
NASA
SILICON VALLEY
IVE
DAYS HOURS MIN SEC
162706:58:30
NASA
SILICON VALLEY
AMES RESEARCH CENTER

1
00:00:28,240 --> 00:00:10,180
dan eight seven six five four three two

2
00:00:31,940 --> 00:00:28,250
[Music]

3
00:00:34,700 --> 00:00:31,950
hi everybody welcome to another episode

4
00:00:37,640 --> 00:00:34,710
of NASA and Silicon Valley live I am

5
00:00:39,799 --> 00:00:37,650
your host Tiffany Blake if this is your

6
00:00:41,240 --> 00:00:39,809
first time tuning in to the show NASA

7
00:00:43,610 --> 00:00:41,250
and Silicon Valley live is a

8
00:00:45,380 --> 00:00:43,620
conversational show out of NASA's Ames

9
00:00:47,930 --> 00:00:45,390
Research Center where we talk about all

10
00:00:51,140 --> 00:00:47,940
the nerdy NASA news you need to know

11
00:00:56,689 --> 00:00:51,150
today I have with me the always awesome

12
00:00:59,960 --> 00:00:56,699
Abby yes I am your co-host today I'm

13
00:01:01,790 --> 00:00:59,970

Abby Taylor thanks for joining us and we

14
00:01:05,360 --> 00:01:01,800
are simultaneously live right now on

15
00:01:07,760 --> 00:01:05,370
twitch YouTube Facebook and periscope

16
00:01:10,010 --> 00:01:07,770
but if you want to join in the chat and

17
00:01:12,250 --> 00:01:10,020
ask our guests questions during the show

18
00:01:17,480 --> 00:01:12,260
you need to do that on Twitch so go to

19
00:01:20,030 --> 00:01:17,490
WWE TV slash NASA so today we are taking

20
00:01:22,250 --> 00:01:20,040
a trip down memory lane and talking

21
00:01:24,980 --> 00:01:22,260
about the upcoming anniversary of the

22
00:01:28,460 --> 00:01:24,990
Apollo moon landing yes I'm super

23
00:01:30,980 --> 00:01:28,470
excited about this July 20th will mark

24
00:01:33,560 --> 00:01:30,990
the 50th anniversary of humans taking

25
00:01:36,440 --> 00:01:33,570
their first steps on the moon on another

26
00:01:38,540 --> 00:01:36,450
world actually if you think about it so

27
00:01:40,850 --> 00:01:38,550
joining us today to talk about this

28
00:01:44,180 --> 00:01:40,860
historic achievement are our guests

29
00:01:46,040 --> 00:01:44,190
Kimberly and Chad hi guys hello why

30
00:01:47,450 --> 00:01:46,050
don't you introduce yourselves and tell

31
00:01:49,370 --> 00:01:47,460
the audience a little about yourself

32
00:01:51,650 --> 00:01:49,380
about yourself well Abby and Tiffany

33
00:01:53,420 --> 00:01:51,660
thank you for having us I'm Kimberly

34
00:01:55,310 --> 00:01:53,430
Anika Smith I'm a research

35
00:01:58,490 --> 00:01:55,320
astrophysicist at NASA Ames Research

36
00:02:00,980 --> 00:01:58,500
Center in Silicon Valley and as a NASA

37
00:02:02,660 --> 00:02:00,990
scientist I'm solving problems and I

38
00:02:05,750 --> 00:02:02,670

work a lot with instruments and mission

39
00:02:09,410 --> 00:02:05,760
design for new missions in space so

40
00:02:11,479 --> 00:02:09,420
Google and I I'm Chad frost on the

41
00:02:14,089 --> 00:02:11,489
deputy director for engineering here at

42
00:02:16,490 --> 00:02:14,099
NASA Ames Research Center and our folks

43
00:02:21,410 --> 00:02:16,500
have the most excellent role of

44
00:02:23,180 --> 00:02:21,420
basically making the ideas and concepts

45
00:02:27,020 --> 00:02:23,190
and missions the folks like Kimberly

46
00:02:29,000 --> 00:02:27,030
come up with come to life they they have

47
00:02:30,790 --> 00:02:29,010
these wonderful ideas for science and

48
00:02:35,500 --> 00:02:30,800
missions and we get to build them

49
00:02:38,270 --> 00:02:35,510
awesome yeah like awesome jobs right

50
00:02:40,490 --> 00:02:38,280
before we get into talking about

51
00:02:43,070 --> 00:02:40,500
an anniversary which is just two days

52
00:02:44,660 --> 00:02:43,080
away I want to remind our audience that

53
00:02:46,700 --> 00:02:44,670
we're also counting down to another

54
00:02:49,910 --> 00:02:46,710
important milestone in human space

55
00:02:52,490 --> 00:02:49,920
exploration right that's what the clock

56
00:02:54,500 --> 00:02:52,500
is all about so five years from now NASA

57
00:02:56,630 --> 00:02:54,510
is planning to send humans to the moon

58
00:02:57,590 --> 00:02:56,640
as part of our Artemis program which

59
00:03:00,740 --> 00:02:57,600
we're gonna talk a little more about

60
00:03:03,020 --> 00:03:00,750
later on and this clock here is counting

61
00:03:07,250 --> 00:03:03,030
down the days hours minutes and seconds

62
00:03:09,800 --> 00:03:07,260
until 2024 when the first woman and who

63
00:03:11,690 --> 00:03:09,810

knows the next man will walk on the moon

64
00:03:13,580 --> 00:03:11,700
south pole somewhere humans have never

65
00:03:14,690 --> 00:03:13,590
been before so we're pretty excited

66
00:03:16,850 --> 00:03:14,700
about that we're gonna talk about that

67
00:03:18,350 --> 00:03:16,860
later also in the show so for now let's

68
00:03:23,420 --> 00:03:18,360
get back to Apollo

69
00:03:27,110 --> 00:03:23,430
yes Apollo so the moon ranting kind of a

70
00:03:28,790 --> 00:03:27,120
big deal who do you guys think well it's

71
00:03:32,660 --> 00:03:28,800
really exciting to look back on it right

72
00:03:35,510 --> 00:03:32,670
with the the perspective of 50 years it

73
00:03:38,170 --> 00:03:35,520
was amazing achievement then and and it

74
00:03:41,390 --> 00:03:38,180
hasn't really been duplicated you know

75
00:03:43,160 --> 00:03:41,400
we're coming back to it in Artemis to

76
00:03:45,530 --> 00:03:43,170
finally send humans back to the moon but

77
00:03:49,280 --> 00:03:45,540
it's easy to forget what a huge

78
00:03:52,130 --> 00:03:49,290
undertaking it was back fifty years ago

79
00:03:54,830 --> 00:03:52,140
and so to go back and sort of do a

80
00:03:56,479 --> 00:03:54,840
retrospective and remember all of that

81
00:03:58,310 --> 00:03:56,489
it's just amazing it's a great

82
00:04:01,190 --> 00:03:58,320
opportunity I mean I was not even a

83
00:04:04,400 --> 00:04:01,200
twinkle in my parents I so Apollo I I'm

84
00:04:06,830 --> 00:04:04,410
after Apollo but looking back at

85
00:04:11,990 --> 00:04:06,840
learning about what it took to put

86
00:04:13,699 --> 00:04:12,000
humans on the moon so July 20th 1969 the

87
00:04:16,280 --> 00:04:13,709
first humans landing on the moon it's

88
00:04:20,360 --> 00:04:16,290

the culmination of a lot of work an

89
00:04:23,270 --> 00:04:20,370
incredible engineering promise and it

90
00:04:25,250 --> 00:04:23,280
there was a charge by the President of

91
00:04:27,710 --> 00:04:25,260
the United States John F Kennedy he

92
00:04:30,950 --> 00:04:27,720
addressed Congress and I looked this up

93
00:04:34,400 --> 00:04:30,960
May 25th 1961 mm-hmm

94
00:04:36,800 --> 00:04:34,410
that was 20 days after Alan Shepard did

95
00:04:41,270 --> 00:04:36,810
the first suborbital human flight okay

96
00:04:44,090 --> 00:04:41,280
and he charged the nation to put a man

97
00:04:46,430 --> 00:04:44,100
on the moon and return him safely to

98
00:04:52,230 --> 00:04:46,440
earth within the decade so labor

99
00:04:56,950 --> 00:04:54,999
you had you had this mercury program

100
00:04:58,930 --> 00:04:56,960
that had all these firsts and then the

101
00:05:03,370 --> 00:04:58,940
Gemini which had two astronauts there

102
00:05:05,920 --> 00:05:03,380
was a period in the mid-60s 65 66 we had

103
00:05:08,650 --> 00:05:05,930
10 human missions in space in a period

104
00:05:11,650 --> 00:05:08,660
of 12 months what they were doing was

105
00:05:14,050 --> 00:05:11,660
working out all the different legs of

106
00:05:17,129 --> 00:05:14,060
doing the Apollo mission a little bit to

107
00:05:19,629 --> 00:05:17,139
put humans on the moon what a time yeah

108
00:05:22,270 --> 00:05:19,639
unlike Kimberly I actually remember the

109
00:05:26,080 --> 00:05:22,280
first moon landing and I was a little

110
00:05:28,960 --> 00:05:26,090
kid but I remember distinctly having my

111
00:05:34,000 --> 00:05:28,970
little space helmet on and sitting in

112
00:05:36,670 --> 00:05:34,010
front of our little watching the first

113
00:05:38,920 --> 00:05:36,680

moon landing is really formative

114
00:05:41,409 --> 00:05:38,930
experiences is probably why I'm here as

115
00:05:43,860 --> 00:05:41,419
a NASA engineer today incredibly but to

116
00:05:47,589 --> 00:05:43,870
think back on it and and it was such a

117
00:05:48,430 --> 00:05:47,599
hugely impactful event really for all of

118
00:05:50,350 --> 00:05:48,440
humanity

119
00:05:53,439 --> 00:05:50,360
certainly for those of us in the US but

120
00:05:56,050 --> 00:05:53,449
it was a global event that everybody

121
00:05:57,760 --> 00:05:56,060
that could see it or watch it did it was

122
00:06:00,159 --> 00:05:57,770
it all the papers around the globe

123
00:06:03,310 --> 00:06:00,169
because was such a big deal but it took

124
00:06:04,839 --> 00:06:03,320
a lot of work to get yeah absolutely I'm

125
00:06:08,439 --> 00:06:04,849
really mentioned this whole succession

126
00:06:11,170 --> 00:06:08,449
of launches and missions to you know to

127
00:06:13,629 --> 00:06:11,180
chip away at the really hard engineering

128
00:06:17,140 --> 00:06:13,639
and technical problems which were many

129
00:06:19,270 --> 00:06:17,150
many many to ultimately get to the point

130
00:06:22,560 --> 00:06:19,280
where we could launch a rocket big

131
00:06:25,240 --> 00:06:22,570
enough to carry humans to the moon

132
00:06:28,710 --> 00:06:25,250
around the moon down to the surface of

133
00:06:31,930 --> 00:06:28,720
the Moon and all the way back that was a

134
00:06:34,750 --> 00:06:31,940
nearly insurmountable set of engineering

135
00:06:38,920 --> 00:06:34,760
problems that enormous resources from

136
00:06:41,710 --> 00:06:38,930
the country were put towards let's get

137
00:06:44,620 --> 00:06:41,720
into the basics so who were the

138
00:06:48,279 --> 00:06:44,630

astronauts that actually got this this

139
00:06:50,710 --> 00:06:48,289
great opportunity this to land on the

140
00:06:52,510 --> 00:06:50,720
moon but they're talking about Apollo 11

141
00:06:53,950 --> 00:06:52,520
yes so this is a series of a Polish but

142
00:06:55,980 --> 00:06:53,960
Apollo 11 is the first time we had

143
00:06:59,500 --> 00:06:55,990
humans on the moon and there are three

144
00:07:01,840 --> 00:06:59,510
astronauts per Apollo mission and the

145
00:07:04,390 --> 00:07:01,850
ones that were on that mission which was

146
00:07:06,910 --> 00:07:04,400
not predetermined it was all part of you

147
00:07:09,880 --> 00:07:06,920
know the Roda that they were in Neil

148
00:07:12,790 --> 00:07:09,890
Armstrong and Edwin Buzz Aldrin and

149
00:07:15,760 --> 00:07:12,800
Michael Collins were the three gentlemen

150
00:07:17,440 --> 00:07:15,770
who did this historic first landing on

151
00:07:19,870 --> 00:07:17,450
the moon and Michael Collins is one who

152
00:07:23,890 --> 00:07:19,880
was in the command module in orbit

153
00:07:26,170 --> 00:07:23,900
around them okay but our design of the

154
00:07:29,530 --> 00:07:26,180
Apollo program right hey where did they

155
00:07:30,850 --> 00:07:29,540
land when they reach the moon well they

156
00:07:33,670 --> 00:07:30,860
were they were almost on the equator

157
00:07:35,260 --> 00:07:33,680
right so we had we had a little model in

158
00:07:36,880 --> 00:07:35,270
here the other day we're like looking at

159
00:07:39,040 --> 00:07:36,890
the little moon model going well where

160
00:07:41,260 --> 00:07:39,050
was it oh yeah it's right on the equator

161
00:07:43,480 --> 00:07:41,270
it's actually pretty easy to spot yeah

162
00:07:46,000 --> 00:07:43,490
it was I right on the edge of the the

163
00:07:47,470 --> 00:07:46,010

super tranquility yeah so it's one of

164
00:07:49,240 --> 00:07:47,480
these dark areas but if you look at the

165
00:07:55,860 --> 00:07:49,250
wiggle the face in the moon it's one of

166
00:08:01,330 --> 00:07:55,870
the eyes was interesting on the actual

167
00:08:05,560 --> 00:08:01,340
moon landing July 20th 1969 the moon was

168
00:08:07,960 --> 00:08:05,570
a waxing crescent and when the landing

169
00:08:11,020 --> 00:08:07,970
occurred it was about four o'clock in

170
00:08:13,300 --> 00:08:11,030
the afternoon Eastern Time but when it

171
00:08:14,920 --> 00:08:13,310
was time to open up the lunar module and

172
00:08:18,460 --> 00:08:14,930
take the first steps on the moon it was

173
00:08:21,430 --> 00:08:18,470
around 11 o'clock p.m. Eastern Time the

174
00:08:22,720 --> 00:08:21,440
Sun had set around 8:00 so it was

175
00:08:25,510 --> 00:08:22,730
nighttime if you were on the east side

176
00:08:32,950 --> 00:08:25,520
side of the US and you could look up and

177
00:08:34,990 --> 00:08:32,960
go there are some people we're talking

178
00:08:36,700 --> 00:08:35,000
the other day that people went out and

179
00:08:38,890 --> 00:08:36,710
look to see if they could see them yeah

180
00:08:42,430 --> 00:08:38,900
of course they're a little too small to

181
00:08:44,170 --> 00:08:42,440
see but people did that right they're so

182
00:08:46,420 --> 00:08:44,180
excited to go and say oh there's people

183
00:08:48,220 --> 00:08:46,430
up there right now maybe I can go out

184
00:08:49,330 --> 00:08:48,230
and look up and see them that's right I

185
00:08:51,640 --> 00:08:49,340
think that's fantastic

186
00:08:54,340 --> 00:08:51,650
that's so cool we have a comment I want

187
00:08:55,690 --> 00:08:54,350
to share from tyrannical zombie I legit

188
00:08:57,520 --> 00:08:55,700

didn't know we were planning to go back

189
00:09:03,970 --> 00:08:57,530
to the moon this is absolutely awesome

190
00:09:06,730 --> 00:09:03,980
and I'm so excited yeah absolutely and

191
00:09:08,390 --> 00:09:06,740
it to get to the moon we needed the most

192
00:09:10,579 --> 00:09:08,400
powerful rocket

193
00:09:13,190 --> 00:09:10,589
that had never met me up to now putting

194
00:09:14,870 --> 00:09:13,200
humans or even other spacecraft in was

195
00:09:17,900 --> 00:09:14,880
around or round orbit around the earth

196
00:09:19,760 --> 00:09:17,910
in order to actually escape the Earth's

197
00:09:21,560 --> 00:09:19,770
gravity and then have enough fuel to go

198
00:09:23,900 --> 00:09:21,570
to the moon just a quarter of a million

199
00:09:25,970 --> 00:09:23,910
miles away a three-day trip Wow

200
00:09:28,730 --> 00:09:25,980
yes which other members and come back

201
00:09:32,290 --> 00:09:28,740
yeah that was a big rocket right yeah I

202
00:09:34,730 --> 00:09:32,300
mean I of course was the Saturn five

203
00:09:37,430 --> 00:09:34,740
about the Saturn 5 and they forget just

204
00:09:41,840 --> 00:09:37,440
what a huge rocket that was right the

205
00:09:46,670 --> 00:09:41,850
Saturn 5 you know is let's say it was a

206
00:09:49,280 --> 00:09:46,680
almost 400 feet tall 363 tall yeah where

207
00:09:54,410 --> 00:09:49,290
is that compared to well it's taller

208
00:09:56,769 --> 00:09:54,420
than the Statue of Liberty this is

209
00:09:58,340 --> 00:09:56,779
actually graphic from back in the day

210
00:10:00,710 --> 00:09:58,350
it's huge

211
00:10:02,930 --> 00:10:00,720
you're like 7 million pounds of thrust

212
00:10:04,550 --> 00:10:02,940
and tag you have you were telling about

213
00:10:06,530 --> 00:10:04,560

how you've seen a Falcon 9 launch and

214
00:10:08,630 --> 00:10:06,540
what you could feel it yes I was

215
00:10:10,850 --> 00:10:08,640
fortunate enough to be at it Kennedy

216
00:10:14,660 --> 00:10:10,860
Space Center Cape Canaveral a few months

217
00:10:17,690 --> 00:10:14,670
ago for a Falcon Heavy launch this is a

218
00:10:19,820 --> 00:10:17,700
pretty big crib a rocket and you know

219
00:10:21,860 --> 00:10:19,830
you see these on TV and you're like oh

220
00:10:24,230 --> 00:10:21,870
yeah there's a lot of a lot of smoke and

221
00:10:27,320 --> 00:10:24,240
light and if it goes and and that that's

222
00:10:35,720 --> 00:10:27,330
true but what doesn't come across on TV

223
00:10:38,199 --> 00:10:35,730
is that you you feel it power launch is

224
00:10:40,610 --> 00:10:38,209
coming out and it's rolling towards you

225
00:10:43,670 --> 00:10:40,620
yeah there is fire and smoke and thunder

226
00:10:48,410 --> 00:10:43,680
and yeah you feel one and the Falcon

227
00:10:50,090 --> 00:10:48,420
Heavy is a lot smaller the Saturn 5

228
00:10:54,550 --> 00:10:50,100
still the most powerful rocket that's

229
00:10:58,370 --> 00:10:54,560
ever flown til 9 333 of them were flown

230
00:11:00,320 --> 00:10:58,380
test program Wow yeah that's impressive

231
00:11:03,140 --> 00:11:00,330
and then what was in the Saturn 5 rocket

232
00:11:06,040 --> 00:11:03,150
are these amazing spaceships I mean

233
00:11:09,710 --> 00:11:06,050
these Apollo engineers were creative

234
00:11:11,720 --> 00:11:09,720
elegant and precise right which I think

235
00:11:13,100 --> 00:11:11,730
you would have to have to be in or in

236
00:11:15,770 --> 00:11:13,110
order to you know there's such as

237
00:11:17,270 --> 00:11:15,780
ambitious yeah yeah yeah

238
00:11:21,860 --> 00:11:17,280

we had we had these two amazing

239
00:11:23,960 --> 00:11:21,870
spacecraft we had I just could see we

240
00:11:30,880 --> 00:11:23,970
had the what we would call this sort of

241
00:11:36,350 --> 00:11:33,650
pollen capsule and a command module that

242
00:11:39,320 --> 00:11:36,360
had old the the fuel and the like and

243
00:11:41,840 --> 00:11:39,330
then it was a staged on top of the lunar

244
00:11:43,610 --> 00:11:41,850
excursion module during launch and then

245
00:11:45,890 --> 00:11:43,620
it launched happened this had moved off

246
00:11:48,400 --> 00:11:45,900
and then it had pirouetted around and

247
00:11:50,810 --> 00:11:48,410
attached itself and we had this

248
00:11:52,430 --> 00:11:50,820
combination with two different or one

249
00:11:56,510 --> 00:11:52,440
could say three to four different

250
00:11:58,700 --> 00:11:56,520
spacecraft together go to the moon Wow

251
00:12:02,300 --> 00:11:58,710
and then we have the three astronauts

252
00:12:04,790 --> 00:12:02,310
are in the Apollo the command line the

253
00:12:07,370 --> 00:12:04,800
command module is called Columbia mm-hmm

254
00:12:10,160 --> 00:12:07,380
and then it was time for the lunar

255
00:12:12,530 --> 00:12:10,170
landing on July 20th Aldrin and

256
00:12:14,930 --> 00:12:12,540
Armstrong would move into the lunar

257
00:12:18,650 --> 00:12:14,940
excursion module and they would come

258
00:12:21,050 --> 00:12:18,660
apart Michael Collins will go in orbit

259
00:12:23,870 --> 00:12:21,060
around the moon and I'm left with the

260
00:12:32,720 --> 00:12:23,880
lunar module which Neil Armstrong then

261
00:12:34,520 --> 00:12:32,730
piloted to then land Wow the two

262
00:12:37,310 --> 00:12:34,530
astronauts are on the moon Michael

263
00:12:38,720 --> 00:12:37,320

Collins is around Robert Aeneid

264
00:12:40,490 --> 00:12:38,730
operating the moon and alone the

265
00:12:42,110 --> 00:12:40,500
loneliest job in the world it's not

266
00:12:47,980 --> 00:12:42,120
extraordinary to be on the far side

267
00:12:53,840 --> 00:12:47,990
another story the two astronauts would

268
00:12:56,870 --> 00:12:53,850
egress and then set foot yes tell them

269
00:12:59,600 --> 00:12:56,880
about the debate over the first words

270
00:13:03,620 --> 00:12:59,610
spoken from the moon yeah tell me about

271
00:13:05,960 --> 00:13:03,630
well so we all know or we may if you're

272
00:13:08,660 --> 00:13:05,970
a history if you read about you know

273
00:13:09,740 --> 00:13:08,670
Houston you know tranquility base here

274
00:13:12,200 --> 00:13:09,750
the eagle has landed

275
00:13:13,790 --> 00:13:12,210
lunar excursion module it was called

276
00:13:15,260 --> 00:13:13,800
eagle so you at Columbia in orbit and

277
00:13:18,350 --> 00:13:15,270
then Eagles and if the eagle has landed

278
00:13:20,120 --> 00:13:18,360
we've all heard about this vehicles

279
00:13:22,700 --> 00:13:20,130
being piloted by Armstrong and it was

280
00:13:24,590 --> 00:13:22,710
about to land there are these two poles

281
00:13:29,090 --> 00:13:24,600
there's the three of the four legs had

282
00:13:31,210 --> 00:13:29,100
these poles about five feet long and

283
00:13:35,680 --> 00:13:31,220
when they touch the surface of the moon

284
00:13:38,990 --> 00:13:35,690
Buzz Aldrin calls out contact light

285
00:13:41,330 --> 00:13:39,000
followed by shutdown followed by okay

286
00:13:43,310 --> 00:13:41,340
engine stop followed by out of detent

287
00:13:45,320 --> 00:13:43,320
all these you can hear this Wow they're

288
00:13:49,550 --> 00:13:45,330

going through a checklist and then

289
00:13:51,260 --> 00:13:49,560
somehow between contact light and twenty

290
00:13:53,950 --> 00:13:51,270
seconds later we had landed on the moon

291
00:13:57,830 --> 00:13:53,960
and then Aldrin comes on and says

292
00:14:13,210 --> 00:13:57,840
Houston tranquility base here the eagle

293
00:14:17,450 --> 00:14:15,380
contact Lake is when they actually did

294
00:14:19,160 --> 00:14:17,460
have the and actually if you're an eagle

295
00:14:21,590 --> 00:14:19,170
eyes you can look at the pictures of the

296
00:14:23,180 --> 00:14:21,600
Apollo of the eagle and you can look to

297
00:14:25,460 --> 00:14:23,190
see that the the posts have actually

298
00:14:27,590 --> 00:14:25,470
bent 90 degrees and sticking out oh yeah

299
00:14:30,500 --> 00:14:27,600
Wow because they did not sink into the

300
00:14:33,620 --> 00:14:30,510
surface where they landed I see no no

301
00:14:36,050 --> 00:14:33,630
one had any idea how how soft and fluffy

302
00:14:38,780 --> 00:14:36,060
or in deep the dust on the lunar surface

303
00:14:40,430 --> 00:14:38,790
might be they didn't know you know as we

304
00:14:43,280 --> 00:14:40,440
land the spacecraft is is it going to

305
00:14:44,810 --> 00:14:43,290
sink three feet into the surface or is

306
00:14:46,610 --> 00:14:44,820
it going to be you know hard as a rock

307
00:14:49,130 --> 00:14:46,620
or somewhere in between that we just

308
00:14:51,170 --> 00:14:49,140
didn't know no so they had these probes

309
00:14:54,560 --> 00:14:51,180
on that landing try and see and they

310
00:14:56,000 --> 00:14:54,570
were just mean the LEM is my my favorite

311
00:14:57,770 --> 00:14:56,010
spaceship because there's a first Bishop

312
00:15:00,110 --> 00:14:57,780
designed to exist in a vacuum

313
00:15:03,050 --> 00:15:00,120

I mean it only has the thinnest walls

314
00:15:03,500 --> 00:15:03,060
you know as soon as it is like aluminum

315
00:15:05,600 --> 00:15:03,510
foil

316
00:15:07,460 --> 00:15:05,610
I mean Buzz Aldrin is a story that you

317
00:15:09,290 --> 00:15:07,470
can we could put a pin through it Wow

318
00:15:14,090 --> 00:15:09,300
but if now is protecting the astronauts

319
00:15:16,490 --> 00:15:14,100
from wow the emptiness of space Wow of

320
00:15:18,560 --> 00:15:16,500
course we're in the period where the

321
00:15:21,230 --> 00:15:18,570
astronauts are on the surface for Apollo

322
00:15:22,760 --> 00:15:21,240
live and they were only there for 21 and

323
00:15:32,180 --> 00:15:22,770
a half hours but in terms of walking

324
00:15:35,330 --> 00:15:32,190
around only two and a half hours 300

325
00:15:37,790 --> 00:15:35,340
feet away from the eagle okay lots of

326
00:15:41,600 --> 00:15:37,800
pictures yeah it's for experiments yeah

327
00:15:42,560 --> 00:15:41,610
what kinds of experiences well um well

328
00:15:44,600 --> 00:15:42,570
one of the ones

329
00:15:48,800 --> 00:15:44,610
to put a seismometer they were

330
00:15:51,040 --> 00:15:48,810
interested in moonquake moonquake so

331
00:15:53,720 --> 00:15:51,050
here in California we have

332
00:15:55,760 --> 00:15:53,730
so moonquakes cuz at the time in the

333
00:15:57,800 --> 00:15:55,770
sixties we didn't really know what the

334
00:16:00,320 --> 00:15:57,810
moon's surface interior anything was

335
00:16:02,570 --> 00:16:00,330
like and so they did register moonquakes

336
00:16:05,300 --> 00:16:02,580
that's they also said an instrument to

337
00:16:06,740 --> 00:16:05,310
measure dust they were interested in

338
00:16:09,620 --> 00:16:06,750

they had a flag that they put out just

339
00:16:12,110 --> 00:16:09,630
to see what the what was in the

340
00:16:15,860 --> 00:16:12,120
atmosphere and one of them need us

341
00:16:18,740 --> 00:16:15,870
instruments my favorite well they

342
00:16:21,080 --> 00:16:18,750
deployed a laser retroreflector so it

343
00:16:23,540 --> 00:16:21,090
was a corner reflector that has this

344
00:16:26,180 --> 00:16:23,550
great property of a few shine a laser at

345
00:16:29,180 --> 00:16:26,190
it it reflects bullies are straight back

346
00:16:31,010 --> 00:16:29,190
from where it came and so they deployed

347
00:16:33,860 --> 00:16:31,020
this on the surface of the moon and they

348
00:16:35,960 --> 00:16:33,870
could shine lasers from Earth at the

349
00:16:38,060 --> 00:16:35,970
moon and the laser would be reflected

350
00:16:40,670 --> 00:16:38,070
straight back and they could measure how

351
00:16:42,230 --> 00:16:40,680
long it took the laser to go to the moon

352
00:16:46,220 --> 00:16:42,240
and back and get a very very precise

353
00:16:47,990 --> 00:16:46,230
range measurement and it's it's a really

354
00:16:50,090 --> 00:16:48,000
cool instrument they've deployed others

355
00:16:52,550 --> 00:16:50,100
on the surface of the Moon and they are

356
00:16:55,730 --> 00:16:52,560
still being used today yeah that's

357
00:16:57,980 --> 00:16:55,740
impressive right and we've learned that

358
00:16:59,960 --> 00:16:57,990
the moon is receding from us about one

359
00:17:03,830 --> 00:16:59,970
and a half inches a year that's going

360
00:17:05,720 --> 00:17:03,840
away if you stay around long enough even

361
00:17:08,929 --> 00:17:05,730
confirmed Einstein's theory of general

362
00:17:11,079 --> 00:17:08,939
relativity by a refined knowledge of the

363
00:17:13,880 --> 00:17:11,089

moon's orbit around the Earth oh my gosh

364
00:17:15,500 --> 00:17:13,890
so it's really impressive so now now

365
00:17:17,480 --> 00:17:15,510
we've had our astronauts to deployed and

366
00:17:20,329 --> 00:17:17,490
they took pictures and videos they

367
00:17:23,260 --> 00:17:20,339
planted a flag they had a Preta a phone

368
00:17:25,850 --> 00:17:23,270
conversation with President Nixon and

369
00:17:30,280 --> 00:17:25,860
and you know Neil Armstrong's first

370
00:17:33,560 --> 00:17:30,290
words on the moon a small step for a man

371
00:17:35,480 --> 00:17:33,570
giant leap for mankind we come in peace

372
00:17:37,460 --> 00:17:35,490
for all of were you know all of

373
00:17:42,200 --> 00:17:37,470
humankind was on the plaque yeah I think

374
00:17:45,580 --> 00:17:42,210
we have an image actually of there yeah

375
00:17:49,220 --> 00:17:45,590
let's go with this

376
00:17:51,530 --> 00:17:49,230
that's Buzz Aldrin and it's Neil

377
00:17:53,040 --> 00:17:51,540
Armstrong taking that picture you see

378
00:17:56,070 --> 00:17:53,050
the reflection and

379
00:17:58,230 --> 00:17:56,080
the reflection so yeah the other thing

380
00:17:59,970 --> 00:17:58,240
they did is also collected soil samples

381
00:18:01,650 --> 00:17:59,980
and rock samples and one of the things

382
00:18:03,870 --> 00:18:01,660
that our mitrik did right as he got out

383
00:18:05,250 --> 00:18:03,880
of the LEM was he took a contingency

384
00:18:07,740 --> 00:18:05,260
sample in case they needed to get back

385
00:18:09,210 --> 00:18:07,750
to Earth right away he had something and

386
00:18:11,460 --> 00:18:09,220
he put it up and he put it in his right

387
00:18:12,840 --> 00:18:11,470
right side pocket and he had a soil

388
00:18:14,700 --> 00:18:12,850

sample but during the course of two and

389
00:18:17,100 --> 00:18:14,710
a half hours they were able to collect

390
00:18:21,990 --> 00:18:17,110
rocks and soils which has transformed

391
00:18:24,570 --> 00:18:22,000
lunar Science and forty pounds or so

392
00:18:26,730 --> 00:18:24,580
much 40 45 over the course of all the

393
00:18:29,730 --> 00:18:26,740
Apollo missions we ended up with what

394
00:18:32,610 --> 00:18:29,740
800 840 pounds over six landed missions

395
00:18:35,880 --> 00:18:32,620
oh yeah and they just been instrumental

396
00:18:37,350 --> 00:18:35,890
so after they had gone into the I'll go

397
00:18:38,970 --> 00:18:37,360
back to my model we've had our moon

398
00:18:40,890 --> 00:18:38,980
walks and we've collected our science

399
00:18:43,800 --> 00:18:40,900
the great thing about the engineers is

400
00:18:46,230 --> 00:18:43,810
now we have the lamb is going to depart

401
00:18:47,670 --> 00:18:46,240
with the ascent stage which is also an

402
00:18:49,200 --> 00:18:47,680
engineering achievement had to work on

403
00:18:51,060 --> 00:18:49,210
its first time and now it's gonna

404
00:19:00,300 --> 00:18:51,070
rendezvous with my Collins and he's not

405
00:19:03,360 --> 00:19:00,310
gonna have his buddy and come home and

406
00:19:08,100 --> 00:19:03,370
so this gets jettisoned and then we wind

407
00:19:10,250 --> 00:19:08,110
up having oops the Apollo capsule that's

408
00:19:13,560 --> 00:19:10,260
falling apart

409
00:19:15,180 --> 00:19:13,570
this gets jettison and that's what comes

410
00:19:16,860 --> 00:19:15,190
home that's how he returned home

411
00:19:18,150 --> 00:19:16,870
let's tell they returned home that's

412
00:19:20,460 --> 00:19:18,160
amazing we'll talk more about that later

413
00:19:23,910 --> 00:19:20,470

I want to mention you guys answered the

414
00:19:26,040 --> 00:19:23,920
question from pag on the door sorry if I

415
00:19:27,480 --> 00:19:26,050
got that wrong but how long did they

416
00:19:29,370 --> 00:19:27,490
stay on the moon during the Apollo

417
00:19:31,680 --> 00:19:29,380
missions this one you said they worked

418
00:19:33,120 --> 00:19:31,690
on the surface on the surface through 21

419
00:19:35,340 --> 00:19:33,130
and a half hours but their actual

420
00:19:37,560 --> 00:19:35,350
walking was only two and a half hours

421
00:19:40,200 --> 00:19:37,570
and then what is this about they had to

422
00:19:42,450 --> 00:19:40,210
take a nap before they could leave or

423
00:19:45,150 --> 00:19:42,460
they had to have a rest period what was

424
00:19:46,620 --> 00:19:45,160
that I think there I think there was

425
00:19:48,540 --> 00:19:46,630
some napping I mean they just been a

426
00:19:51,110 --> 00:19:48,550
really intense training and of course

427
00:19:54,300 --> 00:19:51,120
you know not only getting to the moon

428
00:19:56,100 --> 00:19:54,310
but bringing the lander down from orbit

429
00:19:58,260 --> 00:19:56,110
to land and that that was as you may

430
00:19:59,580 --> 00:19:58,270
have seen in some of the you know movies

431
00:20:02,850 --> 00:19:59,590
and other coverage that was a very

432
00:20:05,070 --> 00:20:02,860
exciting ride they did not land right

433
00:20:07,410 --> 00:20:05,080
where they thought they were going to be

434
00:20:11,580 --> 00:20:07,420
overshot by about four miles overshot

435
00:20:14,010 --> 00:20:11,590
had to find a less colder e area a place

436
00:20:15,810 --> 00:20:14,020
that was suitable to land and they

437
00:20:19,320 --> 00:20:15,820
almost ran out of fuel in the process

438
00:20:21,680 --> 00:20:19,330

it's pretty stressful pretty intense so

439
00:20:24,870 --> 00:20:21,690
I think they needed a little downtime

440
00:20:28,350 --> 00:20:24,880
there were also the inherent limitations

441
00:20:30,210 --> 00:20:28,360
of you only have so much oxygen so many

442
00:20:32,010 --> 00:20:30,220
supplies you know you're only equipped

443
00:20:33,300 --> 00:20:32,020
to be there for this relatively short

444
00:20:35,970 --> 00:20:33,310
time yeah

445
00:20:37,830 --> 00:20:35,980
and they knocked it out for you no it's

446
00:20:39,990 --> 00:20:37,840
the very first time anyone had done it

447
00:20:41,670 --> 00:20:40,000
so they were being very conservative in

448
00:20:46,500 --> 00:20:41,680
all regards understand they weren't

449
00:20:48,570 --> 00:20:46,510
pushing the following Apollo missions

450
00:20:49,830 --> 00:20:48,580
would build upon Apollo 11 things that

451
00:20:51,090 --> 00:20:49,840
were I just you know you're always

452
00:20:52,710 --> 00:20:51,100
building upon what you're learning from

453
00:20:54,570 --> 00:20:52,720
a driving such that the later Apollo

454
00:20:56,280 --> 00:20:54,580
missions spent up to three days on the

455
00:20:58,770 --> 00:20:56,290
surface doing science experiments and

456
00:21:00,540 --> 00:20:58,780
had the rover and did all lots of great

457
00:21:02,460 --> 00:21:00,550
things all right yeah this answers my

458
00:21:10,800 --> 00:21:02,470
question which was seriously they have

459
00:21:12,060 --> 00:21:10,810
to go to sleep took out the seats in the

460
00:21:13,980 --> 00:21:12,070
Apollo 11 landing

461
00:21:16,560 --> 00:21:13,990
so they were just like sleeping on the

462
00:21:18,510 --> 00:21:16,570
floor oh really they put a hammock in

463
00:21:22,410 --> 00:21:18,520

but still in order to save weight they

464
00:21:24,540 --> 00:21:22,420
got really sheets it's interesting to

465
00:21:27,800 --> 00:21:24,550
fly the lunar module so I've actually

466
00:21:34,740 --> 00:21:27,810
got some some stick time in our

467
00:21:37,290 --> 00:21:34,750
simulator for the I got to quote land on

468
00:21:39,990 --> 00:21:37,300
the moon it's both rusty Schweickart and

469
00:21:43,170 --> 00:21:40,000
Charlie Duke who were both hello lunar

470
00:21:44,970 --> 00:21:43,180
module pilots okay and you're standing

471
00:21:46,710 --> 00:21:44,980
up you're flying the thing you know

472
00:21:48,600 --> 00:21:46,720
there is no seats if you're staying up

473
00:21:50,940 --> 00:21:48,610
and you know bringing the thing in and

474
00:21:54,090 --> 00:21:50,950
flying it and of course both those guys

475
00:21:56,370 --> 00:21:54,100
are crackerjack at it because they're

476
00:21:57,990 --> 00:21:56,380
they flew the real thing yeah they're

477
00:21:59,850 --> 00:21:58,000
both they were both still very good at

478
00:22:02,490 --> 00:21:59,860
it and you're much better than us but

479
00:22:04,500 --> 00:22:02,500
just that experience of what's what's it

480
00:22:06,660 --> 00:22:04,510
really like to try and go fly and land

481
00:22:07,980 --> 00:22:06,670
on the moon it's it's not like flying an

482
00:22:10,020 --> 00:22:07,990
airplane it's not like flying a

483
00:22:12,210 --> 00:22:10,030
helicopter it's a completely unique and

484
00:22:13,830 --> 00:22:12,220
different experience it has to be right

485
00:22:16,529 --> 00:22:13,840
it's like and we're on the verge of

486
00:22:18,899 --> 00:22:16,539
having to relearn that all again

487
00:22:21,779 --> 00:22:18,909
and we're smarter too as I said we've

488
00:22:24,719 --> 00:22:21,789

learned so much by you know some of the

489
00:22:26,579 --> 00:22:24,729
videos of Buzz and Neil jumping around

490
00:22:28,349 --> 00:22:26,589
the surface Apollo 11 you'll see them

491
00:22:29,219 --> 00:22:28,359
there trying out different steps because

492
00:22:31,229 --> 00:22:29,229
they're trying to figure out how to walk

493
00:22:32,819 --> 00:22:31,239
in 1/6 gravity huh with the bulky

494
00:22:34,919 --> 00:22:32,829
spaceship right so you see the posses

495
00:22:36,689 --> 00:22:34,929
yeah so this I was also part of

496
00:22:38,099 --> 00:22:36,699
experiments well you know way to know

497
00:22:49,709 --> 00:22:38,109
how could we work and live in this

498
00:22:52,439 --> 00:22:49,719
environment in the moment and learn

499
00:22:54,299 --> 00:22:52,449
exactly questions that we did not know

500
00:22:56,339 --> 00:22:54,309
because they can only simulate so much

501
00:22:57,599 --> 00:22:56,349
you have to go there yeah and that's

502
00:22:59,699 --> 00:22:57,609
where you're gonna make the big leaps

503
00:23:01,919 --> 00:22:59,709
and knowledge understanding it's like

504
00:23:08,549 --> 00:23:01,929
smooth Master says moving in those suits

505
00:23:11,159 --> 00:23:08,559
is insane the lunar module is your

506
00:23:14,369 --> 00:23:11,169
favorite spacecraft my favorite

507
00:23:16,289 --> 00:23:14,379
spacecraft I want you to know that a

508
00:23:22,189 --> 00:23:16,299
pitcher combines those my grandfather

509
00:23:28,279 --> 00:23:24,659
the reason the lunar module is my

510
00:23:31,229 --> 00:23:28,289
favorite is because you know it's it's

511
00:23:33,659 --> 00:23:31,239
one of the few vehicles that we've ever

512
00:23:36,749 --> 00:23:33,669
built that is really designed only for

513
00:23:38,669 --> 00:23:36,759

the space environment yeah never has to

514
00:23:40,379 --> 00:23:38,679
go through an atmosphere oh man right

515
00:23:43,439 --> 00:23:40,389
and so it doesn't it doesn't look like

516
00:23:45,239 --> 00:23:43,449
an atmospheric vehicle and you know

517
00:23:47,189 --> 00:23:45,249
International Space Station is another

518
00:23:48,839 --> 00:23:47,199
example but there's not very many that

519
00:23:50,369 --> 00:23:48,849
are like that almost everything else

520
00:23:51,629 --> 00:23:50,379
either at you know it's got to go up

521
00:23:53,579 --> 00:23:51,639
through an atmosphere it's got to come

522
00:23:55,739 --> 00:23:53,589
back through an atmosphere and so it's

523
00:23:58,409 --> 00:23:55,749
just a very distinctly different kind of

524
00:23:59,909 --> 00:23:58,419
vehicle I really like them I can see

525
00:24:02,489 --> 00:23:59,919
that yeah for those of you who build

526
00:24:06,989 --> 00:24:02,499
spacecraft or instruments where the

527
00:24:08,369 --> 00:24:06,999
earth yeah that matters very cool so one

528
00:24:10,469 --> 00:24:08,379
cool thing about celebrating the

529
00:24:12,719 --> 00:24:10,479
anniversary is that we've been gathering

530
00:24:15,269 --> 00:24:12,729
people's memories and so I thought about

531
00:24:17,909 --> 00:24:15,279
what's my memory of Apollo

532
00:24:21,689 --> 00:24:17,919
I wasn't born then but it made me think

533
00:24:24,269 --> 00:24:21,699
oh my gosh my dad had this video tape

534
00:24:26,729 --> 00:24:24,279
that he sat me and my sister down in

535
00:24:28,229 --> 00:24:26,739
front of he popped it on the VCR it was

536
00:24:30,000 --> 00:24:28,239
this weird grainy black-and-white

537
00:24:32,700 --> 00:24:30,010
footage you know

538
00:24:35,370 --> 00:24:32,710

was but it was the Apollo 11 moon

539
00:24:36,870 --> 00:24:35,380
landing and at the time I was an

540
00:24:38,280 --> 00:24:36,880
elementary school or something and I

541
00:24:40,320 --> 00:24:38,290
didn't get it but I needed that this

542
00:24:54,450 --> 00:24:40,330
mattered to my dad he made us sit and

543
00:24:56,310 --> 00:24:54,460
watch it trying to think about just

544
00:24:59,669 --> 00:24:56,320
being back there and just you know it

545
00:25:01,530 --> 00:24:59,679
was a defining moment in history in that

546
00:25:04,049 --> 00:25:01,540
century the world just for the whole

547
00:25:06,299 --> 00:25:04,059
world yeah tuning in and watching this I

548
00:25:08,820 --> 00:25:06,309
think that's amazing right just in like

549
00:25:11,159 --> 00:25:08,830
everyone across the entire group looking

550
00:25:13,440 --> 00:25:11,169
up at the moon just all at once that's

551
00:25:15,990 --> 00:25:13,450
just amazing right do you have some of

552
00:25:19,110 --> 00:25:16,000
those memories to share with us from I

553
00:25:21,390 --> 00:25:19,120
do so we have more stories and they're

554
00:25:23,039 --> 00:25:21,400
actually from you all we invited people

555
00:25:24,600 --> 00:25:23,049
all over the world to share their share

556
00:25:27,360 --> 00:25:24,610
their Apollo 11 minute

557
00:25:30,510 --> 00:25:27,370
moon landing stories and so we collected

558
00:25:32,940 --> 00:25:30,520
their responses and they are part of our

559
00:25:35,850 --> 00:25:32,950
NASA Explorers your Apollo stories

560
00:25:39,750 --> 00:25:35,860
podcast and here's one we have here from

561
00:25:42,419 --> 00:25:39,760
Ellen in Calistoga California we are all

562
00:25:45,090 --> 00:25:42,429
glued to our television that day mind

563
00:25:47,669 --> 00:25:45,100

you this is a television that only got

564
00:25:50,250 --> 00:25:47,679
three channels so I'm grateful that we

565
00:25:54,000 --> 00:25:50,260
were able to watch it was quite fuzzy

566
00:25:56,130 --> 00:25:54,010
but it was so exciting and me being

567
00:25:57,870 --> 00:25:56,140
young I immediately went outside with a

568
00:25:59,850 --> 00:25:57,880
pair of binoculars to stare at the moon

569
00:26:02,669 --> 00:25:59,860
to see if I could see Neil Armstrong

570
00:26:05,960 --> 00:26:02,679
walking on the moon you know when you're

571
00:26:09,750 --> 00:26:05,970
young anything is possible

572
00:26:11,430 --> 00:26:09,760
so nice that's amazing so if you all

573
00:26:25,799 --> 00:26:11,440
want to hear more stories like Ellen's

574
00:26:32,039 --> 00:26:28,950
yeah I wanna do you want to lead us off

575
00:26:35,720 --> 00:26:32,049
into rapid-fire questions Mir really

576
00:26:39,440 --> 00:26:35,730
really quickly okay so we have here from

577
00:26:43,129 --> 00:26:39,450
an easter egg

578
00:26:45,119 --> 00:26:43,139
my question why the moon before Mars

579
00:26:47,969 --> 00:26:45,129
well I think there's a number of reasons

580
00:26:50,969 --> 00:26:47,979
the the biggest challenge with sending

581
00:26:53,009 --> 00:26:50,979
humans to Mars is that you know it's so

582
00:26:57,019 --> 00:26:53,019
much further away it takes a lot longer

583
00:27:00,389 --> 00:26:57,029
to get there than going to the moon and

584
00:27:03,869 --> 00:27:00,399
that duration introduces lots and lots

585
00:27:06,830 --> 00:27:03,879
of big problems right there's longer

586
00:27:11,009 --> 00:27:06,840
exposure to radiation longer exposure to

587
00:27:13,710 --> 00:27:11,019
really no gravity you know living in a

588
00:27:18,389 --> 00:27:13,720

basically a tin can for potentially

589
00:27:21,450 --> 00:27:18,399
months plus all of the technical devices

590
00:27:24,089 --> 00:27:21,460
and systems that have to be reliable

591
00:27:26,609 --> 00:27:24,099
enough to last that long and rather than

592
00:27:27,299 --> 00:27:26,619
just make a go of it and give it a give

593
00:27:29,999 --> 00:27:27,309
it your best shot

594
00:27:32,219 --> 00:27:30,009
it's easier to prove all that out a

595
00:27:35,310 --> 00:27:32,229
little bit closer to home you know we've

596
00:27:38,249 --> 00:27:35,320
got a long period of having humans in

597
00:27:40,589 --> 00:27:38,259
Earth orbit on the space station the

598
00:27:43,979 --> 00:27:40,599
next big step is to go for that much

599
00:27:45,839 --> 00:27:43,989
further away from us and to spend that

600
00:27:47,669 --> 00:27:45,849
much more time that takes us to the moon

601
00:27:49,769 --> 00:27:47,679
and the Mars is a very different mindset

602
00:27:51,869 --> 00:27:49,779
as well right you know communication

603
00:27:54,330 --> 00:27:51,879
could be at much 20 minutes 30 minutes

604
00:27:56,489 --> 00:27:54,340
something we're very independent when

605
00:27:58,769 --> 00:27:56,499
you're out there on your own doing space

606
00:28:01,560 --> 00:27:58,779
exploration

607
00:28:03,779 --> 00:28:01,570
here's one from stinkbutt 34 how much

608
00:28:06,659 --> 00:28:03,789
fuel did it take to lift the lunar

609
00:28:07,560 --> 00:28:06,669
module the LEM off the moon you guys

610
00:28:08,159 --> 00:28:07,570
happen to know that that's a good

611
00:28:10,499 --> 00:28:08,169
question

612
00:28:15,749 --> 00:28:10,509
you know I remember seeing the the

613
00:28:19,049 --> 00:28:15,759

number for the the LEM crew module and I

614
00:28:23,940 --> 00:28:19,059
want to say don't quote me on this but I

615
00:28:26,159 --> 00:28:23,950
think we didn't tear out you know a few

616
00:28:29,969 --> 00:28:26,169
let's say a few hundred gallons it was

617
00:28:32,969 --> 00:28:29,979
not a huge not a huge amount but it only

618
00:28:35,729 --> 00:28:32,979
had that one job to do yeah that'll work

619
00:28:37,739 --> 00:28:35,739
that one time right yeah I know the

620
00:28:38,609 --> 00:28:37,749
numbers published I just don't have it

621
00:28:40,830 --> 00:28:38,619
at the tip of my tongue

622
00:28:43,169 --> 00:28:40,840
but that's there it's interests all the

623
00:28:45,119 --> 00:28:43,179
Apollo technical documents they are out

624
00:28:46,950 --> 00:28:45,129
there you can go online and download all

625
00:28:49,919 --> 00:28:46,960
the Apollo reports all the experience

626
00:28:51,960 --> 00:28:49,929
reports and like all those technical

627
00:28:53,950 --> 00:28:51,970
details they're all in there you can

628
00:29:08,159 --> 00:28:53,960
just go look them up it's really cool

629
00:29:12,880 --> 00:29:11,169
there are some excited comments like

630
00:29:14,799 --> 00:29:12,890
can't wait to experience the same thing

631
00:29:16,840 --> 00:29:14,809
in five years as some did 50 years ago

632
00:29:18,570 --> 00:29:16,850
that's right where the Artemis

633
00:29:21,580 --> 00:29:18,580
generation we are the argumentation

634
00:29:22,210 --> 00:29:21,590
collinear is Apollo but we learn from

635
00:29:27,850 --> 00:29:22,220
Apollo

636
00:29:28,990 --> 00:29:27,860
we actually have a question I think it's

637
00:29:31,899 --> 00:29:29,000
because we talk so much about the

638
00:29:34,269 --> 00:29:31,909

astronauts from it's crazy K what did it

639
00:29:36,310 --> 00:29:34,279
take to become an astronaut good

640
00:29:38,470 --> 00:29:36,320
question what did the astronauts have to

641
00:29:44,500 --> 00:29:38,480
do in order to land on the moon an

642
00:29:47,529 --> 00:29:44,510
education skill determination of a luck

643
00:29:59,760 --> 00:29:47,539
right I think the last astronaut class

644
00:30:06,100 --> 00:30:03,399
yeah and our future astronauts for he

645
00:30:07,840 --> 00:30:06,110
sustains humans in space you know we're

646
00:30:09,460 --> 00:30:07,850
gonna need all different types you know

647
00:30:11,110 --> 00:30:09,470
engineers and scientists but we're gonna

648
00:30:13,810 --> 00:30:11,120
need people can keep the machines

649
00:30:16,480 --> 00:30:13,820
working you know any plumbers or any

650
00:30:18,610 --> 00:30:16,490
surveyors we're gonna need you folks who

651
00:30:24,779 --> 00:30:18,620
are you can climb down you know canyon

652
00:30:28,960 --> 00:30:27,700
kinds of specialties here's a really

653
00:30:30,970 --> 00:30:28,970
good question maybe this should be our

654
00:30:34,000 --> 00:30:30,980
last for now but we'll get back to more

655
00:30:35,649 --> 00:30:34,010
your questions later but Latino 67 su

656
00:30:37,750 --> 00:30:35,659
Kimberly how long did you go to college

657
00:30:40,600 --> 00:30:37,760
to get the to get the knowledge for your

658
00:30:42,760 --> 00:30:40,610
current job once you get here as I say I

659
00:30:45,789 --> 00:30:42,770
stayed in school for a very long time I

660
00:30:47,710 --> 00:30:45,799
did four years as an undergraduate got a

661
00:30:50,830 --> 00:30:47,720
physics degree physics is a great degree

662
00:30:53,230 --> 00:30:50,840
to learn how to solving problems then I

663
00:30:56,230 --> 00:30:53,240

did four years in grad school I got PhD

664
00:30:58,149 --> 00:30:56,240
in astrophysics and so yeah steeped in

665
00:30:59,680 --> 00:30:58,159
school then I remember um when I got my

666
00:31:01,210 --> 00:30:59,690
first job which was called a postdoc

667
00:31:02,799 --> 00:31:01,220
it's what you get after your doctorate I

668
00:31:04,060 --> 00:31:02,809
went to another university and my dad

669
00:31:05,849 --> 00:31:04,070
would call me up are you still school

670
00:31:11,409 --> 00:31:05,859
still in school

671
00:31:17,739 --> 00:31:11,419
this time it was a good eight years of

672
00:31:21,549 --> 00:31:17,749
schooling outside of high school we

673
00:31:23,679 --> 00:31:21,559
never stopped learning I mean a job here

674
00:31:25,599 --> 00:31:23,689
working in the space business you never

675
00:31:27,579 --> 00:31:25,609
never stop learning yes in a good way

676
00:31:28,779 --> 00:31:27,589
obviously I think by the time you're

677
00:31:31,149 --> 00:31:28,789
doing your PhD you're doing something

678
00:31:34,419 --> 00:31:31,159
you're passionate about and so you're in

679
00:31:36,759 --> 00:31:34,429
love innate right I do think that school

680
00:31:39,759 --> 00:31:36,769
for at least for me school got even more

681
00:31:41,949 --> 00:31:39,769
fun and exciting more years of it I had

682
00:31:44,019 --> 00:31:41,959
yeah you know I think back to like my

683
00:31:45,909 --> 00:31:44,029
freshman year of college and it was a

684
00:31:47,649 --> 00:31:45,919
lot of work and it was really

685
00:31:50,609 --> 00:31:47,659
challenging and I didn't know what I was

686
00:31:53,259 --> 00:31:50,619
doing and as I spent more years in my

687
00:31:55,119 --> 00:31:53,269
academic career it actually got easier

688
00:31:57,279 --> 00:31:55,129

and more fun it didn't stop being

689
00:31:58,779 --> 00:31:57,289
challenging yeah but it'd be can take on

690
00:32:01,569 --> 00:31:58,789
a different note so if you're if you're

691
00:32:03,309 --> 00:32:01,579
just starting in college or if you're in

692
00:32:07,839 --> 00:32:03,319
high school or even in elementary school

693
00:32:09,639 --> 00:32:07,849
you know it does get easier and and I

694
00:32:11,079 --> 00:32:09,649
would argue it gets more fun as you as

695
00:32:15,489 --> 00:32:11,089
you go along so don't be afraid of

696
00:32:17,499 --> 00:32:15,499
spending lots in school that's great

697
00:32:19,119 --> 00:32:17,509
excellent all right so we're gonna get

698
00:32:21,639 --> 00:32:19,129
back to more questions later and before

699
00:32:24,039 --> 00:32:21,649
we move on I just want to let people

700
00:32:25,689 --> 00:32:24,049
know I want to invite you to join us in

701
00:32:28,149 --> 00:32:25,699
celebrating the 50th anniversary of the

702
00:32:31,569 --> 00:32:28,159
Apollo 11 moon landing and hear about

703
00:32:34,239 --> 00:32:31,579
our future plans to go to the moon and

704
00:32:36,489 --> 00:32:34,249
then on to Mars by tuning in to a

705
00:32:38,769 --> 00:32:36,499
special two-hour live NASA television

706
00:32:41,019 --> 00:32:38,779
broadcast that's tomorrow at 10:00 a.m.

707
00:32:43,749 --> 00:32:41,029
Pacific so to learn about the show and

708
00:32:47,279 --> 00:32:43,759
how to watch you can go to WWN a sea of

709
00:32:50,349 --> 00:32:47,289
slash apollo 50th and click on events

710
00:32:51,819 --> 00:32:50,359
are you gonna watch it definitely I will

711
00:32:53,979 --> 00:32:51,829
be watching I'm actually excited this

712
00:32:55,779 --> 00:32:53,989
stuff was really really cool it's nice

713
00:32:57,519 --> 00:32:55,789

so you know go back in time and meet

714
00:32:59,799 --> 00:32:57,529
this history and see that you know what

715
00:33:02,109 --> 00:32:59,809
Amy yes and so let's dig a little bit

716
00:33:05,589 --> 00:33:02,119
deeper into the Apollo history and talk

717
00:33:06,969 --> 00:33:05,599
about all of those those cool cool facts

718
00:33:08,709 --> 00:33:06,979
that you don't know about you know in

719
00:33:12,339 --> 00:33:08,719
order to do that we have our history

720
00:33:14,979 --> 00:33:12,349
year James tell us a little about

721
00:33:15,970 --> 00:33:14,989
yourself so my name is James Anderson

722
00:33:18,039 --> 00:33:15,980
and

723
00:33:20,529 --> 00:33:18,049
the NASA Ames historian have been here

724
00:33:26,129 --> 00:33:20,539
for a couple months right in all the

725
00:33:28,269 --> 00:33:26,139
excitement leading up to jumped right in

726
00:33:31,029 --> 00:33:28,279
and the last few months have been really

727
00:33:34,389 --> 00:33:31,039
wonderful we've had an opportunity to

728
00:33:37,200 --> 00:33:34,399
meet a lot of Apollo era veterans who

729
00:33:41,620 --> 00:33:37,210
worked at Ames and just getting to hear

730
00:33:43,350 --> 00:33:41,630
even more stories from that time many of

731
00:33:45,549 --> 00:33:43,360
which you know we're not the ones that

732
00:33:48,820 --> 00:33:45,559
have it you hear you know sort of all

733
00:33:52,810 --> 00:33:48,830
the time again so what what do you know

734
00:33:56,440 --> 00:33:52,820
about that time at Ames it was an

735
00:33:59,919 --> 00:33:56,450
exciting time the during the whole

736
00:34:01,840 --> 00:33:59,929
Apollo program the the scope of the

737
00:34:06,039 --> 00:34:01,850
number of people involved at its peak

738
00:34:07,330 --> 00:34:06,049

there were around 400,000 Americans men

739
00:34:13,060 --> 00:34:07,340
and women from diverse backgrounds

740
00:34:15,040 --> 00:34:13,070
working on the Apollo project and here

741
00:34:17,530 --> 00:34:15,050
at Ames there was also it was a time of

742
00:34:21,180 --> 00:34:17,540
building to a number of new facilities

743
00:34:24,520 --> 00:34:21,190
came online and got funding at that time

744
00:34:29,379 --> 00:34:24,530
and a lot of that research directly

745
00:34:32,740 --> 00:34:29,389
influenced the design of Apollo Wow that

746
00:34:34,839 --> 00:34:32,750
it's amazing 400,000 people all coming

747
00:34:37,240 --> 00:34:34,849
together you know this to solve this

748
00:34:39,609 --> 00:34:37,250
ambitious and really get this this this

749
00:34:41,559 --> 00:34:39,619
plan going and this project going to get

750
00:34:43,720 --> 00:34:41,569
to the moon and to me there was an

751
00:34:44,740 --> 00:34:43,730
incredibly huge that's a lot of effort

752
00:34:46,089 --> 00:34:44,750
yeah

753
00:34:48,069 --> 00:34:46,099
what are some of the facilities that

754
00:34:50,409 --> 00:34:48,079
they were building to support the new

755
00:34:56,470 --> 00:34:50,419
missions well funny you should ask have

756
00:34:59,740 --> 00:34:56,480
brought some historical artifacts from

757
00:35:01,660 --> 00:34:59,750
our facilities here at Ames Kimberly was

758
00:35:03,550 --> 00:35:01,670
showing a little bit earlier the model

759
00:35:06,099 --> 00:35:03,560
of the Apollo command module I've got

760
00:35:10,240 --> 00:35:06,109
another kind of model of the Apollo

761
00:35:15,970 --> 00:35:10,250
command module oh so you've got this one

762
00:35:18,430 --> 00:35:15,980
here it's just like it yeah it's got the

763
00:35:20,470 --> 00:35:18,440

exact same shape of Apollo and you

764
00:35:23,990 --> 00:35:20,480
notice one side is pointy and the other

765
00:35:25,970 --> 00:35:24,000
side not why is that Chad well it's

766
00:35:28,550 --> 00:35:25,980
this is one of the unique contributions

767
00:35:30,320 --> 00:35:28,560
that Ames Research Center made to not

768
00:35:33,080 --> 00:35:30,330
just the Apollo program but it's all of

769
00:35:36,760 --> 00:35:33,090
the the manned spaceflight programs of

770
00:35:39,380 --> 00:35:36,770
the time as Harvey Allen was one of the

771
00:35:41,540 --> 00:35:39,390
aerodynamicists here at the Senators

772
00:35:45,860 --> 00:35:41,550
later one of the center's directors and

773
00:35:48,860 --> 00:35:45,870
he was studying how to protect these

774
00:35:51,640 --> 00:35:48,870
vehicles from heat as they came back

775
00:35:55,640 --> 00:35:51,650
into the Earth's atmosphere and

776
00:35:57,830 --> 00:35:55,650
previously all the high-speed vehicles

777
00:35:59,570 --> 00:35:57,840
they were very pointy right sort of like

778
00:36:01,670 --> 00:35:59,580
the front end you know I had a sharp

779
00:36:03,950 --> 00:36:01,680
point because that was the least amount

780
00:36:06,470 --> 00:36:03,960
of drag coming back into the atmosphere

781
00:36:09,050 --> 00:36:06,480
but they got too hot and Harvey Allen

782
00:36:12,740 --> 00:36:09,060
realized that if you went with this very

783
00:36:14,810 --> 00:36:12,750
blunt shape it created a lot more drag

784
00:36:17,300 --> 00:36:14,820
and it would slow them down but it

785
00:36:19,670 --> 00:36:17,310
allowed the heat to go out and around

786
00:36:21,830 --> 00:36:19,680
and it the heat would not be transferred

787
00:36:24,530 --> 00:36:21,840
into the surface of the vehicle so

788
00:36:26,780 --> 00:36:24,540

basically that you know that the crew

789
00:36:29,240 --> 00:36:26,790
members in the vehicle would be

790
00:36:30,920 --> 00:36:29,250
protected from all that heat as as it

791
00:36:32,810 --> 00:36:30,930
came back into the atmosphere and of

792
00:36:35,120 --> 00:36:32,820
course we're doing basically the same

793
00:36:37,070 --> 00:36:35,130
the same concept today so it's really a

794
00:36:38,480 --> 00:36:37,080
lasting contribution that he made you

795
00:36:39,650 --> 00:36:38,490
can see that with all the vehicles are

796
00:36:42,140 --> 00:36:39,660
returning from the International Space

797
00:36:44,810 --> 00:36:42,150
Station you know even the Commercial

798
00:36:47,570 --> 00:36:44,820
Crew you know the the Boeing and the and

799
00:36:49,820 --> 00:36:47,580
the SpaceX capsules followed the same

800
00:36:51,350 --> 00:36:49,830
engineering achievement to shave me

801
00:36:52,580 --> 00:36:51,360
something write the design and

802
00:36:56,630 --> 00:36:52,590
engineering of something how would you

803
00:36:59,870 --> 00:36:56,640
come up with that job you had a he was

804
00:37:07,680 --> 00:36:59,880
an eccentric character and it really is

805
00:37:12,880 --> 00:37:10,540
it's an odd idea that turned out to work

806
00:37:15,940 --> 00:37:12,890
really well and that concept the blunt

807
00:37:18,760 --> 00:37:15,950
body concept was developed it's older

808
00:37:20,800 --> 00:37:18,770
than NASA itself NASA was founded in

809
00:37:23,560 --> 00:37:20,810
1958 but Allen came up with that idea

810
00:37:27,850 --> 00:37:23,570
here at Ames in the 50s when it was

811
00:37:30,280 --> 00:37:27,860
still part of the NACA so Ames before it

812
00:37:32,980 --> 00:37:30,290
was NASA Ames yeah exactly he was before

813
00:37:35,680 --> 00:37:32,990

was NASA Ames and solving a problem that

814
00:37:37,810 --> 00:37:35,690
was gonna be not you know who's gonna be

815
00:37:39,700 --> 00:37:37,820
used decades later oh yeah you know

816
00:37:41,890 --> 00:37:39,710
that's incredible - well

817
00:37:43,720 --> 00:37:41,900
forward-thinking a lot of work Leon the

818
00:37:48,060 --> 00:37:43,730
future James what do you do with that

819
00:37:50,980 --> 00:37:48,070
model what is it solid metal it is and

820
00:37:53,100 --> 00:37:50,990
you've launched them all right and one

821
00:37:56,620 --> 00:37:53,110
of the facilities that was built

822
00:37:59,140 --> 00:37:56,630
construction began in 1964 on what's

823
00:38:03,580 --> 00:37:59,150
known as the hypervelocity free flight

824
00:38:07,180 --> 00:38:03,590
facility and it formally opened in 1965

825
00:38:13,080 --> 00:38:07,190
and this model and I've got another one

826
00:38:16,390 --> 00:38:13,090
here this facility imagine a tube okay

827
00:38:19,690 --> 00:38:16,400
75 feet long three and a half feet in

828
00:38:22,660 --> 00:38:19,700
diameter and from one end you've got a

829
00:38:33,240 --> 00:38:22,670
really high speed stream of air at one

830
00:38:45,040 --> 00:38:35,650
would we do with this cannon while you

831
00:38:47,710 --> 00:38:45,050
shoot it these projectiles they're

832
00:38:52,710 --> 00:38:47,720
they're made here in Ames's machine

833
00:38:55,240 --> 00:38:52,720
shops and this is another Apollo model

834
00:38:58,030 --> 00:38:55,250
quite a bit smaller than the first one

835
00:39:03,160 --> 00:38:58,040
that we saw but actually this one it

836
00:39:06,970 --> 00:39:03,170
would be loaded into the mccannon at one

837
00:39:09,610 --> 00:39:06,980
end and launched upstream into that air

838
00:39:11,980 --> 00:39:09,620

so that it's traveling really really

839
00:39:14,200 --> 00:39:11,990
fast Wow no way through the years we

840
00:39:17,890 --> 00:39:14,210
look this event the the facility has a

841
00:39:19,310 --> 00:39:17,900
top speed for that model of about 27,000

842
00:39:23,760 --> 00:39:19,320
miles per hour

843
00:39:27,270 --> 00:39:23,770
I'm moving now yeah and it's really to

844
00:39:29,190 --> 00:39:27,280
reproduce the conditions of the capsule

845
00:39:31,950 --> 00:39:29,200
coming back into the Earth's atmosphere

846
00:39:34,110 --> 00:39:31,960
or or the atmosphere of another world

847
00:39:36,090 --> 00:39:34,120
and traveling from say a distance as the

848
00:39:37,560 --> 00:39:36,100
moon I mean this was a unique problem

849
00:39:40,830 --> 00:39:37,570
for when you're sending something really

850
00:39:41,700 --> 00:39:40,840
far away and it's coming back right

851
00:39:44,250 --> 00:39:41,710
right right

852
00:39:47,430 --> 00:39:44,260
we have an image don't we have what they

853
00:39:49,380 --> 00:39:47,440
would see here taking high-speed photos

854
00:39:52,020 --> 00:39:49,390
of that I think tell us what that's all

855
00:39:54,750 --> 00:39:52,030
about so you're looking at a an image of

856
00:39:57,390 --> 00:39:54,760
the shock wave that's coming off of that

857
00:40:00,330 --> 00:39:57,400
little tiny model as it goes down down

858
00:40:02,250 --> 00:40:00,340
the tube and in this image the the

859
00:40:05,580 --> 00:40:02,260
capsules traveling from right to left

860
00:40:08,430 --> 00:40:05,590
right so as it comes into the atmosphere

861
00:40:10,830 --> 00:40:08,440
this shock wave is created and we talked

862
00:40:12,510 --> 00:40:10,840
earlier about how this blunt shape on

863
00:40:14,610 --> 00:40:12,520

the end of the capsule protects it from

864
00:40:16,320 --> 00:40:14,620
the heat here you can see it actually is

865
00:40:18,840 --> 00:40:16,330
making this layer the shockwave is

866
00:40:22,110 --> 00:40:18,850
making a layer around the capsule that

867
00:40:24,120 --> 00:40:22,120
that's protecting it from the heat

868
00:40:26,430 --> 00:40:24,130
generated by friction as it comes into

869
00:40:29,130 --> 00:40:26,440
the atmosphere and so it's an amazing

870
00:40:31,260 --> 00:40:29,140
photo to see you can you know this is

871
00:40:33,530 --> 00:40:31,270
this was you know back in the you know

872
00:40:36,930 --> 00:40:33,540
pre digital age and so they had a

873
00:40:39,690 --> 00:40:36,940
cameras set up down the tunnel to snap

874
00:40:42,150 --> 00:40:39,700
pictures as as the thing was flying down

875
00:40:43,650 --> 00:40:42,160
it amazing that is amazing we actually

876
00:40:45,690 --> 00:40:43,660
have a comment here from quite saying

877
00:40:55,560 --> 00:40:45,700
amazing how far we have come in such a

878
00:40:58,320 --> 00:40:55,570
short amount of time yeah old Morden

879
00:41:02,010 --> 00:40:58,330
says awesome stream NASA thank you yeah

880
00:41:10,830 --> 00:41:02,020
thanks for watching I had another

881
00:41:14,160 --> 00:41:10,840
comment to share I'm over the moon so

882
00:41:16,470 --> 00:41:14,170
are we mm-hmm excellent all right James

883
00:41:19,880 --> 00:41:16,480
did you bring anything else for us yeah

884
00:41:32,029 --> 00:41:19,890
we've got another exciting artifact here

885
00:41:33,680 --> 00:41:32,039
really has it it's encased in glass

886
00:41:37,819 --> 00:41:33,690
what is that James tell us what that is

887
00:41:42,099 --> 00:41:37,829
that is a genuine moon rock Wow this one

888
00:41:45,160 --> 00:41:42,109

was rock returned by Apollo 15 and

889
00:41:50,539 --> 00:41:45,170
weighs under a pound

890
00:41:52,519 --> 00:41:50,549
0.3 pounds and it's still but I don't

891
00:41:55,819 --> 00:41:52,529
know I get shivers every time I see it

892
00:42:03,940 --> 00:41:55,829
it's it's it's so weird just to to wrap

893
00:42:08,109 --> 00:42:03,950
your mind around four billion years old

894
00:42:11,289 --> 00:42:08,119
that's kind of the age of the first life

895
00:42:14,900 --> 00:42:11,299
rolling of the ocean here on earth

896
00:42:16,370 --> 00:42:14,910
understanding yeah the the moon is this

897
00:42:18,979 --> 00:42:16,380
treasure trove of science the moon

898
00:42:22,009 --> 00:42:18,989
preserves the ancient history of the of

899
00:42:24,319 --> 00:42:22,019
the solar system and even today

900
00:42:26,329 --> 00:42:24,329
researchers applied to NASA all over the

901
00:42:29,269 --> 00:42:26,339
world to look at samples of the apollo

902
00:42:32,900 --> 00:42:29,279
moonrocks oh yeah and it still we're

903
00:42:34,910 --> 00:42:32,910
still learning new new things Wow I love

904
00:42:37,009 --> 00:42:34,920
it that in a way it kinda just looks

905
00:42:40,099 --> 00:42:37,019
like a rock because that just reminds me

906
00:42:42,109 --> 00:42:40,109
that these objects and places in space

907
00:42:45,620 --> 00:42:42,119
are part of our solar system you know

908
00:42:48,079 --> 00:42:45,630
just like earthen what I'm noticing that

909
00:42:50,150 --> 00:42:48,089
I don't know comes across on on the

910
00:42:56,089 --> 00:42:50,160
video right is it kind of Sparkle it

911
00:42:57,799 --> 00:42:56,099
does reflection and and I'm looking at

912
00:42:59,420 --> 00:42:57,809
the monitor in the studio and I'm not

913
00:43:02,029 --> 00:42:59,430

sure that that really comes across it is

914
00:43:03,559 --> 00:43:02,039
it is not just this gray lump that it

915
00:43:05,690 --> 00:43:03,569
appears like there's some really neat

916
00:43:07,370 --> 00:43:05,700
stuff going on that that just kind of

917
00:43:12,019 --> 00:43:07,380
brings it brings it well most guys it

918
00:43:15,920 --> 00:43:12,029
brings it to life but that's not at the

919
00:43:18,799 --> 00:43:15,930
time back in the 1960s we didn't know

920
00:43:21,109 --> 00:43:18,809
whether life was on other worlds and

921
00:43:22,910 --> 00:43:21,119
it's still a questioned NASA and the

922
00:43:25,460 --> 00:43:22,920
humanity is looking for are we alone

923
00:43:27,769 --> 00:43:25,470
yeah yeah and when the Apollo samples

924
00:43:31,039 --> 00:43:27,779
were returned Ames was one of two NASA

925
00:43:32,210 --> 00:43:31,049
centers that actually analyzed the

926
00:43:34,640 --> 00:43:32,220
samples in looked for

927
00:43:37,130 --> 00:43:34,650
or whether or not they actually had

928
00:43:39,849 --> 00:43:37,140
lightning for signs of life that's so

929
00:43:42,650 --> 00:43:39,859
cool and how did that how did they do it

930
00:43:47,420 --> 00:43:42,660
I think we actually has some footage of

931
00:43:50,540 --> 00:43:47,430
this we do yeah here in our guns yeah so

932
00:43:53,030 --> 00:43:50,550
from our archives here at Ames there's

933
00:43:55,670 --> 00:43:53,040
some recently rediscovered footage we're

934
00:43:56,750 --> 00:43:55,680
seeing it here now what's goin on here

935
00:43:59,990 --> 00:43:56,760
Kimberly what are we

936
00:44:01,970 --> 00:44:00,000
Oh so this is Apollo 11 soil samples

937
00:44:04,460 --> 00:44:01,980
that brought to the Ames lunar

938
00:44:06,580 --> 00:44:04,470

biological laboratory and they're being

939
00:44:09,440 --> 00:44:06,590
held in a sterile condition of these

940
00:44:11,780 --> 00:44:09,450
glove boxes in a clean room and you see

941
00:44:16,370 --> 00:44:11,790
petri dishes and what they're trying to

942
00:44:19,670 --> 00:44:16,380
do is see if life grows on the lunar

943
00:44:22,099 --> 00:44:19,680
samples and they're mimicking conditions

944
00:44:25,570 --> 00:44:22,109
for which life has been known to grow on

945
00:44:27,680 --> 00:44:25,580
earth bacteria microbes and the like and

946
00:44:33,640 --> 00:44:27,690
and looking at it through a microscope

947
00:44:35,990 --> 00:44:33,650
and you know it's it's a very dedicated

948
00:44:38,120 --> 00:44:36,000
systematic study and it laid the

949
00:44:40,130 --> 00:44:38,130
groundwork for the beginning of what we

950
00:44:43,579 --> 00:44:40,140
call astrobiology at the time was called

951
00:44:46,339 --> 00:44:43,589
exobiology the study of the search for

952
00:44:48,380 --> 00:44:46,349
life elsewhere in the universe and the

953
00:44:50,900 --> 00:44:48,390
study of the origin of life here Wow and

954
00:44:53,690 --> 00:44:50,910
the techniques here you know they learn

955
00:44:55,339 --> 00:44:53,700
that the the the lunar cycle samples did

956
00:44:56,450 --> 00:44:55,349
not have life but they didn't know at

957
00:44:59,359 --> 00:44:56,460
the time until a filming experience

958
00:45:01,099 --> 00:44:59,369
right you had to check yeah it even so

959
00:45:02,570 --> 00:45:01,109
still laying the foundation for more

960
00:45:05,300 --> 00:45:02,580
science research

961
00:45:06,950 --> 00:45:05,310
yeah the techniques that techies and

962
00:45:10,070 --> 00:45:06,960
other techniques look for amino acids

963
00:45:12,560 --> 00:45:10,080

and carbon compounds and stuff of life

964
00:45:14,510 --> 00:45:12,570
and stuff of life led to the development

965
00:45:17,750 --> 00:45:14,520
of the instruments that flew on Viking

966
00:45:21,020 --> 00:45:17,760
that went to Mars in 1976 to look for

967
00:45:23,359 --> 00:45:21,030
life on Mars and then you know several

968
00:45:25,730 --> 00:45:23,369
packages that were also exploring life

969
00:45:27,530 --> 00:45:25,740
you know on other places in our solar

970
00:45:29,990 --> 00:45:27,540
system because our knowledge of the

971
00:45:31,579 --> 00:45:30,000
solar system today is way different it's

972
00:45:34,010 --> 00:45:31,589
a much beautiful more diverse solar

973
00:45:35,480 --> 00:45:34,020
system then the scientist back in the

974
00:45:36,740 --> 00:45:35,490
60s could have ever imagined because

975
00:45:38,060 --> 00:45:36,750
we've been sending all these robotic

976
00:45:40,760 --> 00:45:38,070
explorers over the last couple of

977
00:45:42,530 --> 00:45:40,770
decades out to Pluto out through the

978
00:45:43,460 --> 00:45:42,540
giant planets the moons of the giant

979
00:45:46,609 --> 00:45:43,470
planets in

980
00:45:49,760 --> 00:45:46,619
is an amazing place to explore we're

981
00:45:52,250 --> 00:45:49,770
still looking today and we have yet to

982
00:45:54,500 --> 00:45:52,260
find you know our life on this pale blue

983
00:45:58,700 --> 00:45:54,510
dot our blue Oasis world here is still

984
00:46:04,760 --> 00:45:58,710
one of a kind yeah yeah more to come

985
00:46:06,290 --> 00:46:04,770
you know yes I have a few Moonrock

986
00:46:10,520 --> 00:46:06,300
questions maybe we could take these as

987
00:46:11,839 --> 00:46:10,530
like rapid-fire okay first of all what

988
00:46:13,400 --> 00:46:11,849

is the difference between moon rocks and

989
00:46:15,200 --> 00:46:13,410
earth rocks and to go with that our moon

990
00:46:16,640 --> 00:46:15,210
rocks more porous compared to the rocks

991
00:46:20,450 --> 00:46:16,650
on earth or are they just about the same

992
00:46:23,150 --> 00:46:20,460
how do you know it's a range so short

993
00:46:25,370 --> 00:46:23,160
answer the rocks on the moon are very

994
00:46:27,290 --> 00:46:25,380
similar to that on earth so we have

995
00:46:29,510 --> 00:46:27,300
igneous that were made in a volcano

996
00:46:31,310 --> 00:46:29,520
we have metamorphic that were made with

997
00:46:33,470 --> 00:46:31,320
high temperatures and high pressures we

998
00:46:35,240 --> 00:46:33,480
have not quite sedimentary which were

999
00:46:36,890 --> 00:46:35,250
made on the earth with wind and water on

1000
00:46:37,880 --> 00:46:36,900
the moon they're called Breck is there

1001
00:46:39,770 --> 00:46:37,890
they're shocked

1002
00:46:42,320 --> 00:46:39,780
so we've slightly different types the

1003
00:46:44,510 --> 00:46:42,330
moon on average is lighter in terms of

1004
00:46:45,950 --> 00:46:44,520
its rocks than the earth it's less dense

1005
00:46:47,450 --> 00:46:45,960
oh and this can lead to another

1006
00:46:49,460 --> 00:46:47,460
discussion of how the earth under inform

1007
00:46:50,810 --> 00:46:49,470
so they're very similar but they're

1008
00:46:52,010 --> 00:46:50,820
slightly also different but they're made

1009
00:46:56,230 --> 00:46:52,020
of the same things we're all made out of

1010
00:46:58,460 --> 00:46:56,240
Stardust essentially yeah nice perfect

1011
00:47:00,500 --> 00:46:58,470
history question for James before you

1012
00:47:03,400 --> 00:47:00,510
have to go do the original mission

1013
00:47:07,940 --> 00:47:03,410

control computers still work do you know

1014
00:47:11,210 --> 00:47:07,950
the computers themselves images of them

1015
00:47:16,400 --> 00:47:11,220
have been used to recreate the mission

1016
00:47:19,370 --> 00:47:16,410
control room in Houston and I would

1017
00:47:21,020 --> 00:47:19,380
actually have to have to check but I

1018
00:47:22,970 --> 00:47:21,030
know that the the recreation was done

1019
00:47:25,010 --> 00:47:22,980
some of the some of the material in

1020
00:47:27,109 --> 00:47:25,020
there is original and other stuff was

1021
00:47:30,950 --> 00:47:27,119
actually just sourced on eBay so the

1022
00:47:34,400 --> 00:47:30,960
coffee pots the cigarette ash trays all

1023
00:47:36,740 --> 00:47:34,410
of that stuff to really give the feel of

1024
00:47:39,829 --> 00:47:36,750
what Mission Control was like during

1025
00:47:42,290 --> 00:47:39,839
that time and the flight director Gene

1026
00:47:45,950 --> 00:47:42,300
Kranz when he went in just a few weeks

1027
00:47:47,540 --> 00:47:45,960
ago and saw this installation I think he

1028
00:47:49,520 --> 00:47:47,550
made the comment was something like he

1029
00:47:51,920 --> 00:47:49,530
could hear the voices of all the

1030
00:47:55,339 --> 00:47:51,930
controllers at their computer stations

1031
00:47:56,390 --> 00:47:55,349
at their monitors that recreation was so

1032
00:48:00,230 --> 00:47:56,400
spot-on

1033
00:48:02,770 --> 00:48:00,240
that just brought back this is a really

1034
00:48:05,000 --> 00:48:02,780
intense moment of a memory that you know

1035
00:48:06,850 --> 00:48:05,010
how could you not forget so they really

1036
00:48:11,810 --> 00:48:06,860
got it right

1037
00:48:13,390 --> 00:48:11,820
beautiful one last comment before the

1038
00:48:23,000 --> 00:48:13,400

moon rock has to go away

1039
00:48:24,890 --> 00:48:23,010
emergy a member Jim not sure sar coming

1040
00:48:27,170 --> 00:48:24,900
even though we're still have a lot you

1041
00:48:30,230 --> 00:48:27,180
still studying the there's been samples

1042
00:48:33,230 --> 00:48:30,240
that have been kept in have not been

1043
00:48:34,400 --> 00:48:33,240
touched in 47 50 years that are being

1044
00:48:36,770 --> 00:48:34,410
looked at researchers say because our

1045
00:48:39,830 --> 00:48:36,780
laboratory equipment today is much more

1046
00:48:41,030 --> 00:48:39,840
sophisticated in advance so I'm thanking

1047
00:48:43,190 --> 00:48:41,040
the scientists of the previous

1048
00:48:46,070 --> 00:48:43,200
generation who left this gift to us

1049
00:48:48,400 --> 00:48:46,080
today so that we can continue our search

1050
00:48:50,450 --> 00:48:48,410
of knowledge and when we get even

1051
00:48:52,400 --> 00:48:50,460
different moon rocks from different

1052
00:48:53,990 --> 00:48:52,410
places of the Moon yes we will be able

1053
00:48:55,160 --> 00:48:54,000
to answer some pretty tough questions

1054
00:48:56,990 --> 00:48:55,170
that we haven't been able to answer the

1055
00:48:58,430 --> 00:48:57,000
moon rocks gave us a huge leap in

1056
00:48:58,730 --> 00:48:58,440
understanding and we're still being

1057
00:49:00,590 --> 00:48:58,740
studied

1058
00:49:02,390 --> 00:49:00,600
that's awesome amazing time capsule or

1059
00:49:03,860 --> 00:49:02,400
time capsule yeah there are teams of

1060
00:49:05,600 --> 00:49:03,870
ames that are gonna study those samples

1061
00:49:07,730 --> 00:49:05,610
so we'll be able to provide an update

1062
00:49:11,210 --> 00:49:07,740
yes sometime in the future

1063
00:49:16,640 --> 00:49:11,220

sometimes yeah well thank you James for

1064
00:49:21,380 --> 00:49:16,650
joining with the history we'll see you

1065
00:49:23,030 --> 00:49:21,390
another time and you all don't forget to

1066
00:49:25,010 --> 00:49:23,040
join us and celebrating the 50th

1067
00:49:28,160 --> 00:49:25,020
anniversary of the Apollo 11 moon

1068
00:49:30,620 --> 00:49:28,170
landing and hear about our future plans

1069
00:49:33,400 --> 00:49:30,630
to go forward to the moon and on to Mars

1070
00:49:36,950 --> 00:49:33,410
by tuning in into a special two-hour

1071
00:49:40,250 --> 00:49:36,960
live NASA television broadcast tomorrow

1072
00:49:42,760 --> 00:49:40,260
at 10 a.m. Pacific time learn more about

1073
00:49:47,240 --> 00:49:42,770
the show and how to watch by going to

1074
00:49:48,680 --> 00:49:47,250
WWN assay gov fort slash apollo 40th and

1075
00:50:00,060 --> 00:49:48,690
don't forget to click on event

1076
00:50:07,690 --> 00:50:04,000
back please oh yeah let's talk about our

1077
00:50:13,330 --> 00:50:07,700
next giant leap Artemis

1078
00:50:15,100 --> 00:50:13,340
yes Artemis so what what is Artemis well

1079
00:50:18,730 --> 00:50:15,110
why do we call it morph Artemis the art

1080
00:50:20,320 --> 00:50:18,740
of Artemis was Apollo's twin sister yeah

1081
00:50:23,950 --> 00:50:20,330
right so if you know your Greek

1082
00:50:27,100 --> 00:50:23,960
mythology mythology it's Diana

1083
00:50:32,380 --> 00:50:27,110
but it's great maja kimberley with the

1084
00:50:35,490 --> 00:50:32,390
fun facts a very evocative I mean she's

1085
00:50:38,530 --> 00:50:35,500
the goddess of the moon I mean it's very

1086
00:50:40,450 --> 00:50:38,540
appropriate and and also with the

1087
00:50:43,030 --> 00:50:40,460
Artemis charge we're going to place the

1088
00:50:45,700 --> 00:50:43,040

first woman on the moon yes so with the

1089
00:50:48,870 --> 00:50:45,710
next crew to go to the moon yes and an

1090
00:50:54,990 --> 00:50:48,880
amazing leap for womankind yeah

1091
00:51:01,090 --> 00:50:57,970
women out there students young girls who

1092
00:51:01,540 --> 00:51:01,100
are like watch out moon yeah coming for

1093
00:51:03,070 --> 00:51:01,550
you

1094
00:51:05,230 --> 00:51:03,080
and since we're having our Artemis is a

1095
00:51:07,270 --> 00:51:05,240
sustainable inner exploration program

1096
00:51:09,130 --> 00:51:07,280
it's just different than Apollo Apollo

1097
00:51:13,030 --> 00:51:09,140
was like a road trip I mean it did no

1098
00:51:15,130 --> 00:51:13,040
amazing things and it was a huge

1099
00:51:17,470 --> 00:51:15,140
engineering challenge it just to even

1100
00:51:19,720 --> 00:51:17,480
conceive going from suborbital flight to

1101
00:51:21,580 --> 00:51:19,730
going to the moon and back in less than

1102
00:51:23,710 --> 00:51:21,590
10 years and to build that whole

1103
00:51:25,930 --> 00:51:23,720
infrastructure with a very elegant but

1104
00:51:28,630 --> 00:51:25,940
complicated and logistical solution was

1105
00:51:30,820 --> 00:51:28,640
immense immune Artemis is different

1106
00:51:33,070 --> 00:51:30,830
we're doing not doing it alone it's no

1107
00:51:35,590 --> 00:51:33,080
longer the realm of governments and

1108
00:51:37,180 --> 00:51:35,600
superpowers it's a different era yeah we

1109
00:51:41,170 --> 00:51:37,190
have commercial and international

1110
00:51:43,120 --> 00:51:41,180
partners sustainable presence and you

1111
00:51:45,940 --> 00:51:43,130
know in the pursuit of knowledge and the

1112
00:51:49,060 --> 00:51:45,950
pursuit of innovation with opportunities

1113
00:51:51,160 --> 00:51:49,070

for economic and you know more spin-offs

1114
00:51:52,750 --> 00:51:51,170
you know the Pala programming of us a

1115
00:51:54,790 --> 00:51:52,760
lot of spin-offs what we call things

1116
00:51:56,320 --> 00:51:54,800
that we use today as a result of the

1117
00:51:58,210 --> 00:51:56,330
research the research and the

1118
00:52:00,310 --> 00:51:58,220
engineering technology development that

1119
00:52:02,800 --> 00:52:00,320
that is not just to go right the

1120
00:52:05,110 --> 00:52:02,810
objective of Apollo was to go to the

1121
00:52:07,000 --> 00:52:05,120
moon and safely return right but that

1122
00:52:09,280 --> 00:52:07,010
was that was the objective right with

1123
00:52:11,550 --> 00:52:09,290
Artemis it's to have a longer-term

1124
00:52:13,860 --> 00:52:11,560
sustained presence

1125
00:52:16,710 --> 00:52:13,870
and of course it's the path to Mars

1126
00:52:18,600 --> 00:52:16,720
which is the next giant leap so that

1127
00:52:20,730 --> 00:52:18,610
it's fun as Kimberly said it's

1128
00:52:23,400 --> 00:52:20,740
fundamentally a different approach to

1129
00:52:26,040 --> 00:52:23,410
then Apollo wise you know okay it's the

1130
00:52:28,350 --> 00:52:26,050
same basic destination but we're not

1131
00:52:31,020 --> 00:52:28,360
going to land directly on the moon we're

1132
00:52:32,610 --> 00:52:31,030
going to the Gateway first that will be

1133
00:52:34,860 --> 00:52:32,620
orbiting an orbiting space station

1134
00:52:37,620 --> 00:52:34,870
around the moon and then going down to

1135
00:52:40,710 --> 00:52:37,630
the surface from Gateway we're going to

1136
00:52:43,200 --> 00:52:40,720
the South Pole which is a very different

1137
00:52:45,630 --> 00:52:43,210
place in many respects more challenging

1138
00:52:48,030 --> 00:52:45,640

than where Apollo was landing

1139
00:52:50,420 --> 00:52:48,040
so there's many fascinating different

1140
00:52:53,670 --> 00:52:50,430
things that are going into Artemis that

1141
00:52:55,500 --> 00:52:53,680
were really never something that was

1142
00:52:58,290 --> 00:52:55,510
even approachable back in the Apollo era

1143
00:53:00,450 --> 00:52:58,300
yes it's a big big stretch from where we

1144
00:53:02,220 --> 00:53:00,460
were at with Apollo and of course we

1145
00:53:05,190 --> 00:53:02,230
have this longer objective than of

1146
00:53:08,000 --> 00:53:05,200
taking what we learned from the Moon

1147
00:53:12,240 --> 00:53:08,010
portion and taking that with us to Mars

1148
00:53:13,950 --> 00:53:12,250
nice summary there are a bunch of

1149
00:53:15,930 --> 00:53:13,960
questions that we'll get to about the

1150
00:53:19,140 --> 00:53:15,940
goals and what's different oven I think

1151
00:53:22,230 --> 00:53:19,150
you just gave a great overview of course

1152
00:53:25,200 --> 00:53:22,240
a huge part and really kind of the first

1153
00:53:27,060 --> 00:53:25,210
and biggest step for Artemis right is

1154
00:53:29,190 --> 00:53:27,070
how do how do you launch how do you get

1155
00:53:30,930 --> 00:53:29,200
there yeah we're talking about carrying

1156
00:53:33,930 --> 00:53:30,940
a lot of material we talked earlier

1157
00:53:36,810 --> 00:53:33,940
about the Saturn 5 yes well the big

1158
00:53:40,560 --> 00:53:36,820
rocket for Artemis is the Space Launch

1159
00:53:43,220 --> 00:53:40,570
System SLS and SLS is if you thought

1160
00:53:45,690 --> 00:53:43,230
Saturn 5 was impressive SLS is even more

1161
00:53:52,560 --> 00:53:45,700
impressive you can see some video of it

1162
00:53:54,000 --> 00:53:52,570
here the rockets and the the engines

1163
00:53:56,970 --> 00:53:54,010

already being under a lot of tests right

1164
00:53:58,800 --> 00:53:56,980
now right and a lot of this is materials

1165
00:54:01,350 --> 00:53:58,810
that we learned from doing the Space

1166
00:54:04,080 --> 00:54:01,360
Shuttle missions so it's a little bit

1167
00:54:06,750 --> 00:54:04,090
shorter than the Saturn 5 its 322 feet

1168
00:54:10,130 --> 00:54:06,760
tall stature and v was 363 feet so it's

1169
00:54:12,660 --> 00:54:10,140
before t1 feet shorter but it's that's

1170
00:54:15,000 --> 00:54:12,670
also a lot bigger than the Space Shuttle

1171
00:54:17,520 --> 00:54:15,010
which is one we're used to flying right

1172
00:54:20,340 --> 00:54:17,530
this shuttle was huge and it's only 184

1173
00:54:22,470 --> 00:54:20,350
feet tall so this is as we said earlier

1174
00:54:24,810 --> 00:54:22,480
Saturn 5 is taller than the Statue of

1175
00:54:29,250 --> 00:54:24,820
Liberty and right so is that's a lot

1176
00:54:30,750 --> 00:54:29,260
that's it's almost when we have it

1177
00:54:32,730 --> 00:54:30,760
flying it's going to be the biggest

1178
00:54:34,770 --> 00:54:32,740
rocket ever built Wow

1179
00:54:36,840 --> 00:54:34,780
so this capability even take payloads to

1180
00:54:39,240 --> 00:54:36,850
Saturn and Jupiter I mean this is a very

1181
00:54:41,340 --> 00:54:39,250
capable machine we talked about our rush

1182
00:54:44,100 --> 00:54:41,350
how much thrust at how much payload the

1183
00:54:46,350 --> 00:54:44,110
Saturn 5 had and SLS is over a million

1184
00:54:50,160 --> 00:54:46,360
pounds of thrust more powerful oh wow

1185
00:54:53,460 --> 00:54:50,170
right so the SLS can deliver more cargo

1186
00:54:55,890 --> 00:54:53,470
to the moon than the shuttle could take

1187
00:54:59,310 --> 00:54:55,900
to low Earth orbit Wow Wow this is just

1188
00:55:01,470 --> 00:54:59,320

an enormous capability and is Kimberly

1189
00:55:04,320 --> 00:55:01,480
no do it take take this lots of other

1190
00:55:06,180 --> 00:55:04,330
destinations in the future this is a

1191
00:55:08,910 --> 00:55:06,190
huge capability it's a unique capability

1192
00:55:11,040 --> 00:55:08,920
it's not something you need to put

1193
00:55:13,560 --> 00:55:11,050
satellites into orbit for example it's

1194
00:55:17,160 --> 00:55:13,570
that's really for this unique very

1195
00:55:19,110 --> 00:55:17,170
unique mission awesome very cool yeah we

1196
00:55:21,090 --> 00:55:19,120
have a comment here from King to throne

1197
00:55:23,370 --> 00:55:21,100
when they're astronauts on the moon I

1198
00:55:24,780 --> 00:55:23,380
will stand and wave at the moon at the

1199
00:55:29,790 --> 00:55:24,790
full moon I hope they wave back

1200
00:55:31,260 --> 00:55:29,800
I'm sure they'll be waving back Artemus

1201
00:55:32,610 --> 00:55:31,270
if I get my wish I want to land

1202
00:55:35,100 --> 00:55:32,620
astronauts on the far side of the moon

1203
00:55:37,140 --> 00:55:35,110
because we haven't been there yet in

1204
00:55:38,910 --> 00:55:37,150
fact Apollo only may have only gone to

1205
00:55:41,150 --> 00:55:38,920
about 4% of the surface of the Moon

1206
00:55:46,380 --> 00:55:41,160
there's a lot of terrace right Luna

1207
00:55:48,210 --> 00:55:46,390
incognita Latin unknown territories on

1208
00:55:50,930 --> 00:55:48,220
the moon that we have seen we also have

1209
00:55:53,820 --> 00:55:50,940
not yet been to the South Pole right

1210
00:55:56,160 --> 00:55:53,830
destination Decimus and to remind

1211
00:55:59,880 --> 00:55:56,170
everyone what exactly we're counting

1212
00:56:01,560 --> 00:55:59,890
down up here this is the time until 2024

1213
00:56:04,020 --> 00:56:01,570

when the Artemis mission will land

1214
00:56:07,830 --> 00:56:04,030
people on at the South Pole of the moon

1215
00:56:09,810 --> 00:56:07,840
right there is a question someone was

1216
00:56:11,580 --> 00:56:09,820
asking what's special about the Lunar

1217
00:56:14,490 --> 00:56:11,590
South Pole could you tell us quickly

1218
00:56:17,150 --> 00:56:14,500
what we might oh yeah just in the last

1219
00:56:19,440 --> 00:56:17,160
10 years our understanding of the moon

1220
00:56:20,730 --> 00:56:19,450
flip it set itself on the head and we

1221
00:56:22,800 --> 00:56:20,740
learned that there's water on the moon

1222
00:56:23,850 --> 00:56:22,810
I mean of the Apollo generation we

1223
00:56:25,830 --> 00:56:23,860
thought the moon was bone-dry

1224
00:56:27,000 --> 00:56:25,840
turns out there is actually water moon

1225
00:56:29,400 --> 00:56:27,010
it's actually all over the moon has

1226
00:56:31,770 --> 00:56:29,410
different sources but the poles seem to

1227
00:56:33,120 --> 00:56:31,780
have large quantities of water now we

1228
00:56:35,370 --> 00:56:33,130
should we should know this is not liquid

1229
00:56:42,720 --> 00:56:35,380
water

1230
00:56:45,480 --> 00:56:42,730
and so it's scientifically interesting

1231
00:56:47,309 --> 00:56:45,490
because I shouldn't have been there and

1232
00:56:49,890 --> 00:56:47,319
why is it there we'd like to know why

1233
00:56:52,499 --> 00:56:49,900
it's there and and trigger it is but as

1234
00:56:54,960 --> 00:56:52,509
from a human exploration its water is

1235
00:56:59,549 --> 00:56:54,970
h2o can be used for hydrogen and oxygen

1236
00:57:02,609 --> 00:56:59,559
for fuel oxygen to breathe so the pole

1237
00:57:04,499 --> 00:57:02,619
going to the poles is a step in a human

1238
00:57:06,779 --> 00:57:04,509

exploration using resources off the land

1239
00:57:09,509 --> 00:57:06,789
and the same techniques we'd use to

1240
00:57:10,980 --> 00:57:09,519
harvest the moon water similar to what

1241
00:57:12,779 --> 00:57:10,990
we do in Mars because we know Mars has

1242
00:57:15,420 --> 00:57:12,789
subsurface frozen water as well

1243
00:57:17,190 --> 00:57:15,430
okay so training ground that's the big

1244
00:57:19,910 --> 00:57:17,200
reason that's a big reason to go to the

1245
00:57:24,210 --> 00:57:19,920
South Pole South Pole is hard because

1246
00:57:26,480 --> 00:57:24,220
you know it's it's in a lot more shadow

1247
00:57:29,519 --> 00:57:26,490
right the sunlight is a much lower angle

1248
00:57:30,779 --> 00:57:29,529
so you have to really think about how

1249
00:57:32,579 --> 00:57:30,789
you build your mission much more

1250
00:57:35,309 --> 00:57:32,589
carefully how do you generate

1251
00:57:38,069 --> 00:57:35,319
electricity how do you stay warm there's

1252
00:57:39,930 --> 00:57:38,079
a whole new set of challenges that were

1253
00:57:49,650 --> 00:57:39,940
we really didn't have to worry too much

1254
00:57:51,930 --> 00:57:49,660
about in the Apollo mission yes and the

1255
00:57:54,089 --> 00:57:51,940
Artemis program will have humans on the

1256
00:57:55,710 --> 00:57:54,099
moon for weeks at a time initially and

1257
00:57:57,420 --> 00:57:55,720
company two months at a time

1258
00:58:00,089 --> 00:57:57,430
I mean it's also different than Apollo

1259
00:58:02,039 --> 00:58:00,099
Apollo is you know Apollo 11 was two and

1260
00:58:03,749 --> 00:58:02,049
a half hours on the surface 21 hours

1261
00:58:06,059 --> 00:58:03,759
just there on the surface 22 and a half

1262
00:58:08,339 --> 00:58:06,069
hours walking around we most went up to

1263
00:58:10,859 --> 00:58:08,349

three days on the surface so this is a

1264
00:58:12,660 --> 00:58:10,869
very different approach to being

1265
00:58:14,069 --> 00:58:12,670
offworld for long periods of time and

1266
00:58:16,710 --> 00:58:14,079
how you do that from an engineering

1267
00:58:19,880 --> 00:58:16,720
solution your power your fuel your water

1268
00:58:24,180 --> 00:58:19,890
your air your energy that temperature

1269
00:58:25,710 --> 00:58:24,190
extremes you'll experience they all can

1270
00:58:27,029 --> 00:58:25,720
be overcome and they gonna be and the

1271
00:58:29,190 --> 00:58:27,039
solutions are gonna be amazing

1272
00:58:31,470 --> 00:58:29,200
yes you answered a question from pi day

1273
00:58:32,940 --> 00:58:31,480
what are some new difficulties with

1274
00:58:33,630 --> 00:58:32,950
Artemis that were not present during the

1275
00:58:36,630 --> 00:58:33,640
Apollo missions

1276
00:58:38,279 --> 00:58:36,640
yeah well duration that's maybe one of

1277
00:58:41,160 --> 00:58:38,289
the biggest ones is we are sending

1278
00:58:44,819 --> 00:58:41,170
humans out there for much longer periods

1279
00:58:47,760 --> 00:58:44,829
of time and they're beyond the the

1280
00:58:50,040 --> 00:58:47,770
shielding from radiation that's afforded

1281
00:58:51,690 --> 00:58:50,050
Earth's magnetosphere so when astronauts

1282
00:58:53,940 --> 00:58:51,700
are on the International Space Station

1283
00:58:57,540 --> 00:58:53,950
for long periods of time right up to a

1284
00:58:59,700 --> 00:58:57,550
year as the record that that's a

1285
00:59:02,220 --> 00:58:59,710
challenging environment but it doesn't

1286
00:59:05,070 --> 00:59:02,230
have the same degree of exposure to

1287
00:59:08,610 --> 00:59:05,080
radiation that going out away from Earth

1288
00:59:10,910 --> 00:59:08,620

has and so that's I don't know so NASA's

1289
00:59:12,930 --> 00:59:10,920
gonna need a lot of doctors and

1290
00:59:15,030 --> 00:59:12,940
biologists and people who study human

1291
00:59:17,600 --> 00:59:15,040
physiology to work on mitigation and

1292
00:59:21,170 --> 00:59:17,610
also to help with how humans the fragile

1293
00:59:23,760 --> 00:59:21,180
aslong durations based or you know

1294
00:59:29,190 --> 00:59:23,770
exploration how the volumen body behaves

1295
00:59:32,820 --> 00:59:29,200
and reacts and recovers yeah it's gonna

1296
00:59:36,090 --> 00:59:32,830
happen at Mars too yeah this question

1297
00:59:37,470 --> 00:59:36,100
from Sleepy underscore Gary some of your

1298
00:59:40,380 --> 00:59:37,480
answers already answered his question

1299
00:59:42,030 --> 00:59:40,390
what are the main scientific goals of

1300
00:59:43,560 --> 00:59:42,040
the Artemis moon mission and answering

1301
00:59:45,900 --> 00:59:43,570
those questions are scientific in kind

1302
00:59:47,810 --> 00:59:45,910
of Awesome or things that we want to you

1303
00:59:50,490 --> 00:59:47,820
know find out right those are our goals

1304
00:59:52,290 --> 00:59:50,500
yeah scientifically I mean some of the

1305
00:59:54,480 --> 00:59:52,300
biggest unanswered questions even after

1306
00:59:57,900 --> 00:59:54,490
processing the wonderful lunar samples

1307
00:59:59,460 --> 00:59:57,910
from Apollo we still don't really know

1308
01:00:00,780 --> 00:59:59,470
what happened during the early phases of

1309
01:00:03,020 --> 01:00:00,790
the early times of our solar system

1310
01:00:05,820 --> 01:00:03,030
here's the rock samples that we have

1311
01:00:07,050 --> 01:00:05,830
might have have a bias in it they might

1312
01:00:09,060 --> 01:00:07,060
not have been sampling some of the

1313
01:00:11,700 --> 01:00:09,070

oldest places on the moon so looking for

1314
01:00:13,680 --> 01:00:11,710
older rocks how the moon's interior

1315
01:00:15,300 --> 01:00:13,690
looks like we would like to have samples

1316
01:00:17,940 --> 01:00:15,310
of the moon from the mantle something

1317
01:00:19,350 --> 01:00:17,950
below the crust oh yeah that that will

1318
01:00:20,280 --> 01:00:19,360
take service but going to different

1319
01:00:22,350 --> 01:00:20,290
parts of the moon where we can actually

1320
01:00:24,300 --> 01:00:22,360
get to the mantle and press we can

1321
01:00:29,310 --> 01:00:24,310
understand how that moon formed and how

1322
01:00:30,270 --> 01:00:29,320
it cooled and the mode also potentially

1323
01:00:32,430 --> 01:00:30,280
could tell us what happened with our

1324
01:00:34,110 --> 01:00:32,440
early Sun we're interested in how the

1325
01:00:35,600 --> 01:00:34,120
Sun behaved during the earlier solar

1326
01:00:37,830 --> 01:00:35,610
system and this can help us understand

1327
01:00:39,540 --> 01:00:37,840
extrasolar planet systems where we're

1328
01:00:42,060 --> 01:00:39,550
looking at planets around other stars

1329
01:00:44,280 --> 01:00:42,070
today you know more planets and stars

1330
01:00:46,020 --> 01:00:44,290
out there so our view of the universe is

1331
01:00:49,830 --> 01:00:46,030
changing we have our solar system in our

1332
01:00:51,240 --> 01:00:49,840
backyard here the moon has has the

1333
01:00:54,390 --> 01:00:51,250
answers to some of these questions

1334
01:00:56,400 --> 01:00:54,400
awesome there's also the basic science

1335
01:00:59,310 --> 01:00:56,410
around you know human physiology right

1336
01:01:00,770 --> 01:00:59,320
which as we said you know how does the

1337
01:01:02,600 --> 01:01:00,780
human body respond radiate

1338
01:01:05,210 --> 01:01:02,610

an exposure to you know long-term

1339
01:01:07,910 --> 01:01:05,220
deprivation of gravity all these things

1340
01:01:09,890 --> 01:01:07,920
I know those are really basic questions

1341
01:01:11,690 --> 01:01:09,900
that are they're important for our

1342
01:01:14,120 --> 01:01:11,700
eventual journey to Mars but they're

1343
01:01:16,750 --> 01:01:14,130
also you know the the just the basic

1344
01:01:19,460 --> 01:01:16,760
knowledge that's often really helpful in

1345
01:01:22,970 --> 01:01:19,470
unexpected ways for improving life on

1346
01:01:24,320 --> 01:01:22,980
Earth and as a astrophysicist I would be

1347
01:01:25,730 --> 01:01:24,330
amiss if I didn't say I mean it would

1348
01:01:28,070 --> 01:01:25,740
love to put a telescope on the far side

1349
01:01:29,510 --> 01:01:28,080
of the Moon and open up a different

1350
01:01:31,460 --> 01:01:29,520
range of the electromagnetic spectrum

1351
01:01:34,100 --> 01:01:31,470
that we have not explored before because

1352
01:01:36,080 --> 01:01:34,110
it shields from the radio emissions from

1353
01:01:37,430 --> 01:01:36,090
the earth so it becomes a new window

1354
01:01:39,530 --> 01:01:37,440
into the universe just right in our

1355
01:01:41,180 --> 01:01:39,540
backyard because the far side is is

1356
01:01:45,560 --> 01:01:41,190
facing away from us I know what could

1357
01:01:52,730 --> 01:01:45,570
make it really big maybe you'll get your

1358
01:01:54,980 --> 01:01:52,740
telescope speaking of human bodies what

1359
01:01:58,700 --> 01:01:54,990
kind of spacesuits should be used big

1360
01:02:00,710 --> 01:01:58,710
and bulky but safe or a small tight but

1361
01:02:03,320 --> 01:02:00,720
flexible because have been some really

1362
01:02:06,110 --> 01:02:03,330
exciting work done exactly in this area

1363
01:02:07,940 --> 01:02:06,120

and there's a number of different

1364
01:02:10,160 --> 01:02:07,950
designs that are still being considered

1365
01:02:11,870 --> 01:02:10,170
but they kind of hit both ends of that

1366
01:02:14,540 --> 01:02:11,880
spectrum right so some of them look like

1367
01:02:16,100 --> 01:02:14,550
a more traditional a little bulkier suit

1368
01:02:19,130 --> 01:02:16,110
because it offers a lot of protection

1369
01:02:20,960 --> 01:02:19,140
from the environment some of them are a

1370
01:02:22,670 --> 01:02:20,970
little more streamlined and sleeker

1371
01:02:25,160 --> 01:02:22,680
because they're just easier to walk

1372
01:02:27,680 --> 01:02:25,170
around in and do things and get stuff

1373
01:02:30,590 --> 01:02:27,690
done and they just just don't weigh as

1374
01:02:32,810 --> 01:02:30,600
much but I think the jury's still out as

1375
01:02:35,720 --> 01:02:32,820
to which is the preferred one right now

1376
01:02:37,310 --> 01:02:35,730
there it's an area of ongoing research

1377
01:02:39,170 --> 01:02:37,320
and development yeah there's a cool idea

1378
01:02:40,700 --> 01:02:39,180
of a particular design of one of the

1379
01:02:42,080 --> 01:02:40,710
Landers on the moon to deal with the

1380
01:02:43,790 --> 01:02:42,090
lunar dust which is a kind of a

1381
01:02:45,560 --> 01:02:43,800
hazardous glass like because there's no

1382
01:02:47,930 --> 01:02:45,570
wind or water on the moon flowing water

1383
01:02:49,580 --> 01:02:47,940
to just smooth it out and one of them

1384
01:02:51,500 --> 01:02:49,590
has you sort of layer in your your

1385
01:02:54,140 --> 01:02:51,510
spacesuit and you go in and leave your

1386
01:02:56,540 --> 01:02:54,150
face spacesuit on the outside you know

1387
01:02:58,190 --> 01:02:56,550
you kind of cloak or something and then

1388
01:03:00,200 --> 01:02:58,200

yeah therefore the dust doesn't get into

1389
01:03:04,760 --> 01:03:00,210
your habit it never comes in oh yeah I

1390
01:03:08,300 --> 01:03:04,770
like that idea back in the spacesuit the

1391
01:03:10,310 --> 01:03:08,310
docs - yeah that's a your suit always

1392
01:03:12,160 --> 01:03:10,320
stays on the outside where all its all

1393
01:03:14,440 --> 01:03:12,170
the dirt all the contaminants

1394
01:03:16,150 --> 01:03:14,450
out there so there's and there's a lot

1395
01:03:17,470 --> 01:03:16,160
of work ahead I mean you're gonna when

1396
01:03:19,150 --> 01:03:17,480
you're on the surface doing things

1397
01:03:20,530 --> 01:03:19,160
you're gonna learn oh like like the

1398
01:03:22,090 --> 01:03:20,540
Apollo astronauts learned they're gonna

1399
01:03:24,820 --> 01:03:22,100
skip and hop to get maneuvering with

1400
01:03:26,290 --> 01:03:24,830
that bulky things the Artemis astronauts

1401
01:03:28,150 --> 01:03:26,300
are gonna find new things with their

1402
01:03:30,070 --> 01:03:28,160
spacesuits and what things to change I

1403
01:03:32,670 --> 01:03:30,080
can't drill as much I can't climb I

1404
01:03:36,130 --> 01:03:32,680
can't you know rappel down the crater in

1405
01:03:37,060 --> 01:03:36,140
yeah easiest way as I'd like you know so

1406
01:03:38,980 --> 01:03:37,070
there's there's gonna be a lot of

1407
01:03:40,750 --> 01:03:38,990
different suit designs for the

1408
01:03:41,320 --> 01:03:40,760
applications it needs and so we need

1409
01:03:47,530 --> 01:03:41,330
those

1410
01:03:52,540 --> 01:03:47,540
yeah always learning we're learning

1411
01:03:56,920 --> 01:03:52,550
we're learning to have a question in

1412
01:03:59,530 --> 01:03:56,930
mind they think I do well we have one

1413
01:04:04,030 --> 01:03:59,540

here for Chad it's and it's about the

1414
01:04:05,530 --> 01:04:04,040
SLS why why are we designing a new

1415
01:04:07,090 --> 01:04:05,540
system to get to the moon and not just

1416
01:04:08,860 --> 01:04:07,100
use the same Apollo equipment that be

1417
01:04:10,510 --> 01:04:08,870
used last time yet well it's a good

1418
01:04:12,600 --> 01:04:10,520
question maybe you want to tell

1419
01:04:15,340 --> 01:04:12,610
everybody the what the full system

1420
01:04:17,860 --> 01:04:15,350
consists of we talked about SLS mm-hmm

1421
01:04:19,750 --> 01:04:17,870
well I think that's the main one we're

1422
01:04:21,940 --> 01:04:19,760
talking about but there's also you know

1423
01:04:23,740 --> 01:04:21,950
the equivalent to all the Apollo

1424
01:04:25,360 --> 01:04:23,750
vehicles that Kimberly was showing with

1425
01:04:26,920 --> 01:04:25,370
the little props right there's a there's

1426
01:04:29,380 --> 01:04:26,930
a command module which now is the Orion

1427
01:04:30,640 --> 01:04:29,390
there's equivalent to the service module

1428
01:04:33,310 --> 01:04:30,650
which actually the Europeans are

1429
01:04:37,180 --> 01:04:33,320
providing there's a you know lunar

1430
01:04:39,160 --> 01:04:37,190
vehicle that will be you know putting

1431
01:04:41,380 --> 01:04:39,170
the humans down on the moon what's

1432
01:04:43,720 --> 01:04:41,390
different this time from Apollo is we

1433
01:04:46,210 --> 01:04:43,730
also have the Gateway which is an

1434
01:04:48,790 --> 01:04:46,220
orbiting space station around the moon

1435
01:04:50,650 --> 01:04:48,800
and of course the big rocket so the

1436
01:04:52,840 --> 01:04:50,660
question is why don't we just use what

1437
01:04:54,700 --> 01:04:52,850
we had in the Apollo era well in

1438
01:04:58,210 --> 01:04:54,710

principle you you could use those

1439
01:05:01,390 --> 01:04:58,220
designs right but for one thing we'd

1440
01:05:03,160 --> 01:05:01,400
like to carry additional people and the

1441
01:05:04,660 --> 01:05:03,170
Apollo capsule is only big enough to

1442
01:05:08,380 --> 01:05:04,670
carry three we'd really like to carry

1443
01:05:12,040 --> 01:05:08,390
four we have some video footage of the

1444
01:05:13,570 --> 01:05:12,050
Orion they can run that maybe I'll talk

1445
01:05:15,340 --> 01:05:13,580
while we go right and you could you can

1446
01:05:18,190 --> 01:05:15,350
see it's pretty good size one of the

1447
01:05:20,560 --> 01:05:18,200
other reasons is that all those designs

1448
01:05:23,050 --> 01:05:20,570
haven't been produced for 50 years and

1449
01:05:24,859 --> 01:05:23,060
so to go back and recover the design

1450
01:05:28,279 --> 01:05:24,869
recover the tooling

1451
01:05:31,729 --> 01:05:28,289
it's basically as big a job as making a

1452
01:05:34,969 --> 01:05:31,739
new one there's a story about how Eames

1453
01:05:39,079 --> 01:05:34,979
participated in a 21st century detective

1454
01:05:41,150 --> 01:05:39,089
story on the re-entry the thermal the

1455
01:05:42,799 --> 01:05:41,160
tiles on the bottom of the production

1456
01:05:45,170 --> 01:05:42,809
thermal protection system of the Apollo

1457
01:05:46,190 --> 01:05:45,180
capsules they were made of a chemical

1458
01:05:48,469 --> 01:05:46,200
thing called avcoat

1459
01:05:52,039 --> 01:05:48,479
and I had a re-engineered the chemical

1460
01:05:55,430 --> 01:05:52,049
formula and a 21st century version of

1461
01:05:59,209 --> 01:05:55,440
that is on the Orion capsule so we we

1462
01:06:02,599 --> 01:05:59,219
think we thank the Apollo engineers were

1463
01:06:05,120 --> 01:06:02,609

providing that groundwork and we're

1464
01:06:08,059 --> 01:06:05,130
using that research using the learning

1465
01:06:10,219 --> 01:06:08,069
the ideas if not the actual specific

1466
01:06:12,529 --> 01:06:10,229
designs are carried along in the new

1467
01:06:14,329 --> 01:06:12,539
program and I'll you know a lot of the

1468
01:06:16,430 --> 01:06:14,339
elements of this program have actually

1469
01:06:18,589 --> 01:06:16,440
been in development now for more than

1470
01:06:21,499 --> 01:06:18,599
ten years so we're not starting from

1471
01:06:23,930 --> 01:06:21,509
scratch today this has been in

1472
01:06:26,059 --> 01:06:23,940
development for some time but a lot of

1473
01:06:28,940 --> 01:06:26,069
the times if you want to take literally

1474
01:06:31,759 --> 01:06:28,950
the old design and reuse it it can be

1475
01:06:33,890 --> 01:06:31,769
just as much work as doing a clean sheet

1476
01:06:36,049 --> 01:06:33,900
of paper and doing the new design also

1477
01:06:38,559 --> 01:06:36,059
allows you to bring you know all our

1478
01:06:42,739 --> 01:06:38,569
latest and greatest technology and ideas

1479
01:06:44,749 --> 01:06:42,749
which can make things lighter more

1480
01:06:47,749 --> 01:06:44,759
cost-effective and in many cases a lot

1481
01:06:49,999 --> 01:06:47,759
safer so we're always looking at those

1482
01:06:52,940 --> 01:06:50,009
things as we come up with new new pieces

1483
01:06:54,799 --> 01:06:52,950
I mean even the Orion capsule that we

1484
01:06:56,630 --> 01:06:54,809
were just looking at it's essentially

1485
01:06:58,160 --> 01:06:56,640
Apollo on steroids because it has an

1486
01:07:01,009 --> 01:06:58,170
incredible amount of computing power

1487
01:07:02,779 --> 01:07:01,019
then the Apollo capsule did not have

1488
01:07:05,660 --> 01:07:02,789

that makes it can carry a lot more

1489
01:07:07,640 --> 01:07:05,670
payload and it is supports more

1490
01:07:10,999 --> 01:07:07,650
astronauts for very long durations in

1491
01:07:12,979 --> 01:07:11,009
space it's a very different design as

1492
01:07:15,709 --> 01:07:12,989
similar as similar as the Artemis

1493
01:07:16,370 --> 01:07:15,719
program is to Apollo in that we're going

1494
01:07:18,979 --> 01:07:16,380
to the moon

1495
01:07:21,140 --> 01:07:18,989
a lot of it ends right there because the

1496
01:07:23,479 --> 01:07:21,150
the basic requirements for what it has

1497
01:07:25,489 --> 01:07:23,489
to do for how long it has to go for how

1498
01:07:27,650 --> 01:07:25,499
many people it's going to carry are all

1499
01:07:29,719 --> 01:07:27,660
different from a plane which leads you

1500
01:07:32,150 --> 01:07:29,729
to you know somewhat different solutions

1501
01:07:35,209 --> 01:07:32,160
in the design make sense make sense so

1502
01:07:37,609 --> 01:07:35,219
we have the SLS rocket we have the Orion

1503
01:07:39,410 --> 01:07:37,619
spacecraft and then we have

1504
01:07:41,299 --> 01:07:39,420
way you talk a little more about Gateway

1505
01:07:48,049 --> 01:07:41,309
at least gonna be my next favorite

1506
01:07:50,029 --> 01:07:48,059
species fascinating III it's it's

1507
01:07:53,269 --> 01:07:50,039
designed in mind to be essentially our

1508
01:07:55,220 --> 01:07:53,279
first interplanetary space tug and IO

1509
01:07:56,839 --> 01:07:55,230
it's a face ship that could have what

1510
01:07:59,269 --> 01:07:56,849
have the capability of allowing us to

1511
01:08:03,019 --> 01:07:59,279
maneuver things in space and propelling

1512
01:08:06,440 --> 01:08:03,029
other vehicles to Mars but it is a

1513
01:08:08,269 --> 01:08:06,450

orbiting ship around the moon it gets us

1514
01:08:10,670 --> 01:08:08,279
close to a thousand miles of the moon's

1515
01:08:13,400 --> 01:08:10,680
surface and he goes as far away as forty

1516
01:08:17,149 --> 01:08:13,410
thousand miles it's in this rectilinear

1517
01:08:19,519 --> 01:08:17,159
or orbit it allows you to land on any

1518
01:08:21,229 --> 01:08:19,529
place on them on the moon Wow which we

1519
01:08:23,990 --> 01:08:21,239
didn't have with Apollo although the the

1520
01:08:25,610 --> 01:08:24,000
orbit trajectory was you know on a

1521
01:08:28,700 --> 01:08:25,620
specific place could only had Lander on

1522
01:08:29,689 --> 01:08:28,710
the equator this allows us to go to the

1523
01:08:32,479 --> 01:08:29,699
poles which we were talking about

1524
01:08:34,610 --> 01:08:32,489
earlier it allows the far side but it

1525
01:08:36,769 --> 01:08:34,620
has a very unique propulsion on it a

1526
01:08:38,329 --> 01:08:36,779
solar electric propulsion and it's more

1527
01:08:39,829 --> 01:08:38,339
powerful than anything of that type that

1528
01:08:41,990 --> 01:08:39,839
we've seen before and that's the type of

1529
01:08:44,269 --> 01:08:42,000
propulsor we're gonna need when we're

1530
01:08:46,760 --> 01:08:44,279
far from home like on our journey to

1531
01:08:48,320 --> 01:08:46,770
Mars and so that's gonna be used and I

1532
01:08:50,539 --> 01:08:48,330
also love the fact that it's open

1533
01:08:51,849 --> 01:08:50,549
architecture all the ports are gonna be

1534
01:08:53,870 --> 01:08:51,859
made available online because we want

1535
01:08:56,329 --> 01:08:53,880
it's gonna have commercial and

1536
01:08:58,099 --> 01:08:56,339
international partners docking coming

1537
01:08:59,510 --> 01:08:58,109
and going and having humans on it and

1538
01:09:02,629 --> 01:08:59,520

not having humans on it and it's gonna

1539
01:09:03,890 --> 01:09:02,639
be a vacation home type thing you know

1540
01:09:05,840 --> 01:09:03,900
that stress will be there for a few

1541
01:09:07,970 --> 01:09:05,850
weeks or months at a time and then then

1542
01:09:10,070 --> 01:09:07,980
they'll be empty for some time and it

1543
01:09:11,870 --> 01:09:10,080
really is a way a different approach to

1544
01:09:13,370 --> 01:09:11,880
thinking about long term human

1545
01:09:21,349 --> 01:09:13,380
exploration than space it's kind of like

1546
01:09:25,430 --> 01:09:21,359
a space condo the staging place we hang

1547
01:09:26,510 --> 01:09:25,440
out there for a while and and then you

1548
01:09:29,300 --> 01:09:26,520
know then we'll come back later and

1549
01:09:31,399 --> 01:09:29,310
we'll pick back up you Venice propulsion

1550
01:09:33,229 --> 01:09:31,409
to be a tugboat it also allows us to put

1551
01:09:35,180 --> 01:09:33,239
biological experts other science

1552
01:09:37,789 --> 01:09:35,190
experiments on it I'll put a telescope

1553
01:09:39,919 --> 01:09:37,799
on it went on yeah going in there

1554
01:09:41,269 --> 01:09:39,929
control the Rovers on the surface from

1555
01:09:43,190 --> 01:09:41,279
it

1556
01:09:46,150 --> 01:09:43,200
let's go a potential I think we actually

1557
01:09:48,499 --> 01:09:46,160
have an animation of Gateway to show

1558
01:09:51,559 --> 01:09:48,509
there we go this is showing all the

1559
01:09:53,360 --> 01:09:51,569
different component modules from both

1560
01:09:56,120 --> 01:09:53,370
commercial and international partners as

1561
01:09:57,530 --> 01:09:56,130
well as NASA being assembled to form you

1562
01:10:00,590 --> 01:09:57,540
know eventually this this really

1563
01:10:03,440 --> 01:10:00,600

functional outpost and orbit around the

1564
01:10:05,570 --> 01:10:03,450
moon and it also lets have constant

1565
01:10:07,070 --> 01:10:05,580
communication with earth which again is

1566
01:10:08,690 --> 01:10:07,080
you know something you won't have when

1567
01:10:10,460 --> 01:10:08,700
you go to Mars but at least this time

1568
01:10:12,770 --> 01:10:10,470
while we're working out all the

1569
01:10:14,540 --> 01:10:12,780
interesting challenges of being away

1570
01:10:17,810 --> 01:10:14,550
from planet earth and being in this

1571
01:10:20,900 --> 01:10:17,820
environment for long periods of time it

1572
01:10:22,970 --> 01:10:20,910
truly is a proving ground and it's it's

1573
01:10:25,370 --> 01:10:22,980
flexible in terms of what it can be used

1574
01:10:29,150 --> 01:10:25,380
for awesome you guys answered a question

1575
01:10:31,760 --> 01:10:29,160
from oh gosh I've lost it Yoga fire is

1576
01:10:33,170 --> 01:10:31,770
Artemis a joint venture the way that the

1577
01:10:35,030 --> 01:10:33,180
International Space Station is

1578
01:10:38,090 --> 01:10:35,040
International you talked about very very

1579
01:10:39,560 --> 01:10:38,100
much so yeah and and more partners as

1580
01:10:41,900 --> 01:10:39,570
well International Space Station this

1581
01:10:44,270 --> 01:10:41,910
has about 15 partners I mean now we have

1582
01:10:45,920 --> 01:10:44,280
89 nations on this planet that have

1583
01:10:47,990 --> 01:10:45,930
satellites in orbit we are a very

1584
01:10:48,680 --> 01:10:48,000
different species than we were years ago

1585
01:10:52,550 --> 01:10:48,690
yeah

1586
01:10:54,650 --> 01:10:52,560
so as you know the future of space is

1587
01:10:57,200 --> 01:10:54,660
for the whole world and we have a lot of

1588
01:10:59,210 --> 01:10:57,210

nations you know working in space in

1589
01:11:01,760 --> 01:10:59,220
terms of their economics or the

1590
01:11:04,910 --> 01:11:01,770
communication and they'll be partnering

1591
01:11:07,880 --> 01:11:04,920
with you know this is what this the

1592
01:11:09,230 --> 01:11:07,890
honours program is about mm-hmm yeah you

1593
01:11:12,440 --> 01:11:09,240
have a question here from an easter egg

1594
01:11:16,070 --> 01:11:12,450
is gateway bigger than the ISS no no

1595
01:11:17,390 --> 01:11:16,080
it's a ISS is really huge and and

1596
01:11:19,900 --> 01:11:17,400
Gateway because it's so much further

1597
01:11:23,390 --> 01:11:19,910
away is going to be a much more compact

1598
01:11:25,850 --> 01:11:23,400
vehicle you know it'll it'll have a lot

1599
01:11:29,170 --> 01:11:25,860
of the functionality that ISS does just

1600
01:11:31,700 --> 01:11:29,180
be a little smaller well a lot smaller

1601
01:11:34,070 --> 01:11:31,710
is they still need to be occupied not so

1602
01:11:36,320 --> 01:11:34,080
the ISS an amazing achievement has been

1603
01:11:36,680 --> 01:11:36,330
continuously occupied for almost 20

1604
01:11:40,190 --> 01:11:36,690
years

1605
01:11:42,980 --> 01:11:40,200
November of 2000 was the first occupants

1606
01:11:45,590 --> 01:11:42,990
that's a people on space soon and

1607
01:11:47,300 --> 01:11:45,600
definitely designed for that reason is

1608
01:11:48,830 --> 01:11:47,310
so are tough so gateway is gonna be

1609
01:11:50,450 --> 01:11:48,840
designed differently because it has to

1610
01:11:51,800 --> 01:11:50,460
be able to support humans for periods of

1611
01:11:54,800 --> 01:11:51,810
time in the period where it doesn't have

1612
01:11:56,150 --> 01:11:54,810
humans and too

1613
01:11:58,820 --> 01:11:56,160

that can be done because of our

1614
01:12:02,030 --> 01:11:58,830
advancements in robotics and autonomy

1615
01:12:03,590 --> 01:12:02,040
and smart software I mean you know it's

1616
01:12:05,150 --> 01:12:03,600
a different vehicle but you know we're

1617
01:12:07,220 --> 01:12:05,160
starting to see self-driving cars

1618
01:12:09,200 --> 01:12:07,230
self-driving trucks our satellites are a

1619
01:12:12,080 --> 01:12:09,210
lot more autonomous we are smarter

1620
01:12:13,190 --> 01:12:12,090
species now and now that the space could

1621
01:12:14,530 --> 01:12:13,200
take advantage of the knowledge that

1622
01:12:17,090 --> 01:12:14,540
we've gained in that field

1623
01:12:18,290 --> 01:12:17,100
awesome yeah I think we have time for

1624
01:12:25,060 --> 01:12:18,300
like one more question

1625
01:12:26,780 --> 01:12:25,070
yeah maybe this one from a random clown

1626
01:12:29,420 --> 01:12:26,790
what are some of the design challenges

1627
01:12:34,490 --> 01:12:29,430
that have yet to be solved for this trip

1628
01:12:35,630 --> 01:12:34,500
can you identify there's so many I mean

1629
01:12:37,490 --> 01:12:35,640
if you just think about we were just

1630
01:12:40,310 --> 01:12:37,500
talking about Apollo earlier in this

1631
01:12:43,790 --> 01:12:40,320
this show when the charge came to go to

1632
01:12:45,440 --> 01:12:43,800
the moon in 61 it was only 20 days after

1633
01:12:46,730 --> 01:12:45,450
what they had done a first suborbital

1634
01:12:48,100 --> 01:12:46,740
flight they hadn't even done an orbital

1635
01:12:50,300 --> 01:12:48,110
flight they hadn't figured out how to do

1636
01:12:52,460 --> 01:12:50,310
rendezvous to spacecraft that had been a

1637
01:13:11,770 --> 01:12:52,470
lot of they didn't done a spacewalk they

1638
01:13:20,680 --> 01:13:18,520

a much better place no doubt about it

1639
01:13:23,290 --> 01:13:20,690
they'll be new and that's the beauty of

1640
01:13:25,120 --> 01:13:23,300
it because when you have a problem that

1641
01:13:28,060 --> 01:13:25,130
has not been solved that's when you get

1642
01:13:29,920 --> 01:13:28,070
your creative new solutions now you know

1643
01:13:31,000 --> 01:13:29,930
you're gonna attack a problem and come

1644
01:13:32,890 --> 01:13:31,010
back with something that no one's ever

1645
01:13:33,990 --> 01:13:32,900
thought of before and then who knows

1646
01:13:40,120 --> 01:13:34,000
where that's going to me

1647
01:13:43,560 --> 01:13:40,130
Lina nicely said yeah well yes we can

1648
01:13:45,940 --> 01:13:43,570
that's the perfect way to end this huh

1649
01:13:48,720 --> 01:13:45,950
that's about all the time we have today

1650
01:13:51,010 --> 01:13:48,730
you guys a huge thanks to our guests and

1651
01:13:53,410 --> 01:13:51,020
everyone who joined us in the chat today

1652
01:13:55,990 --> 01:13:53,420
on twitch we will be back on Thursday

1653
01:13:58,800 --> 01:13:56,000
July 25th talking about how to get an

1654
01:14:00,670 --> 01:13:58,810
internship at NASA that's how it starts

1655
01:14:02,800 --> 01:14:00,680
there are a lot of people here today who

1656
01:14:06,100 --> 01:14:02,810
serve as interns right yeah so that's

1657
01:14:07,930 --> 01:14:06,110
our next show for this game here but

1658
01:14:11,170 --> 01:14:07,940
remember to join us tomorrow in

1659
01:14:12,910 --> 01:14:11,180
celebrating the Apollo 50th and hearing

1660
01:14:15,130 --> 01:14:12,920
about more about our future plans to go

1661
01:14:17,170 --> 01:14:15,140
to the moon and on to Mars so tune in to

1662
01:14:19,390 --> 01:14:17,180
our special two-hour live NASA

1663
01:14:21,490 --> 01:14:19,400

television broadcast tomorrow at 10:00

1664
01:14:23,020 --> 01:14:21,500
a.m. Pacific and you can learn more

1665
01:14:27,130 --> 01:14:23,030
about the show and how to watch it by

1666
01:14:29,620 --> 01:14:27,140
going to www.a gov slash Apollo 50th and

1667
01:14:31,360 --> 01:14:29,630
click on events so check it out and