03,039
JOURNEY.
WE'RE BUILDING THE SPACECRAFT

29
00:02:03,039 --> 00:02:06,569
LIKE THE OR RYAN MULTIPURPOSE
CREW VEHICLE.

30
00:02:06,569 --> 00:02:12,310
WE'RE BUILDING THE SPACE LAUNCH
SYSTEM AND PULLING IT ALL

31

00:02:12,310 --> 00:02:17,160
TOGETHER WITH GROUND SUPPORT AND
DEVELOPMENT AND SYSTEMS

32
00:02:17,160 --> 00:02:20,330
OPERATION.
SO, WE'RE DOING A LOT OF WORK TO

33
00:02:20,330 --> 00:02:22,910
GET US FLYING.
ESPECIALLY ON AMERICA'S NEXT

34
00:02:22,910 --> 00:02:25,950
SPACE VEHICLE AND TRAVELING INTO
SPACE.

35
00:02:25,950 --> 00:02:28,360
AND NOT JUST AROUND THE
BUILDINGS.

36
00:02:28,360 --> 00:02:31,140
WE'RE GOING TO JOURNEY AWAY FROM
EARTH AND GO TO SOME AMAZING

37
00:02:31,140 --> 00:02:35,090
PLACES LIKE MARS.
WE'RE GOING TO LEARN ABOUT MARS

38
00:02:35,090 --> 00:02:38,180
AND WHAT BETTER WAY TO LEARN
THAN FROM THE EXPERTS.

39
00:02:38,180 --> 00:02:43,340
WE'VE GOT THREE SPECIAL EXPERTS.
GETTING TO MARS IS A VERY

40
00:02:43,340 --> 00:02:46,100
DIFFICULT TASK.
HOW DO WE DO IT?

41

00:02:46,100 --> 00:02:50,430
FIRST, WE COME UP WITH THE IDEA.
WE HAVE TO GET INSPIRATION.

42
00:02:50,430 --> 00:02:53,790
AND WHAT BETTER WAY TO GET
INSPIRATION FROM WRITER AND

43
00:02:53,790 --> 00:02:58,170
ARTISTS AND CREATIVE TYPES THAT
ACTUALLY SPARK OUR IMAGINATION

44
00:02:58,170 --> 00:03:00,420
AND GET US MOVING IN THE RIGHT
TRACK.

45
00:03:00,420 --> 00:03:03,960
WE'VE GOT A SCIENCE FICTION
WRITER TODAY, ANDY WEIR WHO IS

46
00:03:03,960 --> 00:03:07,040
THE WRITER FOR "THE MARTIAN"
JUST ABOUT TO COME OUT IN

47
00:03:07,040 --> 00:03:09,620
THEATERS.
IT'S AN AMAZING BOOK IF YOU GET

48
00:03:09,620 --> 00:03:13,320
A CHANCE TO READ IT.
HE DOES A BOOK ABOUT AN

49
00:03:13,320 --> 00:03:16,710
ASTRONAUT WHO GETS STRANDED ON
MARS AND HAS TO USE HIS

50
00:03:16,710 --> 00:03:21,400
INGENUITY AND INTELLIGENCE AND
ENGINEERING SKILLS TO MAKE SURE

51

00:03:21,400 --> 00:03:25,430
HE GETS BACK TO EARTH AND
ACTUALLY STAY ALIVE ON THE

52

00:03:25,430 --> 00:03:27,250
MARTIAN SURFACE.
WE'RE GOING TO TALK TO ANDY

53

00:03:27,250 --> 00:03:30,500
WEIR.
ANDY, DO YOU WANT TO SAY HI?

54

00:03:30,500 --> 00:03:33,070
>> HI, EVERYBODY, HOW ARE YOU
DOING?

55

00:03:33,070 --> 00:03:35,450
>> EXCELLENT.
THANK YOU SO MUCH.

56

00:03:35,450 --> 00:03:38,069
WE'RE GOING TO COME TO YOU AND
GET A LOT OF INFORMATION ABOUT

57

00:03:38,069 --> 00:03:41,510
HOW YOU CAME UP WITH YOUR IDEAS
IN ONCE A SECOND.

58

00:03:41,510 --> 00:03:46,760
ONCE WE HAVE THOSE IDEA, WE NEED
TO PUT THEM IN A CONCRETE PATH.

59

00:03:46,760 --> 00:03:49,970
WE NEED TO LEARN AND HAVE A BASE
OF KNOWLEDGE BEFORE WE CAN

60

00:03:49,970 --> 00:03:52,470
ACTUALLY CREATE THE NOTIFICATION
GO TO MARS.

61

00:03:52,470 --> 00:03:56,660
SO, WE NEED A REALLY BRILLIANT
SCIENTIST THAT STUDIES NOT ONLY

62
00:03:56,660 --> 00:04:00,200
THE EARTH BUT OTHER CELESTIAL
BODIES IN OUR SOLAR SYSTEM.

63
00:04:00,200 --> 00:04:04,480
TODAY, WE'VE GOT DR. †McKAY WHO
IS GOING TO BE TALKING TO US.

64
00:04:04,480 --> 00:04:09,260
HE IS A PLANETARY SCIENTIST
WORKING AT THE AMES RESEARCH

65
00:04:09,260 --> 00:04:11,560
CENTER.
AND HIS SPECIALTY IS ASTRO

66
00:04:11,560 --> 00:04:15,569
GEOPHYSICS.
HE'S GOING TO TALK ABOUT MARS

67
00:04:15,569 --> 00:04:18,659
ITSELF, WHAT IT CAN HOLD, CAN IT
IT SUPPORT LIFE?

68
00:04:18,659 --> 00:04:22,939
AND CAN MARTIANS ACTUALLY LIVE
ON THE SURFACE AND CAN WE

69
00:04:22,939 --> 00:04:26,080
ACTUALLY DO THAT?
DR. †McKAY, ARE YOU THERE?

70
00:04:26,080 --> 00:04:27,969
>> I AM.
HELLO, EVERYBODY.

71

00:04:27,969 --> 00:04:33,389
GOOD TO BE TALKING WITH YOU.
>> EXCELLENT.

72
00:04:33,389 --> 00:04:36,969
AND THEN FINALLY, WE HAVE THOSE
BRAVE COURAGEOUS FOLKS THAT

73
00:04:36,969 --> 00:04:43,659
ACTUALLY EXPLORE SPACE, THE
ASTRONAUTS.

74
00:04:43,659 --> 00:04:46,770
WE'RE ACTUALLY LEARNING A LOT ON
THE INTERNATIONAL SPACE STATION.

75
00:04:46,770 --> 00:04:49,999
WE HAVE ASTRONAUTS UP THERE.
TWO OF THEM STAYING FOR ONE

76
00:04:49,999 --> 00:04:55,919
WHOLE YEAR.
WE ACTUALLY HAVE AN ASTRONAUT IN

77
00:04:55,919 --> 00:04:57,610
OUR STUDIO.
RICKY ARNOLD IS GOING TO TALK TO

78
00:04:57,610 --> 00:05:01,599
YOU GUYS ABOUT THE HUMAN
ELEMENT, HOW ARE WE GOING TO GET

79
00:05:01,599 --> 00:05:04,379
WATER?
HOW ARE WE GOING TO GET AIR?

80
00:05:04,379 --> 00:05:11,180
HOW ARE WE GOING TO KEEP THOSE
ASTRONAUTS ALIVE, LIVING THERE.

81

00:05:11,180 --> 00:05:14,539
SO HE'S GOING TO TALK TO US A
LITTLE BIT BUT FIRST I WANT TO

82
00:05:14,539 --> 00:05:18,370
SEE WHO IS CONNECTED AS WELL.
WE'VE GOT SEVERAL ACTIVE

83
00:05:18,370 --> 00:05:22,349
PARTICIPANTS.
HIGH SCHOOLS AROUND THE COUNTRY.

84
00:05:22,349 --> 00:05:26,550
FIRST, YOU GUYS GET READY IN
YOUR MICROPHONES AND SAY HI.

85
00:05:26,550 --> 00:05:30,909
THE FIRST LOCATION I WANT TO GO
TO HOLDEN HIGH SCHOOL IN HOLDEN,

86
00:05:30,909 --> 00:05:34,219
MISSOURI CAN YOU GUYS UNMUTE
YOUR MICROPHONES AND GIVE A BIG

87
00:05:34,219 --> 00:05:41,530
WARM WELCOME.
>> All: HI!

88
00:05:41,530 --> 00:05:43,240
>> EXCELLENT JOB.
ALL RIGHT.

89
00:05:43,240 --> 00:05:44,860
WONDERFUL.
THAT'S HOLDEN HIGH SCHOOL.

90
00:05:44,860 --> 00:05:48,259
NOW CARVER MIDDLE SCHOOL IS
TRYING TO GET CONNECTED.

91

00:05:48,259 --> 00:05:50,800
THEY WERE FORTUNATE ENOUGH TO
SEND IN QUESTIONS BEFORE.

92
00:05:50,800 --> 00:05:53,870
SO IF THEY CAN'T GET CONNECTED,
I WILL GO AHEAD AND ASK THE

93
00:05:53,870 --> 00:05:56,839
QUESTIONS THAT THEY'VE ALREADY
SUBMITTED.

94
00:05:56,839 --> 00:06:01,830
LET'S GO TO THE THIRD CLIENT,
BASICALLY EAST STROUDSBURG, IN

95
00:06:01,830 --> 00:06:07,020
EAST STROUDSBURG, PENNSYLVANIA.
ARE YOU THERE.

96
00:06:07,020 --> 00:06:09,789
>> All: HEY!
>> EXCELLENT.

97
00:06:09,789 --> 00:06:19,129
LOOKS LIKE WE HAVE A WHOLE
CLASSROOM FULL.

98
00:06:19,129 --> 00:06:23,020
THIS IS WHAT WE WANT, AN
INTERACTIVE, EDUCATIONAL EVENT.

99
00:06:23,020 --> 00:06:26,339
GUYS, REMEMBER, YOU'RE THE ONES
THAT ARE ACTUALLY DOING THIS.

100
00:06:26,339 --> 00:06:29,309
WE'RE LAYING THE FOUNDATIONS
RIGHT NOW HERE IN NASA, BUILDING

101

00:06:29,309 --> 00:06:32,300
THE VEHICLES.
TESTING THEM OUT, BUT YOU GUYS

102
00:06:32,300 --> 00:06:37,020
ARE GOING TO BE IMPROVING ON
THAT TECHNOLOGY, ADVANCING OUR

103
00:06:37,020 --> 00:06:39,080
HUMAN SPACEFLIGHTS.
AND YOU'RE THE ONES THAT ARE

104
00:06:39,080 --> 00:06:42,050
ACTUALLY GOING TO BE LANDING ON
MARS.

105
00:06:42,050 --> 00:06:44,919
SO, WE'RE REALLY EXCITED.
HOPEFULLY, YOU GUYS GET EXCITED

106
00:06:44,919 --> 00:06:47,270
ABOUT TALKING TO OUR GUESTS
TODAY.

107
00:06:47,270 --> 00:06:50,559
LET'S GO AHEAD AND JUMP IN.
NOW, FIRST I WANT TO TALK TO

108
00:06:50,559 --> 00:06:53,059
ANDY WEIR.
WE'RE GOING TO THE AMES RESEARCH

109
00:06:53,059 --> 00:06:54,659
CENTER.
AND ANDY IS GOING TO GIVE US A

110
00:06:54,659 --> 00:06:58,759
LITTLE INFORMATION ABOUT WHAT
HIS INSPIRATION WAS.

111

00:06:58,759 --> 00:07:02,800
HOW HE DID HIS RESEARCH FOR
HAVING ASTRONAUTS GO TO MARS.

112
00:07:02,800 --> 00:07:06,379
AND JUST SOME OF THE INSIGHT
INTO THE CREATION OF HIS BOOK

113
00:07:06,379 --> 00:07:09,919
"THE MARTIAN."
TAKE IT AWAY, ANDY.

114
00:07:09,919 --> 00:07:18,159
>> THANKS.
WELL, I JUST BEEN IN MY WHOLE

115
00:07:18,159 --> 00:07:21,529
LIFE, I'VE ALWAYS BEEN A FAN OF
IT.

116
00:07:21,529 --> 00:07:24,360
I WAS SITTING AROUND WONDERING
HOW CAN WE DO A MANNED MISSION

117
00:07:24,360 --> 00:07:28,020
TO MARS.
THE SAME AS NASA FOLKS DO, ONLY

118
00:07:28,020 --> 00:07:32,339
THEY'RE EXPERTS AND I'M NOT.
I THOUGHT, HOW DO WE GET THE

119
00:07:32,339 --> 00:07:35,229
ASTRONAUTS THERE, HOW DO WE KEEP
THEM ALIVE ON THE SURFACE, AND

120
00:07:35,229 --> 00:07:40,099
HOW DO WE GET THEM HOME?
AND JUST GENERALLY, HOW CAN THIS

121

00:07:40,099 --> 00:07:42,789
WORK?
WITH TODAY'S TECHNOLOGY, NO MADE

122
00:07:42,789 --> 00:07:45,979
UP FANTASY DRAFT, JUST REAL
STUFF.

123
00:07:45,979 --> 00:07:49,809
SO WHAT DO WE DO?
WELL, I CAME UP WITH A MISSION

124
00:07:49,809 --> 00:07:52,669
PROFILE THAT I THINK WOULD WORK
WELL.

125
00:07:52,669 --> 00:07:55,569
AND THEN ANY MISSION PLANS NEEDS
TO DEAL WITH FAILURES AND

126
00:07:55,569 --> 00:07:57,939
POTENTIAL PROBLEMS.
OKAY.

127
00:07:57,939 --> 00:07:59,949
WHAT DOES THE CREW DO IF THIS
THING BREAKS?

128
00:07:59,949 --> 00:08:02,129
WHAT IF THIS OTHER THING BREAKS?
WHAT IF THESE TWO THINGS BREAK

129
00:08:02,129 --> 00:08:06,969
AT THE SAME TIME, THERE NEEDS TO
BE A PLAN IN PLACE.

130
00:08:06,969 --> 00:08:09,619
WHAT THEY DO, FALLBACKS.
BACKUPS, THAT SORT OF THING.

131

00:08:09,619 --> 00:08:13,349
WELL I STARTED TO REALIZE THAT
THESE INCREASINGLY DESPERATE

132
00:08:13,349 --> 00:08:15,649
SITUATIONS MIGHT MAKE FOR A GOOD
STORY.

133
00:08:15,649 --> 00:08:18,740
SO I CREATED AN UNFORTUNATE
PROTAGONIST AND SUBJECTED HIM TO

134
00:08:18,740 --> 00:08:22,339
ALL OF IT.
SO I'M AN ANGRY GUY.

135
00:08:22,339 --> 00:08:27,539
I SORT OF HAD A STORY HERE.
BUT I REALLY WANTED TO BE

136
00:08:27,539 --> 00:08:32,320
SCIENTIFICALLY ACCURATE.
OVER THE PRIOR TEN YEARS I

137
00:08:32,320 --> 00:08:35,580
PICKED UP A READER BASE THAT WAS
A BUNCH OF SCIENCE DORKS LIKE

138
00:08:35,580 --> 00:08:38,200
MYSELF.
PEOPLE WHO ARE KNIT PICKY†-- YOU

139
00:08:38,200 --> 00:08:47,850
KNOW, WANTED TO BE ACCURATE.
SO I ENDED UP DOING A TON OF

140
00:08:47,850 --> 00:08:52,040
RESEARCH TO FIND OUT EXACTLY HOW
ALL OF THESE THINGS WORKED.

141

00:08:52,040 --> 00:08:54,350
AND I DIDN'T KNOW ANYONE IN
AEROSPACE AT THE TIME.

142
00:08:54,350 --> 00:08:57,810
I DO NOW.
BUT I DIDN'T THEN.

143
00:08:57,810 --> 00:09:00,240
I DID ALL OF MY RESEARCH WITH
GOOGLE.

144
00:09:00,240 --> 00:09:03,250
ABOUT 90% OF THE TIME I ENDED UP
ON WIKIPEDIA.

145
00:09:03,250 --> 00:09:07,820
THAT'S PRETTY MUCH HOW THE
RESEARCH EFFORT WENT.

146
00:09:07,820 --> 00:09:09,900
THAT WAS THE EASY PART.
THE HARD PART FOR ME IS THE

147
00:09:09,900 --> 00:09:12,430
ACTUAL WRITING.
IT'S EASY FOR ME TO LOOK THINGS

148
00:09:12,430 --> 00:09:16,270
UP ABOUT SPACE, BECAUSE I ENJOY
THAT.

149
00:09:16,270 --> 00:09:21,370
SO, DURING MY TIME, MESSING
AROUND, LEARNING THINGS ABOUT

150
00:09:21,370 --> 00:09:26,290
MARS AND INNERPLANETARY SPACE
TRAVEL, I LEARNED A FEW STRANGE

151

00:09:26,290 --> 00:09:28,590
AND FUN FACTS WHICH I'LL SHARE
HERE.

152
00:09:28,590 --> 00:09:32,580
FIRST OFF, THE LARGEST MOUNTAIN
IN OUR SOLAR SYSTEM IS ONLY THIS

153
00:09:32,580 --> 00:09:35,630
LONG.
IT'S ON MARS.

154
00:09:35,630 --> 00:09:38,940
MOST PEOPLE KNOW THAT.
IT'S ABOUT EIGHT TIMES THE

155
00:09:38,940 --> 00:09:41,200
HEIGHT OF MT. †EVEREST.
OR IS IT FOUR†-- SIX?

156
00:09:41,200 --> 00:09:43,800
I DON'T KNOW.
IT'S MANY TIMES THE HEIGHT OF

157
00:09:43,800 --> 00:09:47,520
MT. †EVEREST.
IT'S SO WIDE THAT THE BASE OF IT

158
00:09:47,520 --> 00:09:52,270
IS ABOUT THE SIZE OF NEVADA.
SO THAT'S HOW BIG THAT MOUNTAIN

159
00:09:52,270 --> 00:09:56,740
IS, BUT IT'S SO WIDE COMPARED TO
ITS HEIGHT THAT THE GRADE, THE

160
00:09:56,740 --> 00:10:01,960
ANGLE, OF THE MOUNTAIN SIDE, THE
SLOPE, IS SO GENTLE THAT YOU

161

00:10:01,960 --> 00:10:04,140
WOULDN'T EVEN KNOW YOU'RE ON A
MOUNTAIN IF YOU WERE STANDING ON

162
00:10:04,140 --> 00:10:05,900
IT.
TO YOU, IT WOULD LOOK LIKE A

163
00:10:05,900 --> 00:10:09,550
FLAT, FEATURELESS PLANE BECAUSE
IT'S THAT SUBTLE.

164
00:10:09,550 --> 00:10:14,610
IN FACT, THE CURVATURE OF MARS,
JUST THE HORIZON HAS A LARGER

165
00:10:14,610 --> 00:10:18,630
EFFECT ON THE GRADE, THAN THE
ACTUAL MOUNTAIN ITSELF.

166
00:10:18,630 --> 00:10:20,890
SO YOU COULD BE STANDING ON THE
LARGEST MOUNTAIN IN THE SOLAR

167
00:10:20,890 --> 00:10:24,910
SYSTEM AND YOU'D THINK YOU WERE
IN A BLACK FEATURELESS PLANE.

168
00:10:24,910 --> 00:10:30,710
KIND OF WEIRD, HUH?
MARS HAS TWO MOONS.

169
00:10:30,710 --> 00:10:34,220
AND THEY BOTH CIRCLE MARS IN THE
SAME DIRECTION.

170
00:10:34,220 --> 00:10:36,600
KIND OF THE PREDOMINANT
DIRECTION THAT ALMOST EVERYTHING

171

00:10:36,600 --> 00:10:40,830
GOES AROUND IN THE SOLAR SYSTEM.
SO YOU WOULD THINK THEY BOTH

172
00:10:40,830 --> 00:10:44,510
CROSS THE SKY IN THE SAME
DIRECTION BUT IT TURNS OUT

173
00:10:44,510 --> 00:10:50,030
BECAUSE SOBOS IS SO CLOSE TO
MARS.

174
00:10:50,030 --> 00:10:56,250
THEY APPEAR TO BE GOING OPPOSITE
DIRECTIONS IN THE SKY.

175
00:10:56,250 --> 00:11:00,240
I ALWAYS THOUGHT THAT WAS A NEAT
BIT OF TRIVIA.

176
00:11:00,240 --> 00:11:02,870
THOSE ARE A FEW OF THE THINGS I
FOUND OUT DOING RESEARCH BUT I

177
00:11:02,870 --> 00:11:09,640
FOUND OUT AN AWFUL LOT MORE.
IF YOU WANT TO SEE THAT STUFF,

178
00:11:09,640 --> 00:11:13,320
BUY MULTIPLE COPIES, BUY THEM
FOR ALL OF YOUR FRIENDS.

179
00:11:13,320 --> 00:11:18,870
THEY'RE IN 35 LANGUAGES.
YOU SHOULD BUY ONE OF EACH, I

180
00:11:18,870 --> 00:11:20,450
THINK.
>> THANK YOU SO MUCH, ANDY.

181

00:11:20,450 --> 00:11:24,080
WE REALLY APPRECIATE IT.
AND HOPEFULLY, THAT GIVE US THE

182
00:11:24,080 --> 00:11:28,120
INSIGHT ON SOME OF THE RESEARCH
HE DID AND GETTING THE REALLY

183
00:11:28,120 --> 00:11:30,620
NEAT INFORMATION FOR THE BOOK
ITSELF.

184
00:11:30,620 --> 00:11:34,230
JUST LEARNING ABOUT MARS.
AND HOPEFULLY, YOU GUYS START

185
00:11:34,230 --> 00:11:37,330
LEARNING ABOUT MARS.
WE'VE GOT GREAT WEBSITES FOR YOU

186
00:11:37,330 --> 00:11:40,290
GUYS TO GO AT THE END OF IT.
I'LL PUT THAT ON THE SCREEN.

187
00:11:40,290 --> 00:11:45,350
NEXT, WE'RE GOING TO DR.†CHRIS
McKAY WHO IS A PLANETARY

188
00:11:45,350 --> 00:11:48,600
SCIENTIST AT AMES RESEARCH
CENTER AS WELL.

189
00:11:48,600 --> 00:11:51,630
AND HE IS ACTUALLY GOING TO BE
TALKING TO YOU ABOUT MARS

190
00:11:51,630 --> 00:11:54,130
ITSELF.
AND WHAT WE CAN GAIN BY ACTUALLY

191

00:11:54,130 --> 00:11:59,160
GOING TO MARS.
WHAT WE CAN ACTUALLY LEARN FROM

192
00:11:59,160 --> 00:12:01,850
THE MARTIAN SURFACE.
SO, NOW I'M GOING TO HAND IT

193
00:12:01,850 --> 00:12:05,170
OVER TO DR. †McKAY.
>> THANKS.

194
00:12:05,170 --> 00:12:09,820
I THINK AN IMPORTANT POINT
THAT'S BEING MADE HERE, AND IT'S

195
00:12:09,820 --> 00:12:12,890
BEING MADE IN THE BOOK "THE
MARTIAN" AND THE MOVIE, IS THAT

196
00:12:12,890 --> 00:12:17,860
MARS SAY PLACE WHERE HUMANS CAN
OBTAIN EVERYTHING THEY NEED TO

197
00:12:17,860 --> 00:12:20,030
SURVIVE.
WE CAN GET WATER IN THE

198
00:12:20,030 --> 00:12:22,750
ENVIRONMENT OF MARS.
WE CAN GET OXYGEN IN THE

199
00:12:22,750 --> 00:12:26,320
ENVIRONMENT OF MARS.
WE CAN GROW FOOD ON MARS.

200
00:12:26,320 --> 00:12:30,220
AND WE CAN OBTAIN ENERGY FROM
THE SUN AND FROM THE WIND ON

201

00:12:30,220 --> 00:12:33,400

MARS.

SO IN A FUNDAMENTAL WAY, MARS IS

202

00:12:33,400 --> 00:12:35,810

A PLACE WHERE HUMANS CAN GIVE
AND WORK.

203

00:12:35,810 --> 00:12:37,690

AND THAT'S WHAT MAKES IT SO
ATTRACTIVE.

204

00:12:37,690 --> 00:12:40,920

AND THAT'S WHAT MAKES IT SUCH A
GREAT SETTING FOR STORIES LIKE

205

00:12:40,920 --> 00:12:45,160

"THE MARTIAN" AND FOR MOVIES
LIKE THIS MOVIE "THE MARTIAN" AS

206

00:12:45,160 --> 00:12:47,500

WELL.

MARS IS A PLACE THAT IN A WAY

207

00:12:47,500 --> 00:12:51,440

IT'S CALLING US, SAYING
EVERYTHING IS HERE.

208

00:12:51,440 --> 00:12:55,500

COME CHECK IT OUT.
AND IT'S THAT SAME ABUNDANCE OF

209

00:12:55,500 --> 00:12:59,310

RESOURCES, WATER, OXYGEN, CARBON
DIOXIDE.

210

00:12:59,310 --> 00:13:03,050

EARTH-LIKE ENVIRONMENTS,
EVIDENCE OF PAST WATER, THAT

211

00:13:03,050 --> 00:13:06,990
INDICATES IN THE PAST PERHAPS,
MARS HAD HAD LIFE AND THAT

212
00:13:06,990 --> 00:13:11,250
BECOMES THE SCIENCE DRIVER.
THE STORY OF MARS IS THE STORY

213
00:13:11,250 --> 00:13:14,700
OF LIFE, LIFE THAT HUMANS CAN
SURVIVE ON MARS.

214
00:13:14,700 --> 00:13:17,700
AND THAT EVERYTHING NEEDED TO
SUPPORT LIFE IS THERE.

215
00:13:17,700 --> 00:13:21,890
AND THE STORY OF LIFE AND ALL
THE SAME RESOURCES MAY HAVE MADE

216
00:13:21,890 --> 00:13:25,350
MARS HABITABLE IN THE PAST.
AND THEY HAVE SUPPORTED A BIO

217
00:13:25,350 --> 00:13:31,980
SPHERE FROM LONG AGO.
SO IT'S A COMPELLING

218
00:13:31,980 --> 00:13:34,670
DESTINATION.
I'VE BEEN EXCITED ABOUT THE

219
00:13:34,670 --> 00:13:37,580
SUCCESS OF THIS BOOK AND THE
PROSPECT OF THIS MOVIE IN

220
00:13:37,580 --> 00:13:40,850
REMINDING US WHY MARS IS SO
EXCITING.

221

00:13:40,850 --> 00:13:44,450
WHY WE NEED TO SEND HUMANS.
WHY ROBOTS ARE NOT ENOUGH.

222
00:13:44,450 --> 00:13:47,160
ULTIMATELY, MARS IS THE STORY
ABOUT LIFE.

223
00:13:47,160 --> 00:13:49,450
WE NEED TO LEARN HOW TO SEND
HUMANS THERE.

224
00:13:49,450 --> 00:13:51,820
THAT'S FUNDAMENTALLY WHAT WE'RE
DOING THERE, DEVELOPING THE

225
00:13:51,820 --> 00:13:54,750
TECHNOLOGIES AND LEARNING ON THE
SPACE STATION HOW TO DO THAT.

226
00:13:54,750 --> 00:13:59,620
AND I THINK THAT'S WHAT WE'RE
GOING TO GO TO NEXT.

227
00:13:59,620 --> 00:14:01,260
>> ALL RIGHT.
AND THAT'S AN EXCELLENT TIE-IN

228
00:14:01,260 --> 00:14:04,560
TO WHAT RICKY WANTS TO TALK
ABOUT.

229
00:14:04,560 --> 00:14:07,660
WE DO HAVE PEOPLE LIVING UP ON
THE INTERNATIONAL SPACE STATION.

230
00:14:07,660 --> 00:14:10,590
WE STARTED BUILDING IT WAY BACK
IN 1988 AND PEOPLE HAVE BEEN

231

00:14:10,590 --> 00:14:12,130
LIVING ON BOARD SINCE THE YEAR
2000.

232
00:14:12,130 --> 00:14:17,180
WE'RE GOING TO TALK ABOUT WHAT
WE'RE LEARNING NOW HOW TO EXTEND

233
00:14:17,180 --> 00:14:22,370
THE MISSION DURATION TIME AND
ALL OF THE RESOURCES WE NEED.

234
00:14:22,370 --> 00:14:27,010
>> ABSOLUTELY GREAT TO BE HERE
WITH YOU TODAY.

235
00:14:27,010 --> 00:14:29,230
AND I GOT TO HELP BUILD THE
INTERNATIONAL SPACE STATION.

236
00:14:29,230 --> 00:14:37,880
I HOPE TO LIVE IN IT ONE DAY.
MY RIDE TO SPACE TOOK 8½

237
00:14:37,880 --> 00:14:41,350
MINUTES.
AND NOW WE CAN EVEN DOCK AT THE

238
00:14:41,350 --> 00:14:43,800
SPACE STATION AND BE THERE ANY
FEW HOURS.

239
00:14:43,800 --> 00:14:50,310
YOU'RE WORKING AT LONG DURATIONS
TO GET TO MARS.

240
00:14:50,310 --> 00:14:52,420
WHAT THE EFFECT ON THE HUMAN
BODY?

241

00:14:52,420 --> 00:14:56,580
YESTERDAY, SCOTT KELLY AND
MIKHAIL KORNIENKO CELEBRATED THE

242

00:14:56,580 --> 00:15:01,290
HALFWAY POINT FOR THEIR MISSION.
THERE ARE CHALLENGES AND THERE

243

00:15:01,290 --> 00:15:06,240
WILL BE CHALLENGES IN DEEP
SPACE, IN TERMS OF HUMAN HEALTH.

244

00:15:06,240 --> 00:15:09,280
SOME OF THE THINGS WE'RE
LEARNING, BONE LOSS.

245

00:15:09,280 --> 00:15:12,680
THE MINUTE WE GET ON BOARD, THEY
BOTH LOSE CALCIUM.

246

00:15:12,680 --> 00:15:17,970
WE'VE FOUND THROUGH REGULAR
EXERCISE THAT WE'RE ABLE TO

247

00:15:17,970 --> 00:15:19,960
MAINTAIN BONE DENSITY AND
STRENGTH.

248

00:15:19,960 --> 00:15:27,450
THIS IS IMPORTANT BECAUSE YOU
HAVE TO LAND AND START WORKING.

249

00:15:27,450 --> 00:15:30,720
SO THEY HAVE TO BE IN A PHYSICAL
CONDITION SO THEY CAN GET THERE.

250

00:15:30,720 --> 00:15:35,250
HAVING A ONE-YEAR CREW UP THERE,
WORKING AND EXERCISING AND DOING

251

00:15:35,250 --> 00:15:37,940
A TEST TO SEE HOW THEY'RE
BEHAVING AND HOW THEIR BODIES

252
00:15:37,940 --> 00:15:43,250
ARE PERFORMING IS ABSOLUTELY
CRITICAL TO OUR MISSION OF MARS.

253
00:15:43,250 --> 00:15:47,790
WE'VE ALSO NOTICED THAT THERE'S
SOME VISION SHIFT ISSUES IN

254
00:15:47,790 --> 00:15:50,880
ASTRONAUTS THAT HAVE COME HOME.
SOME PEOPLE TEND TO GET A LITTLE

255
00:15:50,880 --> 00:15:54,490
FAR-SIGHTED.
WE'RE DOING A LOT OF STUDIES TO

256
00:15:54,490 --> 00:16:02,370
IDENTIFY, IS IT A DIETARY THING,
OR FACTORS WE HAVEN'T FIGURED

257
00:16:02,370 --> 00:16:03,750
OUT.
AGAIN, IF WE'RE GOING TO SEND

258
00:16:03,750 --> 00:16:07,279
SOMEONE ON A LONG MISSION, WE
DON'T WANT BIG VISION SHIFTS AND

259
00:16:07,279 --> 00:16:11,450
HAVE THEM GET THERE AND NOT BE
ABLE TO READ THE EQUIPMENT THAT

260
00:16:11,450 --> 00:16:14,670
THEY'RE FOLLOWING ALONG WITH.
THE FINAL THING, MY FIRST NIGHT

261

00:16:14,670 --> 00:16:17,440
IN ORBIT.
I'LL NEVER FORGET, AFTER A LONG

262
00:16:17,440 --> 00:16:20,970
DAY, LEAVING FLORIDA AND FINDING
YOURSELF IN OUTER SPACE.

263
00:16:20,970 --> 00:16:24,980
I WENT TO BED AT NIGHT AND
CLOSED MY EYES.

264
00:16:24,980 --> 00:16:27,940
ALL OF A SUDDEN, I STARTED
EXPERIENCING THESE FLASHES

265
00:16:27,940 --> 00:16:33,740
INSIDE MY EYES WHEN THEY WERE
CLOSED.

266
00:16:33,740 --> 00:16:37,260
WHAT IT WAS, THE SUBATOMIC
PARTICLES FROM THE SUN,

267
00:16:37,260 --> 00:16:39,930
RADIATION STRIKING THE BACK OF
MY EYES.

268
00:16:39,930 --> 00:16:42,670
ON THE INTERNATIONAL SPACE
STATION, WE'RE PROTECTED BY THE

269
00:16:42,670 --> 00:16:46,330
EARTH'S MAGNETIC FIELD.
ONCE WE LEAVE THAT PROTECTIVE

270
00:16:46,330 --> 00:16:50,330
COVER AND HEAD OUT TO MARS,
WE'RE EXPOSING CREW TO

271

00:16:50,330 --> 00:16:53,980

RADIATION.

ANDY IS FORTUNATE, HE SAID HE

272

00:16:53,980 --> 00:16:57,810

COULD WRITE OFF RADIATION AND
PROTECT A FABRIC THAT'S

273

00:16:57,810 --> 00:17:00,240

LIGHTWEIGHT.

THAT'S A CHALLENGE WE'RE GOING

274

00:17:00,240 --> 00:17:04,730

TO HAVE TO DEAL WITH ON THE
SURFACE OF MARS.

275

00:17:04,730 --> 00:17:07,530

WATER IS ALSO VERY CRITICAL AS
DR. †McKAY SAID.

276

00:17:07,530 --> 00:17:12,059

THERE ARE AMPLE SOURCES ON THE
SURFACE OF MARS FOR US TO

277

00:17:12,059 --> 00:17:16,059

UTILIZE.

THE RESOURCES ARE THERE ON THE

278

00:17:16,059 --> 00:17:18,370

INTERNATIONAL SPACE STATION.
OUR WATER HAS TO ALL COME UP

279

00:17:18,370 --> 00:17:21,809

FROM EARTH.

BUT WE'RE ABLE TO RECYCLE ALMOST

280

00:17:21,809 --> 00:17:25,050

ALL OF IT IN A DAILY BASIS.
SO WE CAN TAKE HUMIDITY OUT OF

281

00:17:25,050 --> 00:17:29,559
THE ATMOSPHERE, PERSPIRATION,
EVEN REPROCESS URINE INTO

282
00:17:29,559 --> 00:17:38,820
DRINKING WATER.
IT'S A REALLY IMPORTANT

283
00:17:38,820 --> 00:17:42,490
TECHNOLOGY WHEN WE DO GET TO
MARS.

284
00:17:42,490 --> 00:17:46,010
FOOD, ALL OF OUR FOOD AS HAS TO
COME FROM EARTH.

285
00:17:46,010 --> 00:17:50,350
I'M SHOWING TWO THINGS HERE.
THIS IS MAC 'N' CHEESE.

286
00:17:50,350 --> 00:17:55,120
AND THESE ARE SHRIMP.
AS ONLY NASA CAN PACKAGE THEM,

287
00:17:55,120 --> 00:17:56,660
LIVING HERE ON THE GULF COAST OF
TEXAS.

288
00:17:56,660 --> 00:17:58,420
BUT THEY ACTUALLY TASTE PRETTY
GOOD.

289
00:17:58,420 --> 00:18:01,840
BUT ALL OF OUR FOOD, AGAIN,
THESE COME FROM EARTH.

290
00:18:01,840 --> 00:18:05,980
AND JUST A COUPLE WEEKS AGO, THE
INTERNATIONAL SPACE STATION

291

00:18:05,980 --> 00:18:09,750
ACTUALLY HARVESTED SOME LETTUCE
THAT WAS GROWN ON THE

292

00:18:09,750 --> 00:18:12,860
INTERNATIONAL SPACE STATION.
AND WE ARE GOING TO HAVE, AS WE

293

00:18:12,860 --> 00:18:17,000
HEAD OUT, IN ORBIT, AND START
EXPLORING OTHER PLANETARY

294

00:18:17,000 --> 00:18:19,559
SURFACES, WE'RE GOING TO HAVE TO
GROW OUR OWN FOOD.

295

00:18:19,559 --> 00:18:24,380
AND THAT WAS A REALLY IMPORTANT
STEP ON OUR TRIP TO MARS.

296

00:18:24,380 --> 00:18:29,000
THE COMMUNICATION IS†-- IT'S
INSTANTANEOUS, FROM THE

297

00:18:29,000 --> 00:18:30,630
INTERNATIONAL SPACE STATION.
I CAN CALL HOME.

298

00:18:30,630 --> 00:18:33,559
I CAN CALL MY FRIENDS.
I COULD CALL AND ORDER A PIZZA

299

00:18:33,559 --> 00:18:36,170
IF I WANTED, I COULDN'T GET IT
DELIVERED TO WHERE I WANTED IT,

300

00:18:36,170 --> 00:18:40,050
AT LEAST ON THE INTERNATIONAL
SPACE STATION.

301

00:18:40,050 --> 00:18:45,110
WHEN WE GO TO MARS IT'S GOING TO
BE A CONDUIT OF 20 TO 30

302
00:18:45,110 --> 00:18:47,080
MINUTES.
I'VE ACTUALLY LIVED LIVED UNDER

303
00:18:47,080 --> 00:18:51,820
THE OCEAN WHERE WE PRETENDED A
20 TO 30-MINUTE TIME DELAY TO

304
00:18:51,820 --> 00:18:56,150
SIMULATE LIVING ON MARS.
IT'S CHALLENGING.

305
00:18:56,150 --> 00:19:00,750
IT'S CAPTURED WELL IN THE BOOK.
YOU'RE WAITING FOR INSTRUCTIONS

306
00:19:00,750 --> 00:19:08,090
FOR 20 MINUTES AND YOU'VE GOT A
QUESTION ABOUT THE INSTRUCTIONS.

307
00:19:08,090 --> 00:19:10,990
ON THE INTERNATIONAL SPACE
STATION, MISSION CONTROL

308
00:19:10,990 --> 00:19:14,110
BASICALLY PLANS OUT MOST OF OUR
DAY.

309
00:19:14,110 --> 00:19:17,059
WE'RE GOING TO HAVE TO GIVE
ASTRONAUTS, AS THEY HEAD OUT TO

310
00:19:17,059 --> 00:19:19,390
MARS, SAY HERE'S SOME OF OUR
MAJOR OBJECTIVES.

311

00:19:19,390 --> 00:19:21,630
YOU GUYS FIGURE OUT HOW TO DO
IT.

312
00:19:21,630 --> 00:19:25,130
I REALLY APPRECIATE KIND OF THE
CREATIVE PROBLEM-SOLVING THAT

313
00:19:25,130 --> 00:19:27,300
HAPPENED IN THE BOOK.
BECAUSE I THINK THAT'S HOW IT'S

314
00:19:27,300 --> 00:19:29,550
GOING TO HAVE TO UNFOLD ON A
DAY-TO-DAY BASIS.

315
00:19:29,550 --> 00:19:33,180
YOU CAN ASK THE GROUND FOR HELP,
BUT YOU CAN'T AFFORD TO SIT AND

316
00:19:33,180 --> 00:19:36,170
WAIT FOR AN ANSWER IS ALL THE
TIME.

317
00:19:36,170 --> 00:19:39,290
FINALLY AIR, ATMOSPHERE, AGAIN,
THE INGREDIENTS ARE GOING TO BE

318
00:19:39,290 --> 00:19:42,710
THERE ON THE SURFACE FOR US.
BUT ON THE INTERNATIONAL SPACE

319
00:19:42,710 --> 00:19:45,790
STATION, IT CALL COMES DOWN FROM
EARTH.

320
00:19:45,790 --> 00:19:49,470
WE SEND IT UP, WE'RE ABLE TO
SCRUB IT, PURIFY AND KEEP IT

321

00:19:49,470 --> 00:19:51,520
BREATHABLE.
THAT'S ANOTHER THING WE'RE GOING

322
00:19:51,520 --> 00:19:55,690
TO HAVE TO MINE AND HAVE THERE
ON THE SURFACE OF MARS.

323
00:19:55,690 --> 00:19:59,520
SO WHAT I'VE KIND OF THROWN OUT
TO YOU, THERE'S A LOT OF

324
00:19:59,520 --> 00:20:02,860
TECHNICAL CHALLENGES, WE'RE
WORKING ON AS TOUGH AS WE CAN

325
00:20:02,860 --> 00:20:06,080
FROM NASA TO GET READY FOR IT.
REALLY ALL AROUND THE COUNTRY

326
00:20:06,080 --> 00:20:08,970
AND WORLD.
THESE CHALLENGES ARE FOR YOU

327
00:20:08,970 --> 00:20:17,480
GUYS, STUDY YOUR ENGINEERING,
TECHNOLOGY AND MATH, AS WE HEARD

328
00:20:17,480 --> 00:20:21,240
IN THE TRAILER, IT'S A
FUNDAMENTAL MOMENT WHEN THE

329
00:20:21,240 --> 00:20:23,770
FIRST HUMAN TAKES THEIR FIRST
STEP ON MARS.

330
00:20:23,770 --> 00:20:26,559
TO BE A PART OF THAT IS REALLY
SOMETHING SPECTACULAR, JUST LIKE

331

00:20:26,559 --> 00:20:29,610
IT'S A GREAT HONOR BEING HERE
BEING A PART OF THE

332
00:20:29,610 --> 00:20:31,809
INTERNATIONAL SPACE TEAM.
>> EXCELLENT.

333
00:20:31,809 --> 00:20:36,340
TO KEEP THAT GOING, WE WANT TO
ACTUALLY SEE WHAT YOU GUYS HAVE

334
00:20:36,340 --> 00:20:39,650
AS FAR AS QUESTIONS TO OUR
SUBJECT MATTER EXPERTS.

335
00:20:39,650 --> 00:20:41,290
THIS IS THE WAY WE'RE GOING TO
WORK IT.

336
00:20:41,290 --> 00:20:44,250
WE'RE GOING TO THE HIGH SCHOOLS,
WE'RE GOING TO ASK TWO QUESTIONS

337
00:20:44,250 --> 00:20:47,580
AT EACH LOCATION.
AFTER THAT, WE ALSO HAVE

338
00:20:47,580 --> 00:20:52,220
QUESTIONS AVAILABLE ON THE INFO
CHANNEL.

339
00:20:52,220 --> 00:20:54,770
SO YOU GUYS CAN SUBMIT QUESTIONS
@DLINFOCHANNEL.COM.

340
00:20:54,770 --> 00:21:02,220
FOR ALL OF YOU WATCHING IT ON
THE STREAM.

341

00:21:02,220 --> 00:21:04,850

IF YOU'D LIKE TO SUBMIT
QUESTIONS, FEEL FREE.

342

00:21:04,850 --> 00:21:08,300

I'LL GO TO THE SCHOOLS FIRST,
THEN I'LL TAKE QUESTIONS FROM

343

00:21:08,300 --> 00:21:16,190

DLO.
AND WE HAVE THE TWITTER FEED, IF

344

00:21:16,190 --> 00:21:19,390

YOU WANT TO SUBMIT A QUESTION
THERE, WE'LL TRY TO GET THEM TO

345

00:21:19,390 --> 00:21:24,210

EITHER DR. †McKAY OR ANDY WEIR SO
WE CAN INCLUDE THEM AS WELL.

346

00:21:24,210 --> 00:21:28,050

LET'S GO AHEAD AND KICK IT OFF
WITH HOLDEN HIGH SCHOOL.

347

00:21:28,050 --> 00:21:30,790

AND SEE WHAT YOUR FIRST TWO
QUESTIONS ARE.

348

00:21:30,790 --> 00:21:32,840

DEFINITELY UNMUTE YOUR
MICROPHONES.

349

00:21:32,840 --> 00:21:41,930

SPEAK LOUDLY AND CLEARLY AND LET
US KNOW YOUR QUESTIONS.

350

00:21:41,930 --> 00:21:49,280

>> I THINK THE QUESTION WAS †--
>> I CAN ANSWER THAT.

351

00:21:49,280 --> 00:21:52,420
IT'S A GOOD QUESTION, I THINK
IT'S A QUESTION THAT WILL BE

352
00:21:52,420 --> 00:21:56,190
ADDRESSED BY THE MISSION, THE
NEXT NASA MISSION TO MARS

353
00:21:56,190 --> 00:21:59,340
INSIGHT.
IT WILL BE THE FIRST FUNCTIONING

354
00:21:59,340 --> 00:22:02,600
EARTHQUAKE SYSTEM.
WE EXPECT THERE TO BE

355
00:22:02,600 --> 00:22:05,450
EARTHQUAKES.
MARS IS NOT AS ACTIVE AS THE

356
00:22:05,450 --> 00:22:08,309
EARTH, BUT IT HAS, AS WE HEARD
FROM ANDY, THE LARGEST MOUNTAIN

357
00:22:08,309 --> 00:22:11,670
IN THE SOLAR SYSTEM.
IT HAS A LOT OF ADJUSTMENTS

358
00:22:11,670 --> 00:22:15,460
STILL GOING ON IN ITS CRUST.
WE EXPECT THERE TO BE GRUMBLING

359
00:22:15,460 --> 00:22:19,550
ON THE SURFACE AND WE EXPECT TO
BE ABLE TO PICK IT UP.

360
00:22:19,550 --> 00:22:25,100
WATCH FOR THE MISSION AND LAUNCH
2016, AND IT WILL TELL US TO

361

00:22:25,100 --> 00:22:27,630

WHAT EXTENT MARS HAS
EARTHQUAKES.

362

00:22:27,630 --> 00:22:30,429

IF I WAS BETTING, I'D BET YES,
IT DOES.

363

00:22:30,429 --> 00:22:33,870

>> I GUESS WE'D CALL IT
MARS-QUAKES, WOULDN'T WE?

364

00:22:33,870 --> 00:22:36,980

BUT IT'S GOT THAT RUMBLING AND
GRUMBLING THAT WE'RE SO FAMILIAR

365

00:22:36,980 --> 00:22:41,900

WITH HERE IN CALIFORNIA.
>> GREAT QUESTION.

366

00:22:41,900 --> 00:22:48,150

HOLDEN, YOUR SECOND QUESTION?
>> YES, WHAT KIND OF RESOURCES

367

00:22:48,150 --> 00:22:59,520

ON MARS ARE HUMANS ABLE TO USE?
>> WELL, MARS IS ACTUALLY REALLY

368

00:22:59,520 --> 00:23:02,080

HANDY IF YOU EVER WANTED TO
COLONIZE IT, BECAUSE IT HAS

369

00:23:02,080 --> 00:23:04,480

ABSOLUTELY EVERYTHING YOU NEED
FOR LIFE.

370

00:23:04,480 --> 00:23:08,020

FOR STARTER, IT HAS WATER, LOTS
OF IT.

371

00:23:08,020 --> 00:23:10,750
CURIOSITY, WE ONLY RECENTLY
FOUND THIS OUT, WE THOUGHT IT IT

372
00:23:10,750 --> 00:23:18,179
WAS AN ARID WASTE LAND, BUT
CURIOSITY FOUND OUT THERE'S

373
00:23:18,179 --> 00:23:21,080
ABOUT 35 LITERS OF WATER IN
THERE.

374
00:23:21,080 --> 00:23:25,460
IF YOU LOOK AT THE SIZE OF YOUR
REFRIGERATOR, IF YOU TOOK THAT

375
00:23:25,460 --> 00:23:31,980
MUCH MARTIAN DIRT, YOU'D GET 35
TWO-LITER BOTTLES OUT OF IT.

376
00:23:31,980 --> 00:23:35,179
SO THERE'S PLENTY OF WATER.
THAT HAS TO DO WITH HYDROGEN AND

377
00:23:35,179 --> 00:23:37,929
OXYGEN.
NOW, THERE'S ALSO PLENTY OF

378
00:23:37,929 --> 00:23:40,320
CARBON, IN THE FORM OF CARBON
DIOXIDE.

379
00:23:40,320 --> 00:23:43,910
THE ATMOSPHERE OF MARS IS ALMOST
ENTIRELY Co₂.

380
00:23:43,910 --> 00:23:50,429
IT'S VERY THIN BUT PLENTY OF Co₂
TO GO AROUND.

381

00:23:50,429 --> 00:23:55,470
FINALLY, ABOUT 2% NITROGEN AND
THERE ARE NITRATES IN THE SOIL.

382
00:23:55,470 --> 00:24:14,640
THOSE ARE YOUR FOUR THINGS
CARBON, OXYGEN, NITROGEN.

383
00:24:14,640 --> 00:24:16,660
>> WE'RE LEARNING HOW TO DO
RECYCLING.

384
00:24:16,660 --> 00:24:20,679
HIGH EFFICIENCY RECYCLING OF
AIR, WATER AND CARBON.

385
00:24:20,679 --> 00:24:24,809
THE NEED TO EXTRACT THEM FROM
THE ATMOSPHERE IS MINIMIZED BY

386
00:24:24,809 --> 00:24:28,230
THAT USE OF TECHNOLOGY.
THAT'S AN IMPORTANT WAY BY WHICH

387
00:24:28,230 --> 00:24:31,670
THE TOOLS DEVELOPING ON THE
SPACE STATION WILL APPLY

388
00:24:31,670 --> 00:24:36,640
DIRECTLY ON THE SURFACE OF MARS.
>> ALL RIGHT.

389
00:24:36,640 --> 00:24:39,140
EXCELLENT.
THANK YOU GUYS SO MUCH.

390
00:24:39,140 --> 00:24:41,700
>>> NOW, CARVER MIDDLE SCHOOL IS
STILL TRYING TO GET IN.

391

00:24:41,700 --> 00:24:44,210
BUT THEY DID SUBMIT THEIR
QUESTIONS BEFOREHAND.

392
00:24:44,210 --> 00:24:51,929
I WANT TO ASK THEM QUESTIONS.
HOPEFULLY THEY'RE VIEWING ON THE

393
00:24:51,929 --> 00:24:57,299
STREAM FEED.
THE FIRST QUESTION IS IN REGARDS

394
00:24:57,299 --> 00:25:01,510
TO COLONIZING MARS, WHAT WOULD
THE COST BE, AND HOW LONG WOULD

395
00:25:01,510 --> 00:25:04,370
IT ACTUALLY TAKE?
>> THAT'S A TOUGH ONE.

396
00:25:04,370 --> 00:25:09,660
UNFORTUNATELY, WE DON'T HAVE ANY
NASA ADMINISTRATORS HERE ON THE

397
00:25:09,660 --> 00:25:12,730
PANEL HERE.
BUT WE ARE WORKING ON IT RIGHT

398
00:25:12,730 --> 00:25:15,390
NOW.
WE'RE BUILDING THE VEHICLE,

399
00:25:15,390 --> 00:25:18,860
HOPEFULLY BY THE 2030s, WE'LL BE
ACTUALLY WORKING DIRECT MISSIONS

400
00:25:18,860 --> 00:25:22,559
TO SEND HUMANS TO MARS.
BUT IT'S GOING TO TAKE A LOT.

401

00:25:22,559 --> 00:25:26,140
LIKE WE TALK ABOUT, HARVESTING
ALL OF THE ELEMENTS THAT ARE ON

402
00:25:26,140 --> 00:25:27,350
MARS.
THAT'S GOING TO TAKE EQUIPMENT.

403
00:25:27,350 --> 00:25:30,630
IT'S GOING TO TAKE MANY MISSIONS
TO LAND THAT STUFF ON THE

404
00:25:30,630 --> 00:25:35,780
SURFACE OF THE PLANET BEFORE WE
CAN SEND HUMANS AND DO IT.

405
00:25:35,780 --> 00:25:39,660
IT'S ALSO VERY DIFFICULT TO GIVE
YOU A PRICE TAG AS WELL BECAUSE

406
00:25:39,660 --> 00:25:42,040
IT HAPPENS INCREMENTALLY, IT'S
NOT LIKE IT'S GOING TO HAPPEN

407
00:25:42,040 --> 00:25:44,140
ONE YEAR.
IT'S NOT LIKE IT'S GOING TO BE

408
00:25:44,140 --> 00:25:48,340
THIS MANY BILLIONS OF DOLLARS.
IT'S GOING TO BE OVER A 20 OR

409
00:25:48,340 --> 00:25:50,880
30-YEAR PERIOD OF TIME.
IT'S GOING TO BE DIFFICULT

410
00:25:50,880 --> 00:25:54,640
BECAUSE THE BUDGET GOES UP AND
DOWN FROM YEAR TO YEAR.

411

00:25:54,640 --> 00:25:58,440

IT'S KIND OF A DIFFICULT
QUESTION TO ANSWER, IT

412

00:25:58,440 --> 00:26:01,390

DEFINITELY WILL BE IN THE
BILLIONS OF DOLLARS, BUT IT'S

413

00:26:01,390 --> 00:26:04,090

HARD TO GET THE EXACT AMOUNT.
>> GREAT QUESTION.

414

00:26:04,090 --> 00:26:07,670

LET'S GO TO ANOTHER ONE FROM
CARVER MIDDLE SCHOOL, HOW DOES

415

00:26:07,670 --> 00:26:13,850

BEING AN ASTRONAUT AFFECT A
MISSION?

416

00:26:13,850 --> 00:26:16,830

HOW LONG DID YOU STAY?
>> 13 DAYS.

417

00:26:16,830 --> 00:26:19,360

>> THAT'S NOT BAD.
MOST MISSION, SIX MONTHS.

418

00:26:19,360 --> 00:26:21,570

>> SIX MONTHS.
>> AND SCOTT KELLY AND MIKHAIL

419

00:26:21,570 --> 00:26:29,190

KORNIENKO, A YEAR.
>> WHEN YOU GET HOME, THE GRASS

420

00:26:29,190 --> 00:26:31,809

STILL NEEDS TO BE CUT.
ALL OF THE THINGS THAT YOU GET

421

00:26:31,809 --> 00:26:35,100
BACK TO EARTH, IT'S A PRETTY
EXCITING DAY OR TWO AND THEN

422
00:26:35,100 --> 00:26:39,679
YOU'RE BACK TO LIFE.
ONE OF MY FAVORITE STORIES MY

423
00:26:39,679 --> 00:26:42,630
DAUGHTER'S FIRST DAY OF SCHOOL
WHEN WE MOVED HERE IN 2004.

424
00:26:42,630 --> 00:26:45,920
SHE SAT DOWN IN CLASS, THE
STUDENTS ARE PUT ALPHABETICALLY

425
00:26:45,920 --> 00:26:49,610
LIKE THEY OFTEN ARE IN
ELEMENTARY SCHOOL.

426
00:26:49,610 --> 00:26:51,760
THEY WERE SUPPOSED TO ANNOUNCE
WHAT THEIR NAMES AND WHAT THEIR

427
00:26:51,760 --> 00:26:58,970
PARENTS DO.
MY NAME IS CARRIE, MY MOM IS A

428
00:26:58,970 --> 00:27:01,180
TEACHER AND MY DAD IS AN
ASTRONAUT.

429
00:27:01,180 --> 00:27:08,770
>> AND THE NEXT KID SAID, AND MY
BOSS IS HER DAD'S BOSS.

430
00:27:08,770 --> 00:27:15,900
HE WAS THE COMMANDER.
IT'S VERY COMMON AROUND HERE, A

431

00:27:15,900 --> 00:27:22,610
BIG COMMUNITY MAKING THIS
HAPPEN.

432
00:27:22,610 --> 00:27:26,110
>> AND THE ASTRONAUTS UP ON THE
SPACE STATION DO GET A CHANCE TO

433
00:27:26,110 --> 00:27:28,810
COMMUNICATE DOWN WITH THE GROUND
IN MANY DIFFERENT WAYS.

434
00:27:28,810 --> 00:27:30,980
>> YES.
>> AND THEY HAVE TO DO

435
00:27:30,980 --> 00:27:33,640
COUNSELING†-- OR NOT COUNSELING,
COMMUNICATIONS WITH A FLIGHT

436
00:27:33,640 --> 00:27:34,299
DIRECTOR.
>> RIGHT.

437
00:27:34,299 --> 00:27:37,030
>> A FLIGHT SURGEON.
>> RIGHT.

438
00:27:37,030 --> 00:27:40,720
>> AND OF COURSE, THEY HAVE
VIDEO CONFERENCING WITH THEIR

439
00:27:40,720 --> 00:27:43,090
FAMILIES.
WITH DOCTORS.

440
00:27:43,090 --> 00:27:46,690
WITH SCHOOLS.
THEY CAN BE IN EVENTS FOR PEOPLE

441

00:27:46,690 --> 00:27:49,330
THEY WANT TO TALK TO.
BUT THE REALLY NICE THING FROM

442
00:27:49,330 --> 00:27:51,470
THE INTERNATIONAL SPACE STATION
FROM AN ASTRONAUT'S PERSPECTIVE

443
00:27:51,470 --> 00:27:55,290
IS THE PHONE.
ALL YOU HAVE TO DO IS LOOK FOR

444
00:27:55,290 --> 00:28:05,890
THE GREEN SIGNAL AND YOU CAN
CALL ANYWHERE IN THE WORLD.

445
00:28:05,890 --> 00:28:09,260
ONE SPACE STATION COMMANDER,
BILL McARTHUR, HIS OBJECTIVE, HE

446
00:28:09,260 --> 00:28:12,640
CALLED EVERY TEACHER HE EVER HAD
AND THANKED THEM FROM THE

447
00:28:12,640 --> 00:28:17,090
INTERNATIONAL SPACE STATION.
I THOUGHT THAT WAS PRETTY COOL.

448
00:28:17,090 --> 00:28:18,140
>> THAT IS COOL.
THANK YOU FOR THE QUESTIONS.

449
00:28:18,140 --> 00:28:19,690
NOW, WE'RE GOING TO EAST
STROUDSBURG HIGH SCHOOL IN

450
00:28:19,690 --> 00:28:21,700
PENNSYLVANIA.
GO AHEAD AND UNMUTE YOUR

451

00:28:21,700 --> 00:28:22,090

MICROPHONE.

AND ASK YOUR FIRST QUESTION.

452

00:28:22,090 --> 00:28:22,370

>> HOW ARE YOU ASSURED THAT THE
ASTRONAUT IS CAPABLE OF HANDLING

453

00:28:22,370 --> 00:28:23,120

THIS TRIP TO MARS?

>> DID YOU WANT TO ANSWER THAT?

454

00:28:23,120 --> 00:28:24,450

>> WHEN WE GET SELECTED, THERE'S
A PSYCHOLOGICAL ANALYSIS AS PART

455

00:28:24,450 --> 00:28:24,720

OF OUR SELECTION.

[†STANDBY†]

456

00:28:24,720 --> 00:28:25,040

>>> I DON'T THINK YOU NEED TO
ENCOURAGE IT.

457

00:28:25,040 --> 00:28:25,459

IF YOU'RE PLANNING ON COLONIZING
A PLACE, ABSOLUTELY, THEY'RE

458

00:28:25,460 --> 00:28:25,780

>> INTERESTING QUESTION ABOUT
NATIONALITY, UNDER THE CURRENT

459

00:28:25,780 --> 00:28:26,169

LAWS IF YOU'RE BORN IN
INTERNATIONAL WATERS WHICH IS

460

00:28:26,169 --> 00:28:26,580

WHAT MARS IS, NO ONE IS ALLOWED
TO CLAIM TERRITORY ON MARS.

461

00:28:26,580 --> 00:28:27,090
SO IT WOULD BE ABOUT THE SAME AS
BEING BORN ON A CRUISE SHIP OUT

462
00:28:27,090 --> 00:28:27,179
IN THE MIDDLE OF THE OCEAN.
SO YOUR PARENTS NATIONALITY

463
00:28:27,179 --> 00:28:27,639
WOULD DEFINE YOUR NATIONALITY.
IF YOUR DAD'S CANADIAN AND YOUR

464
00:28:27,640 --> 00:28:27,790
THING.
UNLESS WE'RE IN SOME DISTANT

465
00:28:27,790 --> 00:28:28,400
FUTURE WHERE PEOPLE LIVING ON
MARS DECLARE THEMSELVES TO BE

466
00:28:28,400 --> 00:28:28,570
THEIR OWN COUNTRY, IN WHICH
CASE, WELL, IT'S ALL A MATTER OF

467
00:28:28,570 --> 00:28:28,640
POLITICS.
>> I THINK THE BIOLOGICAL

468
00:28:28,640 --> 00:28:28,730
IMPLICATIONS ARE PERHAPS EVEN
MORE INTERESTING.

469
00:28:28,730 --> 00:28:28,870
MARS HAS A GRAVITY THAT IS
CONSIDERABLY LESS THAN THE

470
00:28:28,870 --> 00:28:28,910
EARTH.
IT'S ONE-THIRD.

471

00:28:28,910 --> 00:28:29,049

WE ARE ASSUMING THAT THAT WILL
BE OKAY FOR ADULTS.

472

00:28:29,049 --> 00:28:29,640

THAT WHEN ADULTS GO TO MARS, AND
THEY WORK ON THE SURFACE FOR A

473

00:28:29,640 --> 00:28:30,690

COUPLE YEARS, THEIR BONES AND
MUSCLES WILL ADAPT TO THAT LOWER

474

00:28:30,690 --> 00:28:30,900

GRAVITY WITHOUT ANY LONG-TERM
DETRIMENTAL EFFECT.

475

00:28:30,900 --> 00:28:31,540

AND THEIR NATURAL ACTIVITY AND
EXERCISE, AS WE'RE LEARNING ON

476

00:28:31,540 --> 00:28:31,770

THE SPACE STATION WILL
CONTRIBUTE TO THAT MAINTAINING

477

00:28:31,770 --> 00:28:32,049

OF GOOD HEALTH.
IT MAY BE QUITE DIFFERENT WITH A

478

00:28:32,049 --> 00:28:32,270

BABY UNDERGOING DEVELOPMENT AND
EMBRYOGENESIS, THE FIRST HUMAN

479

00:28:32,270 --> 00:28:32,610

BORN ON MARS, WILL SOMETIMES BE
A GUINEA PIG.

480

00:28:32,610 --> 00:28:32,959

IT WILL BE AN EXPERIMENT IN HOW
THE HUMAN SPECIES REPRODUCES AT

481

00:28:32,960 --> 00:28:32,970
WE WANT TO BE CAREFUL IN DOING,
BECAUSE IT CAN'T BE UNDONE.

482
00:28:32,970 --> 00:28:33,720
IT HAS A LOT OF ETHICAL
IMPLICATIONS THAT NEEDS TO BE

483
00:28:33,720 --> 00:28:34,630
CONSIDERED BEFORE WE ENCOURAGE
SOMEONE TO GIVE BIRTH ON MARS.

484
00:28:34,630 --> 00:28:35,780
>> AS A FINAL NOTE THAT WOULD
PRESUMABLY BE TESTED WITH RATS

485
00:28:35,780 --> 00:28:38,480
AND ACTUAL GUINEA PIGS TO FIND
OUT WHAT HAPPENS WITH EMBRYONIC

486
00:28:38,480 --> 00:28:40,080
AND MATURING IN LOW GRAVITY,
BEFORE WE SUBJECT HUMANS TO IT.

487
00:28:40,080 --> 00:28:40,120
>> YES.
>> ALL RIGHT, GREAT.

488
00:28:40,120 --> 00:28:40,210
THANK YOU, GUYS NOW WE'RE GOING
TO THE INFO CHANNEL WITH

489
00:28:40,210 --> 00:28:40,299
QUESTIONS, ONCE AGAIN, IF YOU
GUYS HAVE ANY QUESTIONS AND YOU

490
00:28:40,299 --> 00:28:40,650
WANT TO SUBMIT THEM AT E-MAIL,
GO TO THE INFO

491

00:28:40,650 --> 00:28:40,799

CHANNEL†@GMAIL.COM.

A QUESTION FROM WILLIAM OHARA,

492

00:28:40,799 --> 00:28:42,740

ONE OF THE CHALLENGES WE NEED TO
RESOLVE BEFORE LANDING PEOPLE ON

493

00:28:42,740 --> 00:28:46,980

THE SURFACE OF MARS WOULD BE
INTRODUCTION INTO A MECHANICAL

494

00:28:46,980 --> 00:28:52,010

SYSTEM, HABITAT CONTROL SYSTEMS
AND THE GROUP.

495

00:28:52,010 --> 00:28:56,890

IT IS A PROBLEM THAT IS VERY
DIFFICULT TO TEST ON ISS.

496

00:28:56,890 --> 00:28:59,960

BUT WAS ENCOUNTERED DURING THE
APOLLO PROGRAM.

497

00:28:59,960 --> 00:29:03,429

THE MARTIAN, AS YOU MENTIONED,
DIDN'T REALLY DIRECT THIS ISSUE

498

00:29:03,429 --> 00:29:05,470

THAT MUCH.
BUT IT IS A VERY DIFFICULT ONE

499

00:29:05,470 --> 00:29:10,440

ESPECIALLY IN HOW MANY EVA MARK
WATNEY DID DURING THE COURSE OF

500

00:29:10,440 --> 00:29:16,140

THE BOOK.
HE WAS INTERESTED BASICALLY IN 0

501

00:29:16,140 --> 00:29:19,720
YOUR OPINION ON THE ISSUE, AND
WHAT STUDIES HAVE BEEN DONE

502
00:29:19,720 --> 00:29:24,500
ADDRESSING THIS TYPE OF ISSUE?
>> I CAN START AN ANSWER TO THAT

503
00:29:24,500 --> 00:29:26,940
BECAUSE IT'S A VERY IMPORTANT
QUESTION.

504
00:29:26,940 --> 00:29:29,880
AS THE QUESTIONER INDICATED,
THIS WAS THE PROBLEM WITH

505
00:29:29,880 --> 00:29:32,370
APOLLO.
DUST BEING TRACKED INTO THE

506
00:29:32,370 --> 00:29:34,020
HABITAT.
AND IT'S GOING TO BE A PROBLEM

507
00:29:34,020 --> 00:29:35,950
ON MARS.
AND IT'S GOING TO BE AN EVEN

508
00:29:35,950 --> 00:29:39,980
WORSE PROBLEM ON MARS BECAUSE WE
NOW THAT THE DUST ON MARSES

509
00:29:39,980 --> 00:29:46,850
CONTAINS CHLORINE WHICH IS
ACTUALLY TOXIC TO HUMANS.

510
00:29:46,850 --> 00:29:52,179
IT AFFECTS THE THYROID GLAND.
BUT IT'S AN ISSUE THAT'S GOT TO

511

00:29:52,179 --> 00:29:55,710
BE CONTROLLED.
SO DUST MITIGATION IS IMPORTANT.

512
00:29:55,710 --> 00:30:00,020
RIGHT NOW, WHAT NASA IS DOING IS
DESIGNING SPACE SUITS, WHERE YOU

513
00:30:00,020 --> 00:30:03,799
GET IN THE SPACE SUIT, AND THE
SPACE SUIT NEVER COMES INSIDE.

514
00:30:03,799 --> 00:30:09,070
YOU GET IN THE SPACE SUIT IN A
PORT ON THE OUTSIDE.

515
00:30:09,070 --> 00:30:12,350
PLANS LIKE THAT WHERE WE REALLY
TRY HARD TO KEEP THE DIRT OUT.

516
00:30:12,350 --> 00:30:14,040
DON'T BRING THE DIRT IN THE
HOUSE.

517
00:30:14,040 --> 00:30:19,070
IT'S GOING TO BE A VERY
IMPORTANT RULE ON MARS.

518
00:30:19,070 --> 00:30:23,770
>> ONE OTHER ASPECT OF DUST IS
THAT DUST SAY HUGE FIELD.

519
00:30:23,770 --> 00:30:27,650
DUST AND DIRT AND DEBRIS IS A
HUGE DEAL.

520
00:30:27,650 --> 00:30:29,940
WHEN YOU HAVE GRAVITY TO HOLD IT
DOWN, IT BECOMES LESS OF AN

521

00:30:29,940 --> 00:30:33,720

ISSUE.

LUNAR DUST IS ALSO PARTICULARLY

522

00:30:33,720 --> 00:30:37,140

NASTY COMPARED TO MARTIAN DUST
BECAUSE LUNAR DUST HASN'T BEEN

523

00:30:37,140 --> 00:30:42,580

WEATHERED BY WIND AND WATER.
SO IF YOU LOOK AT IT

524

00:30:42,580 --> 00:30:46,010

MICROSCOPICALLY, IT'S EXTREMELY
SHARP AND JAGGED AND POINTY.

525

00:30:46,010 --> 00:30:49,040

IT GETS INTO YOUR LUNGS.
IT TRASHES YOUR LUNGS.

526

00:30:49,040 --> 00:30:53,720

IT WOULD BE A BIG CANCER RISK.
MARTIAN DUST HAS THE ADVANTAGE

527

00:30:53,720 --> 00:30:59,490

OF BEING WEATHERED DOWN AND
SMOOTH, KIND OF LIKE EARTH DIRT.

528

00:30:59,490 --> 00:31:04,220

BUT THE TOXINS IN IT MAKE IT
STILL, YOU KNOW, PRETTY BAD.

529

00:31:04,220 --> 00:31:07,179

>> ALL RIGHT.
EXCELLENT.

530

00:31:07,179 --> 00:31:09,960

THANK YOU VERY MUCH.
WE DO HAVE SEVERAL OF THEM NOW

531

00:31:09,960 --> 00:31:12,580
COMING IN THROUGH THE GMAIL
ACCOUNT.

532
00:31:12,580 --> 00:31:16,190
THE NEXT ONE FROM ALAN COLEMAN.
BASICALLY, WHAT DIFFERENT

533
00:31:16,190 --> 00:31:19,740
ACTIONS WOULD IT TAKE TO MAKE
MARS LIVABLE FOR ANYONE WHO

534
00:31:19,740 --> 00:31:22,340
WANTED TO LIVE THERE IN THE
FUTURE?

535
00:31:22,340 --> 00:31:25,690
AND I'M NOT SURE IF THEY'RE
REFERRING TO TEST FORMING, OR

536
00:31:25,690 --> 00:31:31,309
MAYBE JUST PICKING OUT A SMALL
SECTION IN THE A GEODOME HABITAT

537
00:31:31,309 --> 00:31:35,140
TO ACTUALLY GROW THINGS ON THE
MARTIAN SURFACE.

538
00:31:35,140 --> 00:31:37,519
DR. †McKAY, DO YOU HAVE ANY
INSIGHT?

539
00:31:37,519 --> 00:31:41,630
>> WELL, I THINK THE QUESTION
CAN BE INTERPRETED BOTH WAYS.

540
00:31:41,630 --> 00:31:45,059
INITIALLY, WHEN WE GO TO MARS,
WE'RE GOING TO NEED TO BUILD

541

00:31:45,059 --> 00:31:47,960
DOMES OF EVERYTHING AROUND US
FOR HABITAT.

542
00:31:47,960 --> 00:31:49,919
WHICH EFFECTIVELY IS WHAT THE
SPACE STATION IS.

543
00:31:49,919 --> 00:31:54,860
IT'S A BUBBLE OF EARTH
ENVIRONMENT.

544
00:31:54,860 --> 00:32:01,120
WE'LL HAVE THAT TO GROW IT AS
COMFORTABLE AS WE CAN.

545
00:32:01,120 --> 00:32:03,750
WE MIGHT CONSIDER WHAT WE WOULD
DO TO CHANGE THE ENVIRONMENT OF

546
00:32:03,750 --> 00:32:07,570
MARS TO MAKE IT MORE HABITABLE
ON A LARGE SCALE.

547
00:32:07,570 --> 00:32:09,230
PEOPLE HAVE LOOKED AT IT AND
STUDIED IT.

548
00:32:09,230 --> 00:32:14,230
IT TURNS OUT THE FUNDAMENTAL
PROBLEM IS WARMING UP MARS.

549
00:32:14,230 --> 00:32:21,429
IT'S IN THE DISCOUNT FUTURE
COMPARED TO AN INITIAL

550
00:32:21,429 --> 00:32:23,720
SELF-CONTAINED EARTH-LIKE
HABITAT.

551

00:32:23,720 --> 00:32:25,480

>> OKAY.
EXCELLENT.

552

00:32:25,480 --> 00:32:34,179

NOW, I ALSO HEAR THAT WE'VE GOT
A LOT OF BUZZ ON THE TWITTER

553

00:32:34,179 --> 00:32:38,220

FEED.
@†#ASKNASA.

554

00:32:38,220 --> 00:32:42,309

AT THE AMES RESEARCH CENTER,
HAVE THEY SENT ANY TO YOU YET?

555

00:32:42,309 --> 00:32:44,419

IF NOT, I'VE GOT A COUPLE HERE.
OKAY.

556

00:32:44,419 --> 00:32:49,570

GOOD, LET'S PICK OUT A GOOD ONE.
>> ALL RIGHT.

557

00:32:49,570 --> 00:32:53,299

I WILL JUST GO AHEAD AND START
IN HERE.

558

00:32:53,299 --> 00:33:00,910

THIS ONE SAYS†-- I CAN'T READ
THE USER NAME, SORRY.

559

00:33:00,910 --> 00:33:03,960

CAN MOST OF THE SCIENCE IN THE
BOOK ACTUALLY BE APPLIED FOR A

560

00:33:03,960 --> 00:33:06,770

MISSION TO MARS IN THE FUTURE?
>> WELL, I HOPE SO, THAT WAS MY

561

00:33:06,770 --> 00:33:10,220
GOAL WHEN I WAS WRITING THE BOOK
BUT I PRESENT A REALISTIC

562
00:33:10,220 --> 00:33:12,799
APPROACH.
IN FACT, MOST OF THE SCIENCE IN

563
00:33:12,799 --> 00:33:15,520
THE BOOK, ALMOST EVERYTHING IN
THE BOOK IS REAL SCIENCE THAT

564
00:33:15,520 --> 00:33:19,799
EXISTS TODAY.
IT MIGHT BE IMPROVED UPON

565
00:33:19,799 --> 00:33:22,700
VERSIONS OF WHAT WE HAVE.
BUT THEY'RE NOT†-- THERE'S

566
00:33:22,700 --> 00:33:25,910
NOTHING THAT'S LIKE BRAND NEW.
SO, FOR INSTANCE IN THE BOOK,

567
00:33:25,910 --> 00:33:28,789
THEY HAVE THE OXYGENATOR,
SOMETHING THAT PULLS THE†--

568
00:33:28,789 --> 00:33:32,780
TAKES IN CO_2 .
AND THEN ADDS ENERGY TO SEPARATE

569
00:33:32,780 --> 00:33:38,140
THE CARBON AND RELEASE OXYGEN.
THERE'S AN EXPERIMENT ON THE

570
00:33:38,140 --> 00:33:43,799
MARS 2020 ROVER CALLED MOXIE.
IT'S GOING TO DO THE SAME THING.

571

00:33:43,799 --> 00:33:50,160
WATER RECLAMATION IS ALREADY IN
PLACE ON ISS.

572
00:33:50,160 --> 00:33:54,929
AND JUST CONTROLLING THE AIR,
THE AIR PRESSURE, ALL OF THESE

573
00:33:54,929 --> 00:33:59,039
THING, THE CRITICAL TECHNOLOGIES
THAT ARE ALREADY IN PLACE.

574
00:33:59,039 --> 00:34:03,440
AND THE OTHER ONE I WOULD SAY IS
ION PROPULSION, WHICH IS HOW

575
00:34:03,440 --> 00:34:05,980
HERMES IN THE BOOK GETS BETWEEN
EARTH AND MARS.

576
00:34:05,980 --> 00:34:08,309
THAT'S ALSO A REAL THING.
WITH DRIVES.

577
00:34:08,309 --> 00:34:13,480
AND PEOPLE ARE WORKING ON EVEN
MORE EFFICIENT DRIVERS.

578
00:34:13,480 --> 00:34:16,669
THAT MEANS YOU DON'T HAVE TO
CARE 50 TIMES THE MASS OF YOUR

579
00:34:16,669 --> 00:34:24,050
SHIP TO GET THERE.
SO, YES, PRETTY MUCH ALL OF THE

580
00:34:24,050 --> 00:34:26,599
SCIENCE IN THE BOOK CAN BE
APPLIED TO MISSIONS TO MARS IN

581

00:34:26,599 --> 00:34:32,140

THE FUTURE.

>> DR.†McKAY, DO YOU HAVE ONE?

582

00:34:32,140 --> 00:34:37,200

>> A FIFTH GRADER JULIUS.

LET ME REPHRASE THE QUESTION A

583

00:34:37,200 --> 00:34:39,830

LITTLE BIT?

WHAT WAS MARS LIKE A LONG TIME

584

00:34:39,830 --> 00:34:42,349

AGO?

DID IT HAVE A LOT OF WATER, A

585

00:34:42,349 --> 00:34:47,010

LOT OF LAVA?

THE ANSWER IS YES TO BOTH.

586

00:34:47,010 --> 00:34:52,000

MARS WAS MUCH MORE EARTH LIKE.

IT HAD ACTIVE VOLCANISM.

587

00:34:52,000 --> 00:34:56,119

IT HAD WATER, WIDESPREAD ON THE
SURFACE.

588

00:34:56,119 --> 00:34:59,520

WE SEE EVIDENCE OF THAT.

EARLIER IN MARS HISTORY, IT WAS

589

00:34:59,520 --> 00:35:02,770

MUCH MORE EARTH-LIKE THAN IT IS
NOW.

590

00:35:02,770 --> 00:35:04,790

THAT'S PART OF THE REASON WHY
MARS IS SO INTERESTING.

591

00:35:04,790 --> 00:35:08,940
THIS EARLY LIFELIKE PERIOD AND
THE FACT THAT THERE WAS LIFE ON

592
00:35:08,940 --> 00:35:11,940
MARS DURING THIS EARLY LIFELIKE
PERIOD.

593
00:35:11,940 --> 00:35:17,290
GOOD QUESTION.
>> NOW, WE WANT TO RETURN TO THE

594
00:35:17,290 --> 00:35:21,580
ACTIVE PARTICIPANTS THAT ARE
SITTING VERY PATIENTLY AT HOLDEN

595
00:35:21,580 --> 00:35:24,859
HIGH SCHOOL HAVE A COUPLE OF
GREAT QUESTIONS FOR THE SUBJECT

596
00:35:24,859 --> 00:35:26,810
MATTER EXPERTS.
GO AHEAD AND UNMUTE YOUR

597
00:35:26,810 --> 00:35:32,900
MICROPHONE.
>> WHAT IS THE RELATIONSHIP

598
00:35:32,900 --> 00:35:38,220
BETWEEN EARTH SURFACE ATMOSPHERE
AND WEATHER OF MARS?

599
00:35:38,220 --> 00:35:41,980
>> THAT'S A GOOD QUESTION.
IT'S A QUESTION ACTIVELY

600
00:35:41,980 --> 00:35:46,960
INVOLVED IN STUDYING, WEATHER ON
MARS IS A SCIENTIFIC INTEREST.

601

00:35:46,960 --> 00:35:51,250
IT'S ALSO A PRACTICAL INTEREST.
ROVERS LAND ON PARACHUTES.

602
00:35:51,250 --> 00:35:54,030
HUMANS WHEN THEY GO WILL LAND ON
PARACHUTES AFFECTED BY THE

603
00:35:54,030 --> 00:35:55,950
WEATHER.
BEING ABLE TO PREDICT THE

604
00:35:55,950 --> 00:35:58,750
WEATHER ON MARS IS JUST AS
IMPORTANT AS BEING ABLE TO

605
00:35:58,750 --> 00:36:05,770
PREDICT THE WEATHER ON EARTH.
THE ATMOSPHERE ON MARS IS MUCH

606
00:36:05,770 --> 00:36:07,940
THINNER.
IT'S ABOUT 100 TIMES THINNER

607
00:36:07,940 --> 00:36:11,030
THAN THE EARTH AND IT'S
DOMINATED BY CARBON DIOXIDE

608
00:36:11,030 --> 00:36:15,090
WHICH ANDY INDICATE SAID A
SOURCE FOR OXYGEN AND IT MAKES

609
00:36:15,090 --> 00:36:19,240
FOR A VERY DIFFERENT SOURCE OF
ATMOSPHERE, PARTLY BECAUSE IT

610
00:36:19,240 --> 00:36:23,580
CONDENSES IN THE POLAR REGION.
SO THERE ARE DIFFERENT

611

00:36:23,580 --> 00:36:26,160

PROCESSES.

SOME DIFFERENCES.

612

00:36:26,160 --> 00:36:26,930

WE'RE VERY INTERESTED IN

WEATHER.

613

00:36:26,930 --> 00:36:29,460

THERE COULD BE THOSE INTERESTED

IN WEATHER PREDICTION CAREERS

614

00:36:29,460 --> 00:36:39,430

FOR THOSE INTERESTED IN WEATHER

PREDICTIONS, SO, GET READY.

615

00:36:39,430 --> 00:36:41,400

>> AND ALSO FROM HOLDEN HIGH

SCHOOL.

616

00:36:41,400 --> 00:36:44,400

OUR NEXT ONE, WE'RE GOING TO

HOLDEN AGAIN FOR THE SECOND

617

00:36:44,400 --> 00:36:45,800

QUESTION FROM HOLDEN HIGH

SCHOOL.

618

00:36:45,800 --> 00:36:49,210

GO AHEAD.

>> GO AHEAD.

619

00:36:49,210 --> 00:36:54,670

>> YEAH, HOW IS DOES THE

TEMPERATURE AFFECT LIKE PLANT

620

00:36:54,670 --> 00:37:00,440

GROWTH AND HOW DO HUMANS ADAPT

TO DIFFERENT TEMPERATURES?

621

00:37:00,440 --> 00:37:04,500
>> WELL, THE TEMPERATURE ON MARS
IS JUST COMPLETELY OUTSIDE OF

622
00:37:04,500 --> 00:37:07,980
ANYTHING THAT EARTH LIFE CAN
HANDLE†-- WELL, EXCEPT FOR LIKE

623
00:37:07,980 --> 00:37:12,859
ON EARTH.
I THINK THE HOTTEST IT GETS ON

624
00:37:12,859 --> 00:37:18,040
MARS IS ABOUT ZERO DEGREES
CELSIUS WHICH IS REALLY COLD.

625
00:37:18,040 --> 00:37:21,030
AND AT NIGHT, IT CAN GET DOWN TO
MINUS 100 C.

626
00:37:21,030 --> 00:37:25,410
SO THE WAY WE'LL ADAPT TO THE
TEMPERATURE ON MARS IS BY LIVING

627
00:37:25,410 --> 00:37:30,500
IN AN ENVIRONMENT THAT WE KEEP.
IN THE SAME WAY THAT THEY'VE

628
00:37:30,500 --> 00:37:33,059
ADAPTED TO THE TEMPERATURES OF
CANADA.

629
00:37:33,059 --> 00:37:38,230
>> ALL RIGHT.
THANKS FOR THAT QUESTION FROM

630
00:37:38,230 --> 00:37:40,950
HOLDEN HIGH SCHOOL.
ONCE AGAIN, WE STILL HAVEN'T

631

00:37:40,950 --> 00:37:43,700
GOTTEN CARVER MIDDLE SCHOOL IN
FROM TULSA, OKLAHOMA.

632
00:37:43,700 --> 00:37:47,670
HOPEFULLY, THEY'RE WATCHING.
THE NEXT ONE THAT THEY HAVE,

633
00:37:47,670 --> 00:37:53,450
WHAT IS SOME VIABLE OPTIONS FOR
ELECTRICITY BESIDES SOLAR

634
00:37:53,450 --> 00:37:56,570
PANELS?
WE USE THEM QUITE A BIT UP ON

635
00:37:56,570 --> 00:37:59,550
THE INTERNATIONAL SPACE STATION.
THEY ACTUALLY CAN ROTATE THESE

636
00:37:59,550 --> 00:38:03,080
BIG LARGE SOLAR PANELS TO GET
THE SUNLIGHT AND TURN IT INTO

637
00:38:03,080 --> 00:38:06,520
ELECTRICAL POWER.
THE WATER ENERGY SOURCES USED TO

638
00:38:06,520 --> 00:38:13,430
GO ON TO MARS ITSELF.
LOOKS LIKE AT AMES ARE GOING TO

639
00:38:13,430 --> 00:38:16,430
ANSWER.
>> HE'S GOING TO LET ME ANSWER

640
00:38:16,430 --> 00:38:20,300
THAT.
SO, LOTS OF OPTIONS FOR HOW TO

641

00:38:20,300 --> 00:38:23,609
GENERATE POWER IN SPACE.
OBVIOUSLY, SOLAR PANELS, BUT

642
00:38:23,609 --> 00:38:28,400
OTHER THAN THAT, YOU PRETTY MUCH
HAVE TO GO NUCLEAR.

643
00:38:28,400 --> 00:38:32,330
SO YOU CAN EITHER HAVE A REACTOR
ABOARD YOUR VESSEL.

644
00:38:32,330 --> 00:38:36,119
OR YOU CAN HAVE WHAT'S CALLED AN
RTG.

645
00:38:36,119 --> 00:38:37,710
THEY'RE BOTH NUCLEAR BUT THEY'RE
VERY DIFFERENT.

646
00:38:37,710 --> 00:38:40,770
IN THE CASE OF A REACTOR, YOU
HAVE AN ACTIVE NUCLEAR REACTION

647
00:38:40,770 --> 00:38:43,950
GOING ON THAT GENERATES A HUGE
AMOUNT OF HEAT.

648
00:38:43,950 --> 00:38:48,490
AND THAT HEAT DIFFERENTIAL IS
ULTIMATELY WHAT YOU USE AND

649
00:38:48,490 --> 00:38:50,740
THAT'S JUST HOW A NUCLEAR POWER
PLANT WORKING.

650
00:38:50,740 --> 00:38:58,810
AN RTG IS A VERY RADIOACTIVE
ISOTOPE THAT NATURALLY DECAYS.

651

00:38:58,810 --> 00:39:03,030
IT'S NOT A NUCLEAR REACTION.
IT CAN'T BE CRITICAL, IT CAN

652
00:39:03,030 --> 00:39:06,270
HAVE ANYTHING NEGATIVE HAPPEN
OTHER THAN IT'S SPEWING A BUTT

653
00:39:06,270 --> 00:39:13,940
LOAD OF RADIATION.
IT JUST GENERATES HEAT.

654
00:39:13,940 --> 00:39:19,380
AN RTG IS WHAT'S CURRENTLY
POWERING THE CURIOSITY PROBE ON

655
00:39:19,380 --> 00:39:22,160
MARS.
AND THAT'S GREAT FOR FAIRLY LOW

656
00:39:22,160 --> 00:39:25,550
AMOUNTS OF POWER.
CURIOSITY'S RTG GENERATES ABOUT

657
00:39:25,550 --> 00:39:29,200
110 WATTS WHICH IS GENERALLY A
LITTLE MORE THAN AN OLD SCHOOL

658
00:39:29,200 --> 00:39:34,800
LIGHT BULB.
BUT IF YOU WANT HUGE AMOUNTS OF

659
00:39:34,800 --> 00:39:38,230
POWER, YOU'RE GOING TO HAVE TO
PUT A NUCLEAR REACTOR IN SPACE.

660
00:39:38,230 --> 00:39:44,910
THERE ARE OBVIOUSLY CONCERNS
ABOUT THAT.

661

00:39:44,910 --> 00:39:47,710
BUT WE'VE ALREADY PUT NUCLEAR
REACTORS IN SPACE.

662
00:39:47,710 --> 00:39:51,980
WE DID IT IN THE '60s.
THE RUSSIANS DID IT IN THE '60s.

663
00:39:51,980 --> 00:39:55,700
ALSO, WE HAVE NUCLEAR REACTORS
ABOARD EVERY SUBMARINE AND

664
00:39:55,700 --> 00:40:00,849
AIRCRAFT CARRIER IN OUR FLEET.
I THINK THAT'S PROBABLY THE BEST

665
00:40:00,849 --> 00:40:04,810
SOLUTION.
ALSO, A REACTOR IS BASICALLY

666
00:40:04,810 --> 00:40:08,050
INFINITE ENERGY IN A SMALL
AMOUNT OF MASS.

667
00:40:08,050 --> 00:40:10,430
SO I THINK THAT'S PROBABLY THE
ANSWER.

668
00:40:10,430 --> 00:40:13,170
>> ALL RIGHT.
EXCELLENT.

669
00:40:13,170 --> 00:40:16,450
AND JUST TO LET EVERYONE KNOW,
THE VIEWING PUBLIC AND THE

670
00:40:16,450 --> 00:40:20,540
ACTIVE PARTICIPATE PANTS,
DR. †McKAY AND ANDY WEIR HAVE TO

671

00:40:20,540 --> 00:40:22,760
LEAVE IN ABOUT TWO MINUTES.
THEY HAVE ANOTHER ENGAGEMENT

672
00:40:22,760 --> 00:40:25,550
THEY HAVE TO GO TO.
SO, I'M GOING TO ASK ONE MORE

673
00:40:25,550 --> 00:40:30,140
QUESTION FROM CARVER MIDDLE
SCHOOL THAT IS RELATED TO OUR

674
00:40:30,140 --> 00:40:33,770
EXPERTS.
ANDY WEIR, IN TALKING ABOUT THE

675
00:40:33,770 --> 00:40:39,830
RESEARCH IN WRITING THE BOOK.
YOU SAID YOU DIDN'T DO ACTUALLY

676
00:40:39,830 --> 00:40:44,060
MUCH TALKING TO NASA OFFICIALS
OR PUBLIC AFFAIRS OR ANY

677
00:40:44,060 --> 00:40:47,910
ASTRONAUTS OR ANYTHING.
SO HOW DID YOU CONFIRM THE

678
00:40:47,910 --> 00:40:51,530
SOURCES OF THE RESEARCH THAT YOU
WERE GETTING?

679
00:40:51,530 --> 00:40:55,750
WHAT SITE DID YOU GO TO?
HOW DID YOU GET THE INFORMATION,

680
00:40:55,750 --> 00:40:59,589
AND HOW DID YOU KNOW IT WAS AS
FACTUAL AS IT COULD POSSIBLY BE

681

00:40:59,589 --> 00:41:03,730

FOR YOUR BOOK?

>> WELL, ABOUT 90% OF THE TIME,

682

00:41:03,730 --> 00:41:07,650

I ENDED UP ON A WIKIPEDIA PAGE.

I DECIDED TO TRUST THEM.

683

00:41:07,650 --> 00:41:09,710

SOMETIMES, THEY'RE INACCURATE ON

THINGS BUT ALMOST NEVER

684

00:41:09,710 --> 00:41:17,180

INACCURATE ON MATH OR SCIENCE.

IN TERMS OF WHAT PATHFINDER IS

685

00:41:17,180 --> 00:41:23,140

LIKE OR THE OPERATING SYSTEM

THAT RUNS ON IT, ANY UNRELIABLE

686

00:41:23,140 --> 00:41:25,349

INFORMATION COMES FROM HONEST

MISTAKES.

687

00:41:25,349 --> 00:41:27,670

IF YOU JUST CHECK WITH A FEW

DIFFERENT WEBSITES, AS LONG AS

688

00:41:27,670 --> 00:41:29,640

THEY AGREE, YOU'RE PROBABLY

GOOD.

689

00:41:29,640 --> 00:41:33,030

IN THE END, REMEMBER, I'M JUST

WRITING A BOOK.

690

00:41:33,030 --> 00:41:35,140

ACTUAL HUMAN LIVES DON'T RELY ON

THIS.

691

00:41:35,140 --> 00:41:41,920
IF I MAKE A MISTAKE, IT'S OKAY.
>> EXCELLENT.

692
00:41:41,920 --> 00:41:44,330
YOU HAVE TO GO.
WE ARE GOING TO STAY WITH NASA

693
00:41:44,330 --> 00:41:47,490
ASTRONAUT RICKY ARNOLD.
I WANT TO SEE IF YOU GUYS HAVE

694
00:41:47,490 --> 00:41:50,800
ANY FINAL WORDS THAT YOU WANT TO
GIVE TO THE HIGH SCHOOL STUDENTS

695
00:41:50,800 --> 00:41:53,580
ABOUT FOLLOWING THEIR DREAMS,
ABOUT THEM COMING TO WORK AT

696
00:41:53,580 --> 00:41:58,700
NASA ONE DAY OR SOMETHING IN THE
FIELD OF SCIENCE, TECHNOLOGY,

697
00:41:58,700 --> 00:42:02,369
ENGINEERING AND MATH?
>> LET ME JUST SAY ONE LAST

698
00:42:02,369 --> 00:42:05,960
THING, NASA HAS A LOT OF INTERN
PROGRAMS FOR STUDENTS.

699
00:42:05,960 --> 00:42:08,980
I FIRST CAME TO NASA AS A SUMMER
STUDENT.

700
00:42:08,980 --> 00:42:11,589
AND IT WAS A WONDERFUL
EXPERIENCE.

701

00:42:11,589 --> 00:42:15,950
AND I ENCOURAGE STUDENTS TO
PURSUE THOSE INTERNSHIPS WITH

702
00:42:15,950 --> 00:42:19,300
VIGOR THERE.
MOSTLY FOR GRADUATE STUDENTS AND

703
00:42:19,300 --> 00:42:22,510
UPPER DIVISION UNDERGRADUATES.
BUT SOME OF THEM EXTEND ALL THE

704
00:42:22,510 --> 00:42:25,119
WAY DOWN TO HIGH SCHOOL.
SO NASA HAS SUMMER INTERN

705
00:42:25,119 --> 00:42:27,570
PROGRAMS.
APPLY FOR THEM.

706
00:42:27,570 --> 00:42:34,410
YOU'LL FIND IT VERY INTERESTING.
>> AND I WOULD ENCOURAGE ANYONE

707
00:42:34,410 --> 00:42:38,480
WHO IS INTERESTED IN A S.T.E.M.
CAREER TO GO FOR IT FOR A FEW

708
00:42:38,480 --> 00:42:40,560
REASONS.
FIRST OFF IS HOW YOU PUSH THE

709
00:42:40,560 --> 00:42:42,790
KNOWLEDGE.
SECOND OFF, YOU MAKE A LOT OF

710
00:42:42,790 --> 00:42:47,060
MONEY.
I MEAN, YOU DON'T MAKE A LOT OF

711

00:42:47,060 --> 00:42:51,240
MONEY WORK FOR NASA, YOU DO THAT
TO HELP HUMANITY.

712
00:42:51,240 --> 00:42:56,820
FOR 25 OR 30 YEARS I MADE A LOT
OF MONEY, SO I HIGHLY RECOMMEND

713
00:42:56,820 --> 00:43:01,460
IT.
>> ALL RIGHT.

714
00:43:01,460 --> 00:43:04,579
>> THANKS, GOOD TALKING TO YOU
ALL.

715
00:43:04,579 --> 00:43:07,500
>> WE'RE GOING TO SIGN OFF ON
THIS END.

716
00:43:07,500 --> 00:43:11,400
WE GOT TO HEAD OUT.
>> EXCELLENT.

717
00:43:11,400 --> 00:43:13,460
THANK YOU, GUYS, SO MUCH.
>> NOW, WE WANT TO KEEP THE

718
00:43:13,460 --> 00:43:17,690
QUESTIONS GOING ALONG, AND WE
DID JUST ASK QUESTIONS OF CARVER

719
00:43:17,690 --> 00:43:22,710
MILD SCHOOL, NOW, WE WANT TO GO
TO EAST STROUDSBURG FOR TWO

720
00:43:22,710 --> 00:43:27,089
DIFFERENT QUESTIONS.
IF THEY'RE MARS-RELATED WE CAN

721

00:43:27,089 --> 00:43:30,690
ANSWER THEM AFTER THE PROGRAM.
WE'LL SEND E-MAILS BACK AND

722
00:43:30,690 --> 00:43:34,520
FORTH BECAUSE I HAVE A LIST OF
YOUR QUESTIONS.

723
00:43:34,520 --> 00:43:37,810
IF YOU HAVE ANY, MAYBE WHAT
WE'RE DOING NOW, HOW WE'RE GOING

724
00:43:37,810 --> 00:43:40,609
TO MARS AND WHAT WE'RE DOING
THERE, DEFINITELY LIKE TO TAKE

725
00:43:40,609 --> 00:43:46,080
THOSE QUESTIONS RIGHT NOW.
>> DO WE HAVE ONE?

726
00:43:46,080 --> 00:43:53,930
>> THANKS A LOT.
HOW WOULD LAWS APPLY?

727
00:43:53,930 --> 00:44:07,450
>> HOW DO THE LAWS OF MOTION?
>> LIKE†-- YES, LIKE THAT.

728
00:44:07,450 --> 00:44:11,660
>> WE HAVE†-- AS ANDY SAID
EARLIER, YOU'RE BASICALLY

729
00:44:11,660 --> 00:44:16,920
INTERNATIONAL TREATY†-- THE
INTERNATIONAL CODE FOR THE SEA.

730
00:44:16,920 --> 00:44:19,740
BUT FOR AN ASTRONAUT, I MEAN,
WE'RE ON THE INTERNATIONAL SPACE

731

00:44:19,740 --> 00:44:22,450
STATION.
WE'RE NOT†-- THERE'S HARDWARE UP

732
00:44:22,450 --> 00:44:25,010
THERE OWNED BY JAPAN.
THERE'S HARDWARE OWNED BY

733
00:44:25,010 --> 00:44:28,369
EUROPE, HARDWARE OWNED BY THE
UNITED STATES AND RUSSIA.

734
00:44:28,369 --> 00:44:34,500
WE AS AGREE AND SIGN A CODE OF
CONDUCT, EVERY ASTRONAUT,

735
00:44:34,500 --> 00:44:38,380
COSMONAUT, WHOEVER GOES TO THE
INTERNATIONAL SPACE STATION,

736
00:44:38,380 --> 00:44:40,940
THERE'S EXPECTATIONS THE WAY
WE'RE GOING TO BEHAVE OURSELVES

737
00:44:40,940 --> 00:44:43,510
AND THE THINGS WE'RE GOING TO DO
WHILE WE'RE THERE.

738
00:44:43,510 --> 00:44:46,770
I WOULD EXPECT BEFORE WE GO TO
MARS, THAT PROCESS WILL CONTINUE

739
00:44:46,770 --> 00:44:51,099
GOING FORWARD.
LIKE THE CODE OF CONDUCT YOU

740
00:44:51,099 --> 00:44:54,240
SIGN THE FIRST DAY OF SCHOOL.
WE GET THE SAME THING.

741

00:44:54,240 --> 00:44:58,490

>> ALL RIGHT.

DO WE HAVE ANOTHER QUESTION FROM

742

00:44:58,490 --> 00:45:01,309

EAST STROUDSBURG?

>> YES.

743

00:45:01,309 --> 00:45:08,470

>> YES, MY QUESTION IS HOW DO
ASTRONAUTS TAKE SHOWERS AND

744

00:45:08,470 --> 00:45:11,780

MAINTAIN THEIR PERSONAL HYGIENE?

>> YEAH.

745

00:45:11,780 --> 00:45:15,730

THE INTERNATIONAL SPACE STATION
HAS A 120 DC CURRENT SO FLOWING

746

00:45:15,730 --> 00:45:20,150

WATER IS NOT A GOOD THING.
SCOTT KELLY UP THERE FOR A YEAR,

747

00:45:20,150 --> 00:45:22,349

THAT'S GOING TO BE THE FIRST
THING THEY'RE GOING TO LOOK

748

00:45:22,349 --> 00:45:26,390

FORWARD TO IS A SHOWER SOMEWHERE
IN KAZAKHSTAN.

749

00:45:26,390 --> 00:45:30,520

BASICALLY, WE USE RINSELESS
SHAMPOO LIKE YOU WOULD USE IN

750

00:45:30,520 --> 00:45:41,109

YOUR BACKPACKING OR HIKING OR
WET TOWELETTES.

751

00:45:41,109 --> 00:45:43,940

I WOULD IMAGINE THAT WATER SAY
PREMIUM AND SOMETHING WE

752

00:45:43,940 --> 00:45:46,640

WOULDN'T SPEND A LOT OF TIME AND
ENERGY ON.

753

00:45:46,640 --> 00:45:50,650

>> THEY'RE ON THE SAME BOAT
TOGETHER SO IT'S GOOD.

754

00:45:50,650 --> 00:45:52,530

>> WE ARE QUICKLY RUNNING OUT OF
TIME.

755

00:45:52,530 --> 00:45:56,589

I DID WANT TO GO TO A COUPLE
MORE FROM THE GMAIL ACCOUNT.

756

00:45:56,589 --> 00:46:01,510

WE'VE GOT ONE, ONE YOU SHOULD
WILL TIME AFFECT ASTRONAUTS ON

757

00:46:01,510 --> 00:46:05,089

PARSE VERSUS EARTH?
FOR THE INTERNATIONAL SPACE

758

00:46:05,089 --> 00:46:10,580

STATION, YOU OPERATE ON ONE
TIME?

759

00:46:10,580 --> 00:46:14,820

>> GREENWICH GREEN TIME.
>> THAT HELPS ALL MISSIONS

760

00:46:14,820 --> 00:46:20,930

AROUND THE WORLD KEEP ON TIME.
MAKE SURE YOUR TIME IS WHEN THEY

761

00:46:20,930 --> 00:46:22,319
EXPECT YOU TO DO THINGS.
>> EXACTLY.

762
00:46:22,319 --> 00:46:25,849
>> FOR MARS, IT MIGHT BE A
LITTLE DIFFERENT WEEK TRAVELING

763
00:46:25,849 --> 00:46:29,869
MILLIONS OF MILES AWAY.
BASIC INSTRUCTIONS TO GET THERE.

764
00:46:29,869 --> 00:46:34,890
AND GET THE INSTRUCTIONS ACROSS.
DO YOU THINK WE'LL OPERATE ON

765
00:46:34,890 --> 00:46:37,680
ONE†--
>> I WOULD THINK SO.

766
00:46:37,680 --> 00:46:41,540
RIGHT NOW WE OPERATE ON GNC.
THE CREW DAY STARTS BRIGHT IN

767
00:46:41,540 --> 00:46:46,500
THE EARLY.
AROUND 3:00 CENTRAL TIME.

768
00:46:46,500 --> 00:46:48,560
I IMAGINE WHEN YOU'RE ON MARS,
YOU'RE GOING TO WANT TO TAKE

769
00:46:48,560 --> 00:46:52,810
ADVANTAGE OF DAYLIGHT.
I WOULD IMAGINE THE CREW DAY,

770
00:46:52,810 --> 00:46:56,060
WOULD SHIFT IN TERMS OF WORKING
OUTSIDE AND TAKING CARE OF

771

00:46:56,060 --> 00:46:58,630
NATURAL DAYLIGHT JUST LIKE ON
EARTH.

772
00:46:58,630 --> 00:47:00,200
>> THE COOL THING ABOUT MARS,
THE ROTATION.

773
00:47:00,200 --> 00:47:06,450
IT'S A 39-MINUTE DIFFERENCE.
IT'S ALSO TILTED JUST LIKE EARTH

774
00:47:06,450 --> 00:47:09,520
IS TILTED.
SO IT HAS THE SAME SIMILAR

775
00:47:09,520 --> 00:47:13,980
EFFECT OF SEASONS THROUGHOUT THE
YEAR.

776
00:47:13,980 --> 00:47:16,580
>> RIGHT.
>> SO IT'S JUST A LITTLE BIT

777
00:47:16,580 --> 00:47:20,320
SMALLER.
AND A LITTLE FARTHER AWAY.

778
00:47:20,320 --> 00:47:22,990
>>> AND SO, REALLY WONDERFUL
QUESTIONS, GUYS.

779
00:47:22,990 --> 00:47:27,680
NOW, I DO WANT TO WRAP UP, AND I
WANT TO SHOW YOU SOME THINGS

780
00:47:27,680 --> 00:47:29,710
THAT YOU GUYS CAN GET INTERESTED
IN.

781

00:47:29,710 --> 00:47:34,780
AND HOPEFULLY TAKE IT FROM THIS
PROGRAM AND LEARN MORE AT HOME.

782
00:47:34,780 --> 00:47:37,660
WE'VE GOT LOTS OF AMAZING
WEBSITES THAT YOU CAN GO TO AND

783
00:47:37,660 --> 00:47:40,560
LEARN MORE INFORMATION ABOUT ALL
OF THE THINGS THAT WE TALKED

784
00:47:40,560 --> 00:47:44,660
ABOUT, NONE IS THE ORION
MULTIPURPLE CREW VEHICLE.

785
00:47:44,660 --> 00:47:52,150
IF YOU WANT TO LEARN MORE ABOUT
THE INTERNATIONAL SPACE STATION,

786
00:47:52,150 --> 00:47:55,290
S.T.E.M. STATION AND
SPACEFLIGHT.

787
00:47:55,290 --> 00:47:58,910
IF YOU WANT TO LEARN ABOUT
WHAT'S GOING ON ON MARS, YOU CAN

788
00:47:58,910 --> 00:48:07,670
LEARN ABOUT CURIOSITY ROVER AS
WELL AND ALSO MAVEN LOOKING AT

789
00:48:07,670 --> 00:48:11,849
THE ATMOSPHERE OF MARS.
AND LAUNCHING IN MARS OF NEXT

790
00:48:11,849 --> 00:48:14,020
YEAR, INSIGHT.
WE'RE GOING TO SEND ANOTHER

791

00:48:14,020 --> 00:48:18,119
LANDER TO GO INTO MARS AND
REALLY LEARN WHAT'S UNDERNEATH

792
00:48:18,119 --> 00:48:22,200
THE SURFACE SO WE CAN HELP THE
FUTURE ASTRONAUTS MINE THOSE

793
00:48:22,200 --> 00:48:25,339
RESOURCES THAT EXIST ON THE
MARTIAN SURFACE.

794
00:48:25,339 --> 00:48:29,680
NOW, THERE'S ALSO LOTS OF OTHER
SITES THAT YOU CAN GO TO, JUST

795
00:48:29,680 --> 00:48:34,420
GENERAL INFORMATION ABOUT NASA.
AND HUMAN SPACEFLIGHT AS WELL.

796
00:48:34,420 --> 00:48:37,990
AND DEFINITELY FOLLOW US ON OUR
JOURNEY TO MARS.

797
00:48:37,990 --> 00:48:40,520
NOW, YOU GUYS ARE IN HIGH
SCHOOL.

798
00:48:40,520 --> 00:48:42,849
AND YOU GUYS ARE SOON GOING TO
BE GRADUATING.

799
00:48:42,849 --> 00:48:45,810
IF YOU GUYS WOULD LIKE AN
INTERNSHIP AT NASA, I'D HIGHLY

800
00:48:45,810 --> 00:48:49,040
RECOMMEND GOING TO
INTERN.NASA.GOV.

801

00:48:49,040 --> 00:48:55,070
AND LEARN HOW TO DO WORK STUDY
PROGRAMS WITH NASA, LEARN

802
00:48:55,070 --> 00:48:58,790
VALUABLE INFORMATION WHAT YOU'LL
EXPERIENCE OUTSIDE OF YOUR

803
00:48:58,790 --> 00:49:03,260
ACADEMIC CAREERS.
IT'S REALLY, REALLY IMPORTANT.

804
00:49:03,260 --> 00:49:05,950
NASA THINKS HIGHLY OF THEIR
INTERNS.

805
00:49:05,950 --> 00:49:10,410
AND A GREAT SUCCESS RATE OF
HIRING INTERNS THAT GO THROUGH

806
00:49:10,410 --> 00:49:14,359
THE ENTIRE INTERNSHIP PROGRAM.
I DEFINITELY RECOMMEND YOU GUYS

807
00:49:14,359 --> 00:49:17,520
THINKING ABOUT INTERNSHIPS WITH
NASA.

808
00:49:17,520 --> 00:49:23,109
REMEMBER, HERE AT THE DELTA,
WE'VE JUST ONE OF TEN NASA

809
00:49:23,109 --> 00:49:26,930
CENTERS LOCATED THROUGHOUT THE
UNITED STATES.

810
00:49:26,930 --> 00:49:30,460
SO THERE'S LOTS OF OPPORTUNITIES
AT MANY OF THE NASA FACILITIES.

811

00:49:30,460 --> 00:49:32,849

I WANT TO THANK YOU GUYS FOR
JOINING US TODAY.

812

00:49:32,849 --> 00:49:35,800

WE HOPE YOU GUYS HAD A WONDERFUL
TIME.