
NASA
SILICON VALLEY
IVE
DAYS HOURS MIN SEC
1627 06:49:06
NASA
SILICON VALLEY
AMES RESEARCH CENTER

1
00:00:03,510 --> 00:00:02,070
question which was seriously they had to

2
00:00:06,309 --> 00:00:03,520
go to sleep

3
00:00:07,590 --> 00:00:06,319
they're on the moon and it's like

4
00:00:10,150 --> 00:00:07,600
lie down now

5
00:00:12,789 --> 00:00:10,160
engineers took out the seats in the

6
00:00:14,709 --> 00:00:12,799
apollo 11 lander so they were just like

7
00:00:16,150 --> 00:00:14,719
sleeping on the floor

8
00:00:17,910 --> 00:00:16,160
later once they put a hammock in but

9
00:00:19,590 --> 00:00:17,920
still in order to save weight they got

10
00:00:21,109 --> 00:00:19,600
rid of the seats so they're landing and

11
00:00:23,509 --> 00:00:21,119
standing up it's interesting it's

12
00:00:26,150 --> 00:00:23,519
interesting to fly the lunar module so

13
00:00:35,590 --> 00:00:26,160

i've actually got um some some stick

14
00:00:40,389 --> 00:00:37,670
rusty schweikert and charlie duke who

15
00:00:42,869 --> 00:00:40,399
were both hollow lunar module pilots no

16
00:00:44,709 --> 00:00:42,879
kidding and uh you're standing up you're

17
00:00:46,869 --> 00:00:44,719
flying the things you know there is no

18
00:00:48,470 --> 00:00:46,879
seats that you're staying up and you

19
00:00:51,110 --> 00:00:48,480
know bringing the thing in and flying it

20
00:00:53,189 --> 00:00:51,120
and of course both those guys are you

21
00:00:54,709 --> 00:00:53,199
know crack cracker jack at it because

22
00:00:56,470 --> 00:00:54,719
you know they flew the real thing right

23
00:00:58,310 --> 00:00:56,480
yeah um they're both they were both

24
00:00:59,910 --> 00:00:58,320
still very good at it and you know much

25
00:01:01,830 --> 00:00:59,920
better than us but

26
00:01:03,910 --> 00:01:01,840
just that experience of what's what's it

27
00:01:05,910 --> 00:01:03,920
really like to try and go fly and land

28
00:01:07,270 --> 00:01:05,920
on the moon it's it's not like flying an

29
00:01:09,350 --> 00:01:07,280
airplane it's not like flying a

30
00:01:11,590 --> 00:01:09,360
helicopter it's a completely unique and

31
00:01:13,109 --> 00:01:11,600
different experience it has to be right

32
00:01:15,749 --> 00:01:13,119
it's welcome and we're on the verge of

33
00:01:17,749 --> 00:01:15,759
having to relearn that all again for the

34
00:01:20,710 --> 00:01:17,759
new program and we're smarter too like

35
00:01:23,109 --> 00:01:20,720
you said we learned so much by you know

36
00:01:24,870 --> 00:01:23,119
some of the the videos of buzz and um

37
00:01:26,310 --> 00:01:24,880
and neil jumping around the surface of

38
00:01:27,670 --> 00:01:26,320

apollo 11 you'll see them they're trying

39
00:01:28,870 --> 00:01:27,680
out different steps because they're

40
00:01:31,030 --> 00:01:28,880
trying to figure out how to walk in one

41
00:01:32,550 --> 00:01:31,040
sixth gravity with the bulky spaceship

42
00:01:34,230 --> 00:01:32,560
right so you see them popping you know

43
00:01:35,830 --> 00:01:34,240
that so this that was also part of

44
00:01:37,429 --> 00:01:35,840
experiments right as well i wanted to

45
00:01:50,389 --> 00:01:37,439
know how could we work and live in this

46
00:01:53,670 --> 00:01:51,910
those questions that we did not know

47
00:01:55,670 --> 00:01:53,680
because you can only simulate so much

48
00:01:57,270 --> 00:01:55,680
you have to go there yeah and that's

49
00:01:59,350 --> 00:01:57,280
where you're going to make the big leaps

50
00:02:01,270 --> 00:01:59,360
and knowledge understanding it's like

51
00:02:03,590 --> 00:02:01,280
smooth master says moving in those suits

52
00:02:05,190 --> 00:02:03,600
is insane it must be right yeah and you

53
00:02:06,950 --> 00:02:05,200
got this big chunky thing only looking

54
00:02:09,510 --> 00:02:06,960
off your shoulder and all that and the

55
00:02:11,750 --> 00:02:09,520
lunar module is your favorite spacecraft

56
00:02:13,589 --> 00:02:11,760
this is my favorite spacecraft date okay

57
00:02:15,750 --> 00:02:13,599
well then then i want you to know that

58
00:02:17,110 --> 00:02:15,760
aperture combined says my grandfather

59
00:02:18,550 --> 00:02:17,120
helped with the design of the lunar

60
00:02:20,830 --> 00:02:18,560
module oh my gosh

61
00:02:22,949 --> 00:02:20,840
awesome

62
00:02:24,710 --> 00:02:22,959
lucky the thing i like that the reason

63
00:02:26,470 --> 00:02:24,720

the lunar module is my favorite is

64
00:02:28,390 --> 00:02:26,480
because um

65
00:02:30,550 --> 00:02:28,400
you know it's it's

66
00:02:33,350 --> 00:02:30,560
one of the few vehicles that we've ever

67
00:02:38,710 --> 00:02:33,360
built that is really designed only for

68
00:02:42,470 --> 00:02:41,030
it doesn't look like an atmospheric

69
00:02:44,150 --> 00:02:42,480
vehicle and

70
00:02:45,990 --> 00:02:44,160
you know the international space station

71
00:02:47,589 --> 00:02:46,000
is another example but there's not very

72
00:02:49,270 --> 00:02:47,599
many that are like that almost

73
00:02:50,630 --> 00:02:49,280
everything else either you know it's got

74
00:02:52,550 --> 00:02:50,640
to go up through an atmosphere it's got

75
00:02:54,630 --> 00:02:52,560
to come back through an atmosphere and

76
00:02:57,190 --> 00:02:54,640
so it's just a very distinctly different

77
00:02:58,949 --> 00:02:57,200
kind of vehicle i i really like them

78
00:03:01,430 --> 00:02:58,959
i can see that yeah for those of you who

79
00:03:06,070 --> 00:03:01,440
build spacecraft or design instruments

80
00:03:07,670 --> 00:03:06,080
for them yeah that matters very cool so

81
00:03:09,830 --> 00:03:07,680
one cool thing about celebrating the

82
00:03:12,309 --> 00:03:09,840
anniversary is that we've been gathering

83
00:03:15,190 --> 00:03:12,319
people's memories and so i thought about

84
00:03:17,509 --> 00:03:15,200
what's my memory of apollo the 50th i

85
00:03:21,830 --> 00:03:17,519
wasn't born then but it made me think oh

86
00:03:23,910 --> 00:03:21,840
my gosh my dad had this videotape that

87
00:03:26,229 --> 00:03:23,920
he sat me and my sister down in front of

88
00:03:28,789 --> 00:03:26,239

me popped it on the vcr it was this

89
00:03:30,550 --> 00:03:28,799
weird grainy black and white footage i

90
00:03:33,509 --> 00:03:30,560
didn't even know what it was but it was

91
00:03:35,270 --> 00:03:33,519
the apollo 11 moon landing and at the

92
00:03:36,710 --> 00:03:35,280
time i don't know i was in elementary

93
00:03:38,789 --> 00:03:36,720
school or something and i didn't get it

94
00:03:41,589 --> 00:03:38,799
but i knew that this mattered to my dad

95
00:03:43,990 --> 00:03:41,599
he made us sit and watch it now i get it

96
00:03:46,149 --> 00:03:44,000
to share with you it's so cool that's

97
00:03:48,710 --> 00:03:46,159
probably why you're here at nasa too

98
00:03:52,710 --> 00:03:48,720
like yeah

99
00:03:56,149 --> 00:03:53,750
you know trying to think about just

100
00:03:57,589 --> 00:03:56,159
being back there and just you know it

101
00:04:00,390 --> 00:03:57,599
was a defining

102
00:04:02,470 --> 00:04:00,400
moment in history in that century just

103
00:04:03,830 --> 00:04:02,480
for the whole world yeah tuning in and

104
00:04:05,750 --> 00:04:03,840
watching this

105
00:04:08,309 --> 00:04:05,760
i think that's amazing right just like

106
00:04:10,470 --> 00:04:08,319
everyone across the entire group looking

107
00:04:11,990 --> 00:04:10,480
up at the moon just all at once that's

108
00:04:13,910 --> 00:04:12,000
just amazing right

109
00:04:17,270 --> 00:04:13,920
do you have some of those memories to

110
00:04:18,949 --> 00:04:17,280
share with us from i do so we have uh

111
00:04:21,189 --> 00:04:18,959
more stories and they're actually from

112
00:04:22,629 --> 00:04:21,199
you all uh we invited people all over

113
00:04:23,990 --> 00:04:22,639

the world to share their share their

114
00:04:26,629 --> 00:04:24,000
apollo 11

115
00:04:28,950 --> 00:04:26,639
moon landing stories and so we collected

116
00:04:31,510 --> 00:04:28,960
their responses and

117
00:04:33,830 --> 00:04:31,520
they are part of our nasa explorers your

118
00:04:36,070 --> 00:04:33,840
apollo stories podcast

119
00:04:38,629 --> 00:04:36,080
and here's one we have here from ellen

120
00:04:40,790 --> 00:04:38,639
in calistoga california

121
00:04:42,390 --> 00:04:40,800
we are all glued to our television that

122
00:04:44,870 --> 00:04:42,400
day mind you

123
00:04:47,110 --> 00:04:44,880
this is a television that only got three

124
00:04:48,310 --> 00:04:47,120
channels so i'm grateful that we were

125
00:04:50,870 --> 00:04:48,320
able to watch

126
00:04:54,150 --> 00:04:50,880
it was quite fuzzy but it was so

127
00:04:55,670 --> 00:04:54,160
exciting and me being young i

128
00:04:57,590 --> 00:04:55,680
immediately went outside with a pair of

129
00:05:00,230 --> 00:04:57,600
binoculars to stare at the moon to see

130
00:05:01,270 --> 00:05:00,240
if i could see neil armstrong walking on

131
00:05:03,430 --> 00:05:01,280
the moon

132
00:05:05,990 --> 00:05:03,440
you know when you're young anything is

133
00:05:08,950 --> 00:05:06,000
possible

134
00:05:10,790 --> 00:05:08,960
so nice that's amazing so if you all

135
00:05:13,670 --> 00:05:10,800
want to hear more stories like ellen's

136
00:05:17,189 --> 00:05:13,680
you can go to www.nasa.gov

137
00:05:19,350 --> 00:05:17,199
apollo stories and browse through those

138
00:05:21,510 --> 00:05:19,360

and now we have a whole bunch of

139
00:05:23,830 --> 00:05:21,520
questions waiting for us i think should

140
00:05:27,110 --> 00:05:23,840
we jump

141
00:05:29,909 --> 00:05:27,120
our questions section yeah you wanna

142
00:05:31,590 --> 00:05:29,919
do you wanna lead us off into rapid fire

143
00:05:36,790 --> 00:05:31,600
questions time fire really really

144
00:05:41,350 --> 00:05:39,510
an easter egg um

145
00:05:43,189 --> 00:05:41,360
i have a question why the moon before

146
00:05:44,629 --> 00:05:43,199
mars

147
00:05:45,510 --> 00:05:44,639
well i think there's a number of reasons

148
00:05:50,310 --> 00:05:45,520
the

149
00:05:52,790 --> 00:05:50,320
humans to mars is that you know it's so

150
00:05:56,950 --> 00:05:52,800
much further away it takes a lot longer

151
00:05:59,510 --> 00:05:56,960
to get there than going to the moon

152
00:06:01,350 --> 00:05:59,520
and that duration introduces lots and

153
00:06:03,830 --> 00:06:01,360
lots of big

154
00:06:06,790 --> 00:06:03,840
problems right there's longer exposure

155
00:06:09,270 --> 00:06:06,800
to radiation longer exposure to

156
00:06:12,309 --> 00:06:09,280
really no gravity

157
00:06:14,710 --> 00:06:12,319
you know living in a basically a tin can

158
00:06:17,350 --> 00:06:14,720
for potentially months

159
00:06:20,070 --> 00:06:17,360
plus all of the technical

160
00:06:22,870 --> 00:06:20,080
devices and systems that have to be

161
00:06:25,110 --> 00:06:22,880
reliable enough to last that long and

162
00:06:27,189 --> 00:06:25,120
rather than just make a go of it and

163
00:06:29,590 --> 00:06:27,199

give it a give it your best shot

164
00:06:31,510 --> 00:06:29,600
it's easier to prove all that out a

165
00:06:34,710 --> 00:06:31,520
little bit closer to home you know we've

166
00:06:37,350 --> 00:06:34,720
got a long period of having humans in

167
00:06:39,909 --> 00:06:37,360
earth orbit on the space station

168
00:06:41,350 --> 00:06:39,919
the next big step is to go for that much

169
00:06:43,670 --> 00:06:41,360
further

170
00:06:45,749 --> 00:06:43,680
away from us and to spend that much more

171
00:06:47,189 --> 00:06:45,759
time that takes us to the moon

172
00:06:49,189 --> 00:06:47,199
and the mars is a very different mindset

173
00:06:52,070 --> 00:06:49,199
as well right you know communication

174
00:06:53,589 --> 00:06:52,080
could be at much 20 minutes 30 minutes

175
00:06:55,830 --> 00:06:53,599
you're going to be very independent when

176
00:06:57,749 --> 00:06:55,840
you're out there on your own doing space

177
00:07:00,950 --> 00:06:57,759
exploration

178
00:07:03,510 --> 00:07:00,960
um here's one from stinkfort34 how much

179
00:07:05,909 --> 00:07:03,520
fuel did it take to lift the lunar

180
00:07:07,029 --> 00:07:05,919
module the lem off the moon you guys

181
00:07:09,029 --> 00:07:07,039
happen to know that that's a good

182
00:07:11,749 --> 00:07:09,039
question i don't know i remember seeing

183
00:07:13,350 --> 00:07:11,759
the the number for

184
00:07:17,189 --> 00:07:13,360
the the

185
00:07:21,110 --> 00:07:17,199
lem crew module and i want to say

186
00:07:22,950 --> 00:07:21,120
don't quote me on this but i think zero

187
00:07:24,950 --> 00:07:22,960
i think it was about it it was you know

188
00:07:26,870 --> 00:07:24,960

a few let's say a few hundred gallons

189
00:07:29,430 --> 00:07:26,880
right it was not a huge

190
00:07:31,589 --> 00:07:29,440
um uh not a huge amount but it only had

191
00:07:33,909 --> 00:07:31,599
that one job to do you had that one

192
00:07:36,309 --> 00:07:33,919
and it had to work that one time right

193
00:07:37,670 --> 00:07:36,319
yeah i know the numbers published i i

194
00:07:39,749 --> 00:07:37,680
just don't have it at the tip of my

195
00:07:42,150 --> 00:07:39,759
tongue but it's there's it's interesting

196
00:07:43,749 --> 00:07:42,160
all the apollo technical documents right

197
00:07:45,830 --> 00:07:43,759
are out there you can go online and

198
00:07:48,790 --> 00:07:45,840
download all the apollo reports all the

199
00:07:51,029 --> 00:07:48,800
experience reports um and like all those

200
00:07:52,629 --> 00:07:51,039
technical details they're all in there

201
00:07:54,629 --> 00:07:52,639
you can just go look them up it's really

202
00:07:56,469 --> 00:07:54,639
cool to just browse through it and yeah

203
00:08:07,670 --> 00:07:56,479
doesn't everyone have the apollo

204
00:08:12,230 --> 00:08:10,550
um there are some excited comments i

205
00:08:14,790 --> 00:08:12,240
can't wait to experience the same thing

206
00:08:16,230 --> 00:08:14,800
in five years as some did 50 years ago

207
00:08:20,230 --> 00:08:16,240
that's right we're the artemis

208
00:08:25,350 --> 00:08:22,150
we learn from apollo we're building on

209
00:08:26,950 --> 00:08:25,360
the shoulders of apollo yeah

210
00:08:28,309 --> 00:08:26,960
uh we actually have a question i think

211
00:08:30,869 --> 00:08:28,319
it's because we talk so much about the

212
00:08:33,350 --> 00:08:30,879
astronauts um from it's crazy k what

213
00:08:35,350 --> 00:08:33,360

does it take to become an astronaut oh

214
00:08:36,870 --> 00:08:35,360
good question what did the astronauts

215
00:08:39,430 --> 00:08:36,880
have to do in order to

216
00:08:43,269 --> 00:08:39,440
land on the moon and education

217
00:08:44,550 --> 00:08:43,279
um skill determination um

218
00:08:46,630 --> 00:08:44,560
a little luck

219
00:08:47,590 --> 00:08:46,640
right the i think the last astronaut

220
00:08:52,710 --> 00:08:47,600
class

221
00:08:52,720 --> 00:08:59,910
i really

222
00:09:05,190 --> 00:09:02,790
yeah and our future astronauts ford

223
00:09:06,870 --> 00:09:05,200
sustains uh humans in space you know

224
00:09:08,470 --> 00:09:06,880
we're going to need all different types

225
00:09:09,990 --> 00:09:08,480
you know engineers and scientists but

226
00:09:11,750 --> 00:09:10,000
we're going to need people who can keep

227
00:09:13,030 --> 00:09:11,760
the machines working you know we're

228
00:09:15,350 --> 00:09:13,040
going to need plumbers we're going to

229
00:09:17,509 --> 00:09:15,360
need surveyors we're going to need um

230
00:09:19,910 --> 00:09:17,519
folks who are can climb down you know

231
00:09:22,150 --> 00:09:19,920
canyon walls spelunkers yeah

232
00:09:24,630 --> 00:09:22,160
we're going to kind of

233
00:09:27,430 --> 00:09:25,670
all kinds of

234
00:09:29,190 --> 00:09:27,440
specialties here's a related question

235
00:09:30,470 --> 00:09:29,200
maybe this should be our last for now

236
00:09:33,269 --> 00:09:30,480
but we'll get back to more your

237
00:09:34,949 --> 00:09:33,279
questions later but latios 67 asks you

238
00:09:37,030 --> 00:09:34,959

kimberly how long did you go to college

239
00:09:38,230 --> 00:09:37,040
to get the to get the knowledge for your

240
00:09:40,150 --> 00:09:38,240
current job

241
00:09:42,630 --> 00:09:40,160
once you get here as i say i stayed in

242
00:09:45,030 --> 00:09:42,640
school for a very long time i did four

243
00:09:47,030 --> 00:09:45,040
years as an undergraduate um got a

244
00:09:50,070 --> 00:09:47,040
physics degree physics is a great degree

245
00:09:52,070 --> 00:09:50,080
to learn how to solve problems then i

246
00:09:54,550 --> 00:09:52,080
did four years in grad school and i got

247
00:09:56,070 --> 00:09:54,560
phd in astrophysics um

248
00:09:57,829 --> 00:09:56,080
and so yeah i stayed in school and i

249
00:09:59,350 --> 00:09:57,839
remember um when i got my first job

250
00:10:00,710 --> 00:09:59,360
which was called a post-doc it's what

251
00:10:02,389 --> 00:10:00,720
you get after your doctorate i went to

252
00:10:03,670 --> 00:10:02,399
another university and my dad would call

253
00:10:04,949 --> 00:10:03,680
me up are you still school still in

254
00:10:07,750 --> 00:10:04,959
school

255
00:10:10,150 --> 00:10:07,760
i said no i'm getting paid this time

256
00:10:12,150 --> 00:10:10,160
so yeah so it was a good um good eight

257
00:10:13,190 --> 00:10:12,160
years of schooling outside of high

258
00:10:15,430 --> 00:10:13,200
school

259
00:10:17,590 --> 00:10:15,440
well worth it right and it's important

260
00:10:19,829 --> 00:10:17,600
to recognize too right that we never

261
00:10:22,150 --> 00:10:19,839
stop never learning never stop learning

262
00:10:23,670 --> 00:10:22,160
i mean a job here working in the space

263
00:10:26,150 --> 00:10:23,680

business you're never never stop

264
00:10:27,509 --> 00:10:26,160
learning yes in a good way obviously i

265
00:10:28,949 --> 00:10:27,519
think by the time you're doing your phd

266
00:10:32,069 --> 00:10:28,959
you're doing something you're passionate

267
00:10:33,430 --> 00:10:32,079
about and so you're loving it right i do

268
00:10:35,190 --> 00:10:33,440
think that um

269
00:10:38,150 --> 00:10:35,200
school for at least for me school got

270
00:10:39,670 --> 00:10:38,160
even more fun and exciting for more

271
00:10:41,269 --> 00:10:39,680
years of it i had

272
00:10:43,430 --> 00:10:41,279
yeah you know i think back to like my

273
00:10:45,350 --> 00:10:43,440
freshman year of college and it was a

274
00:10:46,949 --> 00:10:45,360
lot of work and it was really

275
00:10:50,389 --> 00:10:46,959
challenging and i didn't know what i was

276
00:10:52,550 --> 00:10:50,399
doing and as i spent more years in my

277
00:10:54,389 --> 00:10:52,560
academic career it actually got easier

278
00:10:56,630 --> 00:10:54,399
and more fun it didn't stop being

279
00:10:58,069 --> 00:10:56,640
challenging but it became it took on a

280
00:11:00,069 --> 00:10:58,079
different note so if you're if you're

281
00:11:01,910 --> 00:11:00,079
just starting in college

282
00:11:04,790 --> 00:11:01,920
or if you're in high school or even in

283
00:11:07,509 --> 00:11:04,800
elementary school you know

284
00:11:09,430 --> 00:11:07,519
it does get easier um and i would argue

285
00:11:10,949 --> 00:11:09,440
it gets more fun as you as you go along

286
00:11:12,829 --> 00:11:10,959
so don't be afraid of spending lots of

287
00:11:16,310 --> 00:11:12,839
years

288
00:11:17,110 --> 00:11:16,320

yeah that's great excellent all right so

289
00:11:20,069 --> 00:11:17,120
we're going to get back to more

290
00:11:21,829 --> 00:11:20,079
questions later and before we move on i

291
00:11:23,829 --> 00:11:21,839
just want to let people know i want to

292
00:11:26,069 --> 00:11:23,839
invite you to join us in celebrating the

293
00:11:28,870 --> 00:11:26,079
50th anniversary of the apollo 11 moon

294
00:11:29,590 --> 00:11:28,880
landing and hear about our future plans

295
00:11:36,949 --> 00:11:29,600
to

296
00:11:39,509 --> 00:11:36,959
nasa television broadcast that's

297
00:11:41,110 --> 00:11:39,519
tomorrow at 10 a.m pacific so to learn

298
00:11:43,990 --> 00:11:41,120
about the show and how to watch you can

299
00:11:46,949 --> 00:11:44,000
go to www.nasa.gov

300
00:11:48,550 --> 00:11:46,959
apollo 50th and click on events

301
00:11:50,389 --> 00:11:48,560
yes are you going to watch tiffany oh

302
00:11:51,910 --> 00:11:50,399
definitely i will be watching i'm

303
00:11:53,590 --> 00:11:51,920
actually excited this stuff is really

304
00:11:55,269 --> 00:11:53,600
really cool it really is it's nice to

305
00:11:56,949 --> 00:11:55,279
you know go back in time and revisit

306
00:11:58,790 --> 00:11:56,959
history and see that you know what i

307
00:12:00,870 --> 00:11:58,800
mean absolutely and so let's dig a

308
00:12:02,389 --> 00:12:00,880
little bit deeper into the apollo

309
00:12:04,870 --> 00:12:02,399
history and talk about

310
00:12:06,230 --> 00:12:04,880
um all of those those cool cool facts

311
00:12:08,470 --> 00:12:06,240
that we don't know about you know in

312
00:12:11,269 --> 00:12:08,480
order to do that we have our historian

313
00:12:12,870 --> 00:12:11,279

here james hi tiffany hi tell us a

314
00:12:15,269 --> 00:12:12,880
little bit about yourself

315
00:12:17,350 --> 00:12:15,279
uh so my name is james anderson and i'm

316
00:12:19,829 --> 00:12:17,360
the nasa ames historian i've been here

317
00:12:24,629 --> 00:12:19,839
for a couple months right in all the

318
00:12:28,069 --> 00:12:26,389
jumped right in

319
00:12:29,750 --> 00:12:28,079
and the last few months have been uh

320
00:12:31,509 --> 00:12:29,760
really wonderful we've had an

321
00:12:33,910 --> 00:12:31,519
opportunity to meet

322
00:12:35,190 --> 00:12:33,920
a lot of apollo era veterans who worked

323
00:12:37,350 --> 00:12:35,200
at ames

324
00:12:40,550 --> 00:12:37,360
and just getting to hear

325
00:12:42,310 --> 00:12:40,560
even more stories um from that time um

326
00:12:43,350 --> 00:12:42,320
many of which you know are not the ones

327
00:12:44,710 --> 00:12:43,360
that uh

328
00:12:47,269 --> 00:12:44,720
you know that you hear you know sort of

329
00:12:49,030 --> 00:12:47,279
all the time they get told yeah yeah so

330
00:12:50,629 --> 00:12:49,040
what what do you know about that time at

331
00:12:54,230 --> 00:12:50,639
ames

332
00:12:56,949 --> 00:12:54,240
i was uh an exciting time um

333
00:12:57,910 --> 00:12:56,959
the during the the whole apollo program

334
00:13:01,750 --> 00:12:57,920
um

335
00:13:04,069 --> 00:13:01,760
people involved at its peak

336
00:13:06,389 --> 00:13:04,079
there were around 400 000

337
00:13:09,590 --> 00:13:06,399
uh americans men and women from diverse

338
00:13:11,910 --> 00:13:09,600

backgrounds working uh on uh the apollo

339
00:13:13,990 --> 00:13:11,920
project wow um

340
00:13:16,310 --> 00:13:14,000
and here at ames there's also uh it was

341
00:13:18,710 --> 00:13:16,320
a time of building too a number of new

342
00:13:20,790 --> 00:13:18,720
facilities uh came online and got

343
00:13:23,350 --> 00:13:20,800
funding uh at that time

344
00:13:26,310 --> 00:13:23,360
um and a lot of their research um

345
00:13:27,430 --> 00:13:26,320
directly influenced uh the design uh of

346
00:13:29,350 --> 00:13:27,440
apollo

347
00:13:30,710 --> 00:13:29,360
wow that that

348
00:13:31,590 --> 00:13:30,720
it's amazing four hundred thousand

349
00:13:33,990 --> 00:13:31,600
people

350
00:13:36,150 --> 00:13:34,000
all coming together you know to to solve

351
00:13:38,150 --> 00:13:36,160
this ambitious and really get this yeah

352
00:13:40,629 --> 00:13:38,160
this this plan going and this project

353
00:13:42,550 --> 00:13:40,639
going to get to the moon it's amazing it

354
00:13:44,790 --> 00:13:42,560
was an incredibly huge effort that's a

355
00:13:46,550 --> 00:13:44,800
lot of effort yeah what are some of the

356
00:13:49,030 --> 00:13:46,560
facilities that they were building to

357
00:13:50,069 --> 00:13:49,040
support the new missions well uh funny

358
00:13:55,590 --> 00:13:50,079
you should ask i've brought some

359
00:13:59,670 --> 00:13:58,389
from our facilities here at ames uh

360
00:14:01,750 --> 00:13:59,680
kimberly was showing a little bit

361
00:14:03,990 --> 00:14:01,760
earlier uh the model of the apollo

362
00:14:08,870 --> 00:14:04,000
command module i've got another kind of

363
00:14:14,069 --> 00:14:11,910

so you've got this one here

364
00:14:15,670 --> 00:14:14,079
it's just like it yeah

365
00:14:18,230 --> 00:14:15,680
yeah well it's got it's got the exact

366
00:14:21,030 --> 00:14:18,240
same shape of apollo and you notice one

367
00:14:23,430 --> 00:14:21,040
side is pointy on the other side not uh

368
00:14:25,269 --> 00:14:23,440
why is that chad well it's interesting

369
00:14:27,829 --> 00:14:25,279
this is one of the unique contributions

370
00:14:30,230 --> 00:14:27,839
that ames research center made to uh not

371
00:14:32,470 --> 00:14:30,240
just the apollo program but all of the

372
00:14:33,990 --> 00:14:32,480
the manned space flight programs of the

373
00:14:35,990 --> 00:14:34,000
time is

374
00:14:38,550 --> 00:14:36,000
harvey allen was one of the

375
00:14:41,110 --> 00:14:38,560
aerodynamicists um here at the center he

376
00:14:43,350 --> 00:14:41,120
was later one of the center's directors

377
00:14:46,629 --> 00:14:43,360
and he was studying

378
00:14:48,870 --> 00:14:46,639
how to protect these vehicles

379
00:14:51,430 --> 00:14:48,880
from heat as they came back into the

380
00:14:54,470 --> 00:14:51,440
earth's atmosphere and

381
00:14:56,710 --> 00:14:54,480
previously all the high-speed

382
00:14:58,550 --> 00:14:56,720
vehicles they were very pointy right

383
00:15:00,790 --> 00:14:58,560
sort of like the front end you know had

384
00:15:02,710 --> 00:15:00,800
a sharp point because that was the least

385
00:15:05,269 --> 00:15:02,720
amount of drag coming back into the

386
00:15:07,750 --> 00:15:05,279
atmosphere but they got too hot and

387
00:15:10,470 --> 00:15:07,760
harvey allen realized that if you went

388
00:15:12,790 --> 00:15:10,480

with this very blunt shape

389
00:15:15,430 --> 00:15:12,800
it created a lot more drag and it would

390
00:15:18,069 --> 00:15:15,440
slow them down but it allowed the heat

391
00:15:19,590 --> 00:15:18,079
to go out and around and it the heat

392
00:15:22,150 --> 00:15:19,600
would not be transferred into the

393
00:15:23,509 --> 00:15:22,160
surface of the vehicle so basically the

394
00:15:25,829 --> 00:15:23,519
you know the the

395
00:15:27,990 --> 00:15:25,839
crew members in the vehicle

396
00:15:29,910 --> 00:15:28,000
would be protected from all that heat as

397
00:15:32,069 --> 00:15:29,920
the as it came back into the atmosphere

398
00:15:34,150 --> 00:15:32,079
and of course we're doing basically the

399
00:15:35,910 --> 00:15:34,160
same the same concept today so it's

400
00:15:37,189 --> 00:15:35,920
really a lasting contribution that he

401
00:15:38,470 --> 00:15:37,199
made you can see that with all the

402
00:15:40,629 --> 00:15:38,480
vehicles are returning from the

403
00:15:42,470 --> 00:15:40,639
international space station um you know

404
00:15:44,069 --> 00:15:42,480
even the commercial crew you know the

405
00:15:46,150 --> 00:15:44,079
the boeing and the

406
00:15:48,470 --> 00:15:46,160
the spacex capsules

407
00:15:50,470 --> 00:15:48,480
followed the same engineering

408
00:15:51,590 --> 00:15:50,480
the shape of something right the design

409
00:15:53,189 --> 00:15:51,600
and engineering of something but how

410
00:15:56,389 --> 00:15:53,199
would you come up with that shape you

411
00:15:59,030 --> 00:15:56,399
had to do a lot of testing yeah he was

412
00:16:01,829 --> 00:15:59,040
an eccentric uh character and it really

413
00:16:06,550 --> 00:16:01,839

is sort of um the best ideas come from

414
00:16:11,269 --> 00:16:09,030
it's a really it's an odd idea that

415
00:16:14,230 --> 00:16:11,279
turned out to work really well and that

416
00:16:16,629 --> 00:16:14,240
concept the blunt body concept um was

417
00:16:19,590 --> 00:16:16,639
developed it's older than nasa itself

418
00:16:21,910 --> 00:16:19,600
nasa was founded in 1958 but alan came

419
00:16:23,990 --> 00:16:21,920
up with that idea here at ames uh in the

420
00:16:25,990 --> 00:16:24,000
50s when it was still part of uh the

421
00:16:28,470 --> 00:16:26,000
naca yeah yeah

422
00:16:30,710 --> 00:16:28,480
so ames before it was nasa ames yeah

423
00:16:32,550 --> 00:16:30,720
yeah exactly it was before it was nasa

424
00:16:34,629 --> 00:16:32,560
and and solving a problem that was going

425
00:16:36,470 --> 00:16:34,639
to be not you know

426
00:16:38,790 --> 00:16:36,480
was going to be used decades later oh

427
00:16:40,230 --> 00:16:38,800
yeah you know that's incredible too a

428
00:16:42,069 --> 00:16:40,240
little forward thinking there's a lot of

429
00:16:44,470 --> 00:16:42,079
force working on the future james what

430
00:16:48,150 --> 00:16:44,480
do you do with that model what

431
00:16:50,470 --> 00:16:48,160
is it solid metal it is uh and

432
00:16:52,790 --> 00:16:50,480
you launch them all right and one of the

433
00:16:55,430 --> 00:16:52,800
facilities uh that was built uh

434
00:16:57,910 --> 00:16:55,440
construction began in 1964

435
00:17:00,150 --> 00:16:57,920
on what's uh known as the hyper velocity

436
00:17:03,590 --> 00:17:00,160
free flight facility

437
00:17:04,870 --> 00:17:03,600
and it formally opened in 1965

438
00:17:09,829 --> 00:17:04,880

and

439
00:17:15,909 --> 00:17:12,870
this facility imagine a tube okay

440
00:17:17,350 --> 00:17:15,919
75 feet long three and a half feet

441
00:17:19,429 --> 00:17:17,360
in diameter

442
00:17:20,150 --> 00:17:19,439
and from one end you've got a really

443
00:17:22,870 --> 00:17:20,160
high

444
00:17:23,990 --> 00:17:22,880
speed stream of air at one end and then

445
00:17:33,270 --> 00:17:24,000
the other

446
00:17:37,270 --> 00:17:34,950
what do we do with this cannon well you

447
00:17:41,029 --> 00:17:37,280
shoot it

448
00:17:46,630 --> 00:17:44,150
and these these projectiles

449
00:17:47,990 --> 00:17:46,640
they're they're made here in ames

450
00:17:50,630 --> 00:17:48,000
machine shops

451
00:17:51,990 --> 00:17:50,640
and this is another apollo

452
00:17:52,789 --> 00:17:52,000
uh model

453
00:17:54,470 --> 00:17:52,799
uh

454
00:17:57,270 --> 00:17:54,480
quite a bit smaller than the first one

455
00:18:01,190 --> 00:17:57,280
that we saw but actually this one it

456
00:18:03,270 --> 00:18:01,200
would be loaded uh into um

457
00:18:04,310 --> 00:18:03,280
the the cannon at one end

458
00:18:06,630 --> 00:18:04,320
and

459
00:18:08,230 --> 00:18:06,640
uh launched upstream into that air so

460
00:18:09,990 --> 00:18:08,240
that it's traveling

461
00:18:11,830 --> 00:18:10,000
really really fast

462
00:18:14,549 --> 00:18:11,840
wow every three years we looked this up

463
00:18:17,830 --> 00:18:14,559

and the the facility has a top speed for

464
00:18:20,230 --> 00:18:17,840
that model of about 27 000 miles per

465
00:18:21,909 --> 00:18:20,240
hour whoa for real so it's really moving

466
00:18:23,990 --> 00:18:21,919
wow

467
00:18:27,190 --> 00:18:24,000
and it it's really to reproduce the

468
00:18:29,669 --> 00:18:27,200
conditions um of the capsule coming back

469
00:18:31,990 --> 00:18:29,679
into the earth's atmosphere or or the

470
00:18:33,430 --> 00:18:32,000
atmosphere of uh of another world and

471
00:18:35,590 --> 00:18:33,440
traveling from say a distance as the

472
00:18:36,870 --> 00:18:35,600
moon i mean this was a unique problem

473
00:18:38,870 --> 00:18:36,880
for when you're sending something really

474
00:18:40,830 --> 00:18:38,880
far away and it's coming back and a much

475
00:18:43,350 --> 00:18:40,840
faster space right

476
00:18:45,830 --> 00:18:43,360
right we have an image don't we of what

477
00:18:48,070 --> 00:18:45,840
they would see yeah taking

478
00:18:49,430 --> 00:18:48,080
high-speed photos of that i think tell

479
00:18:50,630 --> 00:18:49,440
us what that's all about so you're

480
00:18:53,350 --> 00:18:50,640
looking at

481
00:18:55,510 --> 00:18:53,360
an image of the shock wave that's coming

482
00:18:58,789 --> 00:18:55,520
off of that little tiny model as it goes

483
00:19:01,350 --> 00:18:58,799
down uh down the tube and in this image

484
00:19:03,909 --> 00:19:01,360
the the capsule is traveling from right

485
00:19:05,590 --> 00:19:03,919
to left right so

486
00:19:07,750 --> 00:19:05,600
as it comes into the atmosphere this

487
00:19:10,070 --> 00:19:07,760
shock wave is created and we talked

488
00:19:11,909 --> 00:19:10,080

earlier about how this blunt shape on

489
00:19:13,909 --> 00:19:11,919
the end of the capsule protects it from

490
00:19:15,590 --> 00:19:13,919
the heat here you can see it actually is

491
00:19:18,630 --> 00:19:15,600
making this layer the shock wave is

492
00:19:20,950 --> 00:19:18,640
making a layer around the capsule that

493
00:19:22,950 --> 00:19:20,960
that's protecting it from

494
00:19:25,510 --> 00:19:22,960
the heat generated by friction as it

495
00:19:27,350 --> 00:19:25,520
comes into the atmosphere and so it's an

496
00:19:29,270 --> 00:19:27,360
amazing photo to see

497
00:19:31,590 --> 00:19:29,280
you can you know this is this was you

498
00:19:33,430 --> 00:19:31,600
know back in the you know pre-digital

499
00:19:35,750 --> 00:19:33,440
age and so they had

500
00:19:38,390 --> 00:19:35,760
cameras set up down the tunnel

501
00:19:40,950 --> 00:19:38,400
to snap pictures as as the thing was

502
00:19:42,310 --> 00:19:40,960
flying down it amazing that is amazing

503
00:19:44,390 --> 00:19:42,320
we actually have a comment here from

504
00:19:48,390 --> 00:19:44,400
quartz saying amazing how far we have

505
00:19:51,669 --> 00:19:49,590
it really is

506
00:19:54,150 --> 00:19:51,679
50 years is not that long it's not that

507
00:19:56,230 --> 00:19:54,160
long and just you know yeah

508
00:19:57,430 --> 00:19:56,240
old morton says awesome stream nasa

509
00:19:59,590 --> 00:19:57,440
thank you

510
00:20:00,630 --> 00:19:59,600
yay thanks for watching

511
00:20:03,750 --> 00:20:00,640
um

512
00:20:06,870 --> 00:20:03,760
i had another comment to share

513
00:20:09,909 --> 00:20:06,880

i'm over the moon for the new moon

514
00:20:13,830 --> 00:20:12,070
so are we

515
00:20:16,470 --> 00:20:13,840
excellent all right james did you bring

516
00:20:29,909 --> 00:20:16,480
anything else for us uh yeah we've got

517
00:20:34,789 --> 00:20:32,310
it's encased in glass what is that james

518
00:20:35,990 --> 00:20:34,799
tell us what that is that is a genuine

519
00:20:38,789 --> 00:20:36,000
moon rock

520
00:20:41,430 --> 00:20:38,799
wow this one was rock

521
00:20:45,510 --> 00:20:41,440
returned by apollo 15

522
00:20:46,789 --> 00:20:45,520
and uh weighs under a pound about 0.3

523
00:20:49,510 --> 00:20:46,799
pounds

524
00:20:51,590 --> 00:20:49,520
um and it's still like

525
00:20:52,870 --> 00:20:51,600
i don't know i get shivers every time i

526
00:20:55,590 --> 00:20:52,880
see it it's it's

527
00:20:56,630 --> 00:20:55,600
it's so weird just to to wrap your mind

528
00:20:58,230 --> 00:20:56,640
around

529
00:20:59,870 --> 00:20:58,240
you know that rock's been a long way

530
00:21:02,950 --> 00:20:59,880
right yeah it's

531
00:21:04,070 --> 00:21:02,960
3.4 billion years old

532
00:21:04,950 --> 00:21:04,080
i mean

533
00:21:07,909 --> 00:21:04,960
that's

534
00:21:12,230 --> 00:21:07,919
kind of the age of the first life

535
00:21:17,029 --> 00:21:14,549
um yeah the the moon is this treasure

536
00:21:18,710 --> 00:21:17,039
trove of science the moon preserves the

537
00:21:20,630 --> 00:21:18,720
ancient history of the of the solar

538
00:21:23,029 --> 00:21:20,640

system and uh

539
00:21:25,190 --> 00:21:23,039
even today researchers applied to nasa

540
00:21:27,750 --> 00:21:25,200
all over the world to look at samples of

541
00:21:29,350 --> 00:21:27,760
the apollo moon rocks oh yeah and it's

542
00:21:31,190 --> 00:21:29,360
still we're still

543
00:21:33,830 --> 00:21:31,200
learning new new things

544
00:21:35,750 --> 00:21:33,840
wow i love it that in a way it kind of

545
00:21:37,590 --> 00:21:35,760
just looks like a rock because that just

546
00:21:39,830 --> 00:21:37,600
reminds me that

547
00:21:41,590 --> 00:21:39,840
these objects and places in space are

548
00:21:43,990 --> 00:21:41,600
part of our solar system you know just

549
00:21:45,590 --> 00:21:44,000
like earth and what are all the same

550
00:21:48,230 --> 00:21:45,600
places i'm noticing that i don't know

551
00:21:53,590 --> 00:21:48,240
comes across on the on the video right

552
00:21:57,590 --> 00:21:55,990
and and i i'm looking at the monitor in

553
00:21:59,990 --> 00:21:57,600
the studio and i'm not sure that that

554
00:22:01,750 --> 00:22:00,000
really comes across it is it is not just

555
00:22:03,750 --> 00:22:01,760
this gray lump that it appears like

556
00:22:05,750 --> 00:22:03,760
there's some really neat stuff going on

557
00:22:07,430 --> 00:22:05,760
that that just kind of brings it brings

558
00:22:10,870 --> 00:22:07,440
it well i guess it brings it to life but

559
00:22:17,270 --> 00:22:14,549
but at the time back in the 1960s um

560
00:22:20,070 --> 00:22:17,280
we didn't know whether life was on other

561
00:22:21,909 --> 00:22:20,080
worlds and it's still a quest that nasa

562
00:22:24,390 --> 00:22:21,919
and the humanities looking for are we

563
00:22:26,549 --> 00:22:24,400

alone yeah yeah and when the apollo

564
00:22:28,470 --> 00:22:26,559
samples were returned ames was one of

565
00:22:30,789 --> 00:22:28,480
two nasa centers

566
00:22:32,230 --> 00:22:30,799
that actually analyzed uh the samples

567
00:22:35,110 --> 00:22:32,240
and looked for

568
00:22:37,110 --> 00:22:35,120
whether or not they actually had life

569
00:22:38,470 --> 00:22:37,120
or signs of life that's so cool i didn't

570
00:22:41,350 --> 00:22:38,480
know that and how did they how did they

571
00:22:44,390 --> 00:22:41,360
do it well i think we actually have some

572
00:22:46,310 --> 00:22:44,400
footage of this we do yeah here in our

573
00:22:50,950 --> 00:22:46,320
archives

574
00:22:52,630 --> 00:22:50,960
adams there's some uh recently

575
00:22:55,190 --> 00:22:52,640
rediscovered footage we're seeing it

576
00:22:56,310 --> 00:22:55,200
here now um what's going on here kim

577
00:22:59,430 --> 00:22:56,320
really what are we

578
00:23:01,350 --> 00:22:59,440
oh so um this is apollo 11 soil samples

579
00:23:03,750 --> 00:23:01,360
that brought to the ames lunar

580
00:23:06,630 --> 00:23:03,760
biological laboratory and they're being

581
00:23:08,789 --> 00:23:06,640
held in a sterile condition of these

582
00:23:11,110 --> 00:23:08,799
glove boxes in a clean room and you see

583
00:23:12,710 --> 00:23:11,120
petri dishes and what they're trying to

584
00:23:16,870 --> 00:23:12,720
do is

585
00:23:19,430 --> 00:23:16,880
see if life grows on the lunar samples

586
00:23:21,430 --> 00:23:19,440
and they're mimicking conditions for

587
00:23:24,950 --> 00:23:21,440
which life has been known to grow on

588
00:23:25,909 --> 00:23:24,960

earth bacteria microbes and the like

589
00:23:33,350 --> 00:23:25,919
and

590
00:23:35,270 --> 00:23:33,360
you know it's it's a very dedicated

591
00:23:37,430 --> 00:23:35,280
systematic study and it laid the

592
00:23:39,510 --> 00:23:37,440
groundwork for the beginning of what we

593
00:23:42,950 --> 00:23:39,520
call astrobiology at the times called

594
00:23:43,909 --> 00:23:42,960
exobiology the study of the search for

595
00:23:45,590 --> 00:23:43,919
life

596
00:23:48,390 --> 00:23:45,600
um elsewhere in the universe and the

597
00:23:49,990 --> 00:23:48,400
study of the origin of life here wow and

598
00:23:52,070 --> 00:23:50,000
the techniques here you know they they

599
00:23:54,149 --> 00:23:52,080
learned that the um the uh the lunar

600
00:23:55,269 --> 00:23:54,159
cyber samples did not have life but they

601
00:23:57,350 --> 00:23:55,279
didn't know at the time until they'd

602
00:23:59,110 --> 00:23:57,360
done the experiments right you had to

603
00:24:01,029 --> 00:23:59,120
check right yeah and even so still

604
00:24:03,750 --> 00:24:01,039
laying the foundation for more science

605
00:24:04,789 --> 00:24:03,760
research yeah the techniques and that

606
00:24:06,630 --> 00:24:04,799
you know that techniques and other

607
00:24:08,789 --> 00:24:06,640
techniques looking for amino acids and

608
00:24:10,789 --> 00:24:08,799
um carbon compounds and you know the

609
00:24:12,390 --> 00:24:10,799
stuff of life the stuff of life

610
00:24:13,990 --> 00:24:12,400
led to the development of the

611
00:24:17,430 --> 00:24:14,000
instruments that flew on viking that

612
00:24:19,269 --> 00:24:17,440
went to mars in 1976 to look for life on

613
00:24:20,070 --> 00:24:19,279

mars and then you know

614
00:24:21,909 --> 00:24:20,080
uh

615
00:24:23,909 --> 00:24:21,919
several packages that were also

616
00:24:25,510 --> 00:24:23,919
exploring life you know

617
00:24:27,110 --> 00:24:25,520
on other places in our solar system

618
00:24:29,350 --> 00:24:27,120
because our knowledge of the solar

619
00:24:31,350 --> 00:24:29,360
system today is way different it's a

620
00:24:33,669 --> 00:24:31,360
much beautiful more diverse solar system

621
00:24:34,870 --> 00:24:33,679
than the scientists back in the 60s

622
00:24:36,549 --> 00:24:34,880
could have ever imagined because we've

623
00:24:38,070 --> 00:24:36,559
been sending all these robotic explorers

624
00:24:39,350 --> 00:24:38,080
over the last couple of decades out to

625
00:24:41,269 --> 00:24:39,360
pluto

626
00:24:44,390 --> 00:24:41,279
out through the giant planets the moons

627
00:24:46,390 --> 00:24:44,400
of the giant planets it is an ex amazing

628
00:24:48,310 --> 00:24:46,400
place to explore we're still looking

629
00:24:50,470 --> 00:24:48,320
today and we're still looking and we

630
00:24:53,190 --> 00:24:50,480
have yet to find you know our life on

631
00:24:55,750 --> 00:24:53,200
this pale blue dot our blue oasis world

632
00:24:57,029 --> 00:24:55,760
here is still one of a kind yeah we're

633
00:24:59,430 --> 00:24:57,039
still looking

634
00:25:01,510 --> 00:24:59,440
yeah more to come you know

635
00:25:02,390 --> 00:25:01,520
always more to look forward to

636
00:25:04,549 --> 00:25:02,400
yes

637
00:25:06,149 --> 00:25:04,559
um i have a few moon wrap questions

638
00:25:07,110 --> 00:25:06,159

maybe we could take these as like rapid

639
00:25:07,909 --> 00:25:07,120
fire

640
00:25:09,190 --> 00:25:07,919
okay

641
00:25:10,230 --> 00:25:09,200
um

642
00:25:11,669 --> 00:25:10,240
first of all what is the difference

643
00:25:13,350 --> 00:25:11,679
between moon rocks and earth rocks and

644
00:25:15,029 --> 00:25:13,360
to go with that are moon rocks more

645
00:25:16,710 --> 00:25:15,039
porous compared to the rocks on earth or

646
00:25:17,909 --> 00:25:16,720
are they just about the same

647
00:25:21,110 --> 00:25:17,919
how do you know

648
00:25:23,110 --> 00:25:21,120
it is a range so short answer uh the

649
00:25:25,510 --> 00:25:23,120
rocks on the moon are very similar to

650
00:25:27,750 --> 00:25:25,520
that on earth so we have igneous that

651
00:25:28,950 --> 00:25:27,760
were made in a volcano we have

652
00:25:31,110 --> 00:25:28,960
metamorphic that we made with high

653
00:25:33,110 --> 00:25:31,120
temperatures and high pressures we have

654
00:25:34,870 --> 00:25:33,120
not quite sedimentary which were made on

655
00:25:36,310 --> 00:25:34,880
the earth with wind and water on the

656
00:25:37,990 --> 00:25:36,320
moon they're called breccias they're

657
00:25:40,390 --> 00:25:38,000
they're shocked so we have slightly

658
00:25:42,870 --> 00:25:40,400
different types the moon on average is

659
00:25:44,789 --> 00:25:42,880
lighter in terms of its its rocks than

660
00:25:45,990 --> 00:25:44,799
the earth it's less dense oh um this can

661
00:25:47,430 --> 00:25:46,000
lead to another discussion of how the

662
00:25:49,430 --> 00:25:47,440
earth moon formed so they're very

663
00:25:50,470 --> 00:25:49,440

similar um but they're slightly also

664
00:25:52,149 --> 00:25:50,480
different but they're made of the same

665
00:25:53,990 --> 00:25:52,159
things we're all made out of stardust

666
00:25:56,950 --> 00:25:54,000
essentially you know at the end of the

667
00:25:58,870 --> 00:25:56,960
day nice perfect um history question for

668
00:26:00,230 --> 00:25:58,880
james before you have to go

669
00:26:02,710 --> 00:26:00,240
did the original mission control

670
00:26:06,549 --> 00:26:02,720
computers still work do you know

671
00:26:08,789 --> 00:26:06,559
um the computers themselves

672
00:26:11,669 --> 00:26:08,799
images of them have been used

673
00:26:13,190 --> 00:26:11,679
to recreate the mission control

674
00:26:14,549 --> 00:26:13,200
room in

675
00:26:17,110 --> 00:26:14,559
in houston

676
00:26:19,430 --> 00:26:17,120
and i would actually have to have to

677
00:26:21,510 --> 00:26:19,440
check um but i know that the the

678
00:26:23,669 --> 00:26:21,520
recreation was done some of the some of

679
00:26:25,430 --> 00:26:23,679
the material in there is original and

680
00:26:27,750 --> 00:26:25,440
other stuff was actually just uh sourced

681
00:26:30,470 --> 00:26:27,760
on ebay so the the coffee pots the

682
00:26:32,950 --> 00:26:30,480
cigarette you know the ash trays all of

683
00:26:35,590 --> 00:26:32,960
that stuff to to really give

684
00:26:37,029 --> 00:26:35,600
the feel of what mission control was

685
00:26:39,909 --> 00:26:37,039
like during that time

686
00:26:42,710 --> 00:26:39,919
and the flight director gene krantz when

687
00:26:44,470 --> 00:26:42,720
he went in just a few weeks ago and saw

688
00:26:46,230 --> 00:26:44,480

this installation

689
00:26:48,470 --> 00:26:46,240
uh i think he made the comment with

690
00:26:50,789 --> 00:26:48,480
something like he could hear the voices

691
00:26:53,669 --> 00:26:50,799
of all the controllers at their computer

692
00:26:56,310 --> 00:26:53,679
stations at their monitors um that

693
00:26:59,029 --> 00:26:56,320
recreation was so spot-on that it just

694
00:27:01,190 --> 00:26:59,039
brought back um

695
00:27:02,310 --> 00:27:01,200
this really intense moment of a memory

696
00:27:04,070 --> 00:27:02,320
that you know

697
00:27:06,149 --> 00:27:04,080
um how could you not forget so they

698
00:27:09,350 --> 00:27:06,159
really got it right wow yeah yeah yeah

699
00:27:11,590 --> 00:27:09,360
yeah all beautiful excellent

700
00:27:13,110 --> 00:27:11,600
one last comment before the moon rock

701
00:27:15,830 --> 00:27:13,120
has to go away

702
00:27:17,630 --> 00:27:15,840
mr gm emerging not sure

703
00:27:25,510 --> 00:27:17,640
moon rock

704
00:27:31,350 --> 00:27:28,070
there's been samples that have been kept

705
00:27:32,789 --> 00:27:31,360
in um have not been touched in 47 50

706
00:27:34,310 --> 00:27:32,799
years that are being looked at

707
00:27:35,990 --> 00:27:34,320
researchers say because our laboratory

708
00:27:38,470 --> 00:27:36,000
equipment today is much more

709
00:27:39,909 --> 00:27:38,480
sophisticated in advance so

710
00:27:42,149 --> 00:27:39,919
i'm thanking the scientists of the

711
00:27:44,950 --> 00:27:42,159
previous generation who left this gift

712
00:27:47,430 --> 00:27:44,960
to us today so that we can continue our

713
00:27:49,669 --> 00:27:47,440

our search of knowledge and when we get

714
00:27:51,909 --> 00:27:49,679
even different moon mocks from different

715
00:27:53,350 --> 00:27:51,919
places of the moon we will be able to

716
00:27:54,549 --> 00:27:53,360
answer some pretty tough questions that

717
00:27:56,470 --> 00:27:54,559
we haven't been able to answer the moon

718
00:27:57,669 --> 00:27:56,480
rocks gave us a huge leap in

719
00:27:59,029 --> 00:27:57,679
understanding and we're still being

720
00:28:01,190 --> 00:27:59,039
studied today that's awesome amazing

721
00:28:02,310 --> 00:28:01,200
time capsules time capsules yeah there

722
00:28:04,230 --> 00:28:02,320
are teams at aims that are going to

723
00:28:06,310 --> 00:28:04,240
study those samples so we'll be able to

724
00:28:09,029 --> 00:28:06,320
provide an update yes sometime in the

725
00:28:11,750 --> 00:28:09,039
future fun times yeah

726
00:28:13,590 --> 00:28:11,760
yeah well thank you james for joining us

727
00:28:15,510 --> 00:28:13,600
and taking us down memory lane with the

728
00:28:17,990 --> 00:28:15,520
history yeah take care

729
00:28:21,190 --> 00:28:18,000
we'll see you another time

730
00:28:23,110 --> 00:28:21,200
and uh you all don't forget to join us

731
00:28:26,230 --> 00:28:23,120
in celebrating the 50th anniversary of

732
00:28:28,389 --> 00:28:26,240
the apollo 11 moon landing and hear

733
00:28:32,070 --> 00:28:28,399
about our future plans to go forward to

734
00:28:35,269 --> 00:28:32,080
the moon and on to mars by tuning into a

735
00:28:37,909 --> 00:28:35,279
special two-hour live nasa television

736
00:28:40,070 --> 00:28:37,919
broadcast tomorrow at 10 a.m

737
00:28:41,669 --> 00:28:40,080
pacific time learn more about the show

738
00:28:44,470 --> 00:28:41,679

and how to watch by going to

739
00:28:46,710 --> 00:28:44,480
www.nasa.gov

740
00:28:48,389 --> 00:28:46,720
forward slash apollo 40th and don't

741
00:28:50,870 --> 00:28:48,399
forget to click on events

742
00:28:53,750 --> 00:28:50,880
apollo 50th in fact but

743
00:28:59,990 --> 00:28:53,760
did i say 40th yes i missed 50th

744
00:29:04,870 --> 00:29:01,750
exactly so

745
00:29:06,310 --> 00:29:04,880
yeah let's talk about our uh next giant

746
00:29:09,110 --> 00:29:06,320
leap

747
00:29:12,630 --> 00:29:09,120
artemis yes artemis

748
00:29:14,549 --> 00:29:12,640
so what what is artemis

749
00:29:18,230 --> 00:29:14,559
why do we call it artemis the art

750
00:29:19,590 --> 00:29:18,240
artemis was uh apollo's twin sister

751
00:29:21,990 --> 00:29:19,600
right so if you know your greek

752
00:29:23,830 --> 00:29:22,000
mythology mythology because it's latin

753
00:29:26,149 --> 00:29:23,840
mythology it's diana but it's greek

754
00:29:28,950 --> 00:29:26,159
mythology

755
00:29:33,190 --> 00:29:31,190
i like the words they they're evocative

756
00:29:34,710 --> 00:29:33,200
i mean she's the goddess of the moon

757
00:29:37,669 --> 00:29:34,720
i mean it's

758
00:29:39,510 --> 00:29:37,679
very appropriate and uh and also with

759
00:29:41,990 --> 00:29:39,520
the artemis charge we're going to place

760
00:29:44,230 --> 00:29:42,000
the first woman on the moon yes

761
00:29:48,389 --> 00:29:44,240
with the next crew to go to the moon yes

762
00:29:53,269 --> 00:29:48,399
and um and amazingly for womankind

763
00:29:55,350 --> 00:29:53,279

and humankind absolutely it's about time

764
00:29:57,430 --> 00:29:55,360
exactly you know there are young women

765
00:30:00,789 --> 00:29:57,440
out there students young girls who are

766
00:30:02,470 --> 00:30:00,799
like watch out moon yeah coming for you

767
00:30:04,549 --> 00:30:02,480
and since we're having our artemis is a

768
00:30:06,870 --> 00:30:04,559
sustainable lunar exploration program

769
00:30:08,470 --> 00:30:06,880
it's just different than apollo apollo

770
00:30:10,070 --> 00:30:08,480
was like a road trip i mean it did an

771
00:30:11,830 --> 00:30:10,080
amazing thing

772
00:30:13,830 --> 00:30:11,840
it was road trip to the moon

773
00:30:16,310 --> 00:30:13,840
it's a huge engineering challenge just

774
00:30:18,470 --> 00:30:16,320
to even conceive going from sub-orbital

775
00:30:20,630 --> 00:30:18,480
flight to going to the moon and back

776
00:30:22,950 --> 00:30:20,640
in less than 10 years and to build that

777
00:30:25,430 --> 00:30:22,960
whole infrastructure with a very elegant

778
00:30:28,070 --> 00:30:25,440
but complicated logistical solution was

779
00:30:30,149 --> 00:30:28,080
immense i mean artemis is different

780
00:30:32,310 --> 00:30:30,159
we're doing not doing it alone it's no

781
00:30:34,870 --> 00:30:32,320
longer the realm of governments and

782
00:30:36,470 --> 00:30:34,880
superpowers it's a different era yeah we

783
00:30:39,110 --> 00:30:36,480
have commercial and international

784
00:30:41,590 --> 00:30:39,120
partners sustainable presence

785
00:30:44,070 --> 00:30:41,600
um and you know in the pursuit of

786
00:30:47,350 --> 00:30:44,080
knowledge and the pursuit of innovation

787
00:30:49,590 --> 00:30:47,360
with opportunities for economic and you

788
00:30:51,430 --> 00:30:49,600

know more spin-offs you know the apollo

789
00:30:52,950 --> 00:30:51,440
program gave us a lot of spin-offs what

790
00:30:55,430 --> 00:30:52,960
we call things that we use today as a

791
00:30:57,269 --> 00:30:55,440
result of the research the research and

792
00:30:59,430 --> 00:30:57,279
the engineering technology development

793
00:31:02,070 --> 00:30:59,440
that well and it's not just to go right

794
00:31:04,310 --> 00:31:02,080
the objective of apollo was to go to the

795
00:31:06,310 --> 00:31:04,320
moon and safely return right but that

796
00:31:08,950 --> 00:31:06,320
was that was the objective right with

797
00:31:11,029 --> 00:31:08,960
artemis it's to have a longer-term

798
00:31:13,509 --> 00:31:11,039
sustained presence

799
00:31:15,590 --> 00:31:13,519
and of course it's the path to mars

800
00:31:17,990 --> 00:31:15,600
which is the next giant leap

801
00:31:19,990 --> 00:31:18,000
so it's f as kimberly said it's

802
00:31:21,669 --> 00:31:20,000
fundamentally a different approach to

803
00:31:23,269 --> 00:31:21,679
then apollo was

804
00:31:25,029 --> 00:31:23,279
you know okay it's the same basic

805
00:31:27,190 --> 00:31:25,039
destination but

806
00:31:29,830 --> 00:31:27,200
we're not going to land directly on the

807
00:31:31,909 --> 00:31:29,840
moon we're going to the gateway first

808
00:31:33,990 --> 00:31:31,919
that'll be orbiting an orbiting space

809
00:31:36,230 --> 00:31:34,000
station around the moon and then going

810
00:31:38,789 --> 00:31:36,240
down to the surface from gateway

811
00:31:41,269 --> 00:31:38,799
we're going to the south pole

812
00:31:43,269 --> 00:31:41,279
which is a very different place in many

813
00:31:45,269 --> 00:31:43,279

respects more challenging than where

814
00:31:47,509 --> 00:31:45,279
apollo was landing

815
00:31:50,549 --> 00:31:47,519
so there's many fascinating different

816
00:31:52,389 --> 00:31:50,559
things that are going into artemis that

817
00:31:53,990 --> 00:31:52,399
were really never

818
00:31:55,830 --> 00:31:54,000
something that was even approachable

819
00:31:57,590 --> 00:31:55,840
back in the apollo era

820
00:31:59,750 --> 00:31:57,600
it's a big big stretch from where we

821
00:32:01,830 --> 00:31:59,760
were at with apollo and of course we

822
00:32:03,509 --> 00:32:01,840
have this longer objective than of

823
00:32:06,470 --> 00:32:03,519
taking what we learn

824
00:32:08,149 --> 00:32:06,480
from the moon portion and taking that

825
00:32:10,870 --> 00:32:08,159
with us to mars

826
00:32:11,990 --> 00:32:10,880
nice summary lots of challenges

827
00:32:14,070 --> 00:32:12,000
there are a bunch of questions that

828
00:32:16,070 --> 00:32:14,080
we'll get to about the goals and what's

829
00:32:18,230 --> 00:32:16,080
different and i think you just gave a

830
00:32:21,190 --> 00:32:18,240
good overview to get us started of

831
00:32:23,990 --> 00:32:21,200
course a huge part um and really kind of

832
00:32:26,070 --> 00:32:24,000
the first and biggest step for artemis

833
00:32:27,750 --> 00:32:26,080
right is how how do you launch how do

834
00:32:29,669 --> 00:32:27,760
you get there yeah right we're talking

835
00:32:31,990 --> 00:32:29,679
about carrying a lot of material we

836
00:32:35,590 --> 00:32:32,000
talked earlier about the saturn v yes

837
00:32:37,750 --> 00:32:35,600
well the big rocket for artemis is the

838
00:32:40,549 --> 00:32:37,760

space launch system sls

839
00:32:42,950 --> 00:32:40,559
right and sls is if you thought saturn v

840
00:32:45,029 --> 00:32:42,960
was impressive sls is even more

841
00:32:45,830 --> 00:32:45,039
impressive you can see some video of it

842
00:32:47,029 --> 00:32:45,840
here

843
00:32:50,310 --> 00:32:47,039
um

844
00:32:52,070 --> 00:32:50,320
so animation and animation

845
00:32:53,669 --> 00:32:52,080
the rockets and the the engines already

846
00:32:56,230 --> 00:32:53,679
being under a lot of tests right now

847
00:32:58,070 --> 00:32:56,240
right and a lot of this is um materials

848
00:32:59,830 --> 00:32:58,080
that we learned from doing the space

849
00:33:01,430 --> 00:32:59,840
shuttle missions

850
00:33:04,549 --> 00:33:01,440
so it's a little bit shorter than the

851
00:33:08,630 --> 00:33:04,559
saturn v it's 322 feet tall saturn v was

852
00:33:11,509 --> 00:33:08,640
363 feet so it's 41 feet shorter um

853
00:33:13,350 --> 00:33:11,519
but it's that's also a lot bigger than

854
00:33:15,350 --> 00:33:13,360
the space shuttle which is one we're

855
00:33:17,909 --> 00:33:15,360
used to flying right this shuttle is

856
00:33:18,630 --> 00:33:17,919
huge and it's only 184 feet tall

857
00:33:20,789 --> 00:33:18,640
so

858
00:33:22,950 --> 00:33:20,799
this is as we said earlier saturn v is

859
00:33:25,430 --> 00:33:22,960
taller than the statue of liberty and

860
00:33:27,029 --> 00:33:25,440
right so is sls right it's it's almost

861
00:33:28,549 --> 00:33:27,039
20.

862
00:33:30,149 --> 00:33:28,559
it's going to be when when we have it

863
00:33:33,350 --> 00:33:30,159

flying it's going to be the biggest

864
00:33:35,190 --> 00:33:33,360
rocket ever built wow so capability even

865
00:33:37,669 --> 00:33:35,200
take payloads to saturn and jupiter i

866
00:33:39,830 --> 00:33:37,679
mean this is a very capable machine we

867
00:33:42,070 --> 00:33:39,840
talked about how much um how much thrust

868
00:33:44,470 --> 00:33:42,080
and how much payload the saturn 5 had

869
00:33:47,590 --> 00:33:44,480
sls is over a million pounds of thrust

870
00:33:51,269 --> 00:33:47,600
more powerful oh wow right so the sls

871
00:33:53,350 --> 00:33:51,279
can deliver more cargo to the moon

872
00:33:56,310 --> 00:33:53,360
then the shuttle could take to low earth

873
00:33:57,830 --> 00:33:56,320
orbit oh wow wow that's just an enormous

874
00:34:00,230 --> 00:33:57,840
capability

875
00:34:03,269 --> 00:34:00,240
and as can really know to it takes us to

876
00:34:05,269 --> 00:34:03,279
lots of other destinations in the future

877
00:34:07,830 --> 00:34:05,279
this is a huge capability it's a unique

878
00:34:09,990 --> 00:34:07,840
capability it's not something you need

879
00:34:11,109 --> 00:34:10,000
to put satellites into orbit for example

880
00:34:12,869 --> 00:34:11,119
you know it's for something more yeah

881
00:34:15,829 --> 00:34:12,879
it's really for this unique this very

882
00:34:17,750 --> 00:34:15,839
unique mission awesome very cool yeah um

883
00:34:19,829 --> 00:34:17,760
you have we have a comment here from

884
00:34:21,510 --> 00:34:19,839
king's throne when there are astronauts

885
00:34:22,389 --> 00:34:21,520
on the moon i will stand and wave at the

886
00:34:26,869 --> 00:34:22,399
moon

887
00:34:29,349 --> 00:34:26,879
i'm sure they'll be waving back

888
00:34:31,109 --> 00:34:29,359

i'll join you unless with artemis if i

889
00:34:32,230 --> 00:34:31,119
get my wish i want to land astronauts on

890
00:34:34,310 --> 00:34:32,240
the far side of the moon because we

891
00:34:36,310 --> 00:34:34,320
haven't been there yet

892
00:34:37,829 --> 00:34:36,320
in fact apollo only may have only gone

893
00:34:39,349 --> 00:34:37,839
to about four percent of the surface of

894
00:34:42,310 --> 00:34:39,359
the moon there's a lot of

895
00:34:44,710 --> 00:34:42,320
terra sorry luna incognita

896
00:34:46,149 --> 00:34:44,720
to channel my latin um that we have the

897
00:34:48,230 --> 00:34:46,159
unknown territories on the moon that we

898
00:34:50,069 --> 00:34:48,240
haven't seen we also have not yet been

899
00:34:52,310 --> 00:34:50,079
to the south pole right right which is

900
00:34:54,869 --> 00:34:52,320
the first destination

901
00:34:56,869 --> 00:34:54,879
and to remind everyone what exactly

902
00:34:59,589 --> 00:34:56,879
we're counting down up here

903
00:35:02,390 --> 00:34:59,599
this is the time until 2024 when the

904
00:35:04,390 --> 00:35:02,400
artemis mission will land people on at

905
00:35:07,829 --> 00:35:04,400
the south pole of the moon right

906
00:35:09,430 --> 00:35:07,839
there is a question someone was asking

907
00:35:11,589 --> 00:35:09,440
what's special about the lunar south

908
00:35:13,109 --> 00:35:11,599
pole could you tell us quickly what we

909
00:35:15,190 --> 00:35:13,119
might oh yeah

910
00:35:17,190 --> 00:35:15,200
just in the last 10 years our

911
00:35:18,710 --> 00:35:17,200
understanding of the moon

912
00:35:20,630 --> 00:35:18,720
flipped itself itself on the head and we

913
00:35:22,230 --> 00:35:20,640

learned that there's water on the moon i

914
00:35:24,310 --> 00:35:22,240
mean of the apollo generation we thought

915
00:35:25,589 --> 00:35:24,320
the moon was bone dry it turns out there

916
00:35:27,670 --> 00:35:25,599
is actually water moons actually all

917
00:35:29,829 --> 00:35:27,680
over the moon has different sources but

918
00:35:31,670 --> 00:35:29,839
the poles seem to have large quantities

919
00:35:34,230 --> 00:35:31,680
of water now we should we should know

920
00:35:36,230 --> 00:35:34,240
this is not liquid water correct yeah

921
00:35:38,390 --> 00:35:36,240
it's it's frozen water and water in

922
00:35:41,190 --> 00:35:38,400
different uh yeah frozen water crystals

923
00:35:43,430 --> 00:35:41,200
in the soils in the soil and so it's

924
00:35:45,109 --> 00:35:43,440
scientifically interesting because

925
00:35:46,710 --> 00:35:45,119
i shouldn't have been there and why is

926
00:35:49,670 --> 00:35:46,720
it there we'd like to know why it's

927
00:35:53,030 --> 00:35:49,680
there and where it is um but as from a

928
00:35:55,589 --> 00:35:53,040
human exploration it's a waters h2o can

929
00:35:59,190 --> 00:35:55,599
be used for hydrogen oxygen for fuel

930
00:36:01,510 --> 00:35:59,200
oxygen to to breathe so the pole going

931
00:36:03,430 --> 00:36:01,520
to the poles is a step in

932
00:36:04,470 --> 00:36:03,440
human exploration using resources off

933
00:36:06,069 --> 00:36:04,480
the land

934
00:36:08,230 --> 00:36:06,079
and the same techniques we'd use to

935
00:36:09,670 --> 00:36:08,240
harvest the moon water

936
00:36:11,589 --> 00:36:09,680
similar to what we do on mars because we

937
00:36:14,150 --> 00:36:11,599
know mars has subsurface frozen water as

938
00:36:15,670 --> 00:36:14,160

well okay so perfect training ground

939
00:36:17,829 --> 00:36:15,680
that's the big reason that's a big

940
00:36:21,670 --> 00:36:17,839
reason to go to the south pole softball

941
00:36:24,150 --> 00:36:21,680
is hard because you know um

942
00:36:26,630 --> 00:36:24,160
it's it's in a lot more shadow right the

943
00:36:28,790 --> 00:36:26,640
sunlight is a much lower angle

944
00:36:30,069 --> 00:36:28,800
so you have to really think about how

945
00:36:32,150 --> 00:36:30,079
you build your mission much more

946
00:36:34,390 --> 00:36:32,160
carefully um how do you generate

947
00:36:36,790 --> 00:36:34,400
electricity how do you stay warm

948
00:36:39,030 --> 00:36:36,800
there's a whole new set of challenges

949
00:36:43,030 --> 00:36:39,040
that were we really didn't have to worry

950
00:36:45,109 --> 00:36:43,040
too much about uh in the apollo missions

951
00:36:46,710 --> 00:36:45,119
and we like hard stuff

952
00:36:48,710 --> 00:36:46,720
and we do things because not because

953
00:36:50,950 --> 00:36:48,720
they're easy because they're hard yes

954
00:36:52,630 --> 00:36:50,960
and the artemis program will have humans

955
00:36:54,790 --> 00:36:52,640
on the moon for weeks at a time

956
00:36:56,390 --> 00:36:54,800
initially and culminating to months at a

957
00:36:59,109 --> 00:36:56,400
time i mean this is also different than

958
00:37:01,030 --> 00:36:59,119
apollo apollo was you know apollo 11 was

959
00:37:02,630 --> 00:37:01,040
two and a half hours on the surface 21

960
00:37:04,310 --> 00:37:02,640
hours just there on the surface twenty

961
00:37:05,990 --> 00:37:04,320
two and a half hours walking around

962
00:37:07,270 --> 00:37:06,000
um we most went up to three days on the

963
00:37:09,910 --> 00:37:07,280

surface so

964
00:37:11,829 --> 00:37:09,920
this is a very different um approach to

965
00:37:13,430 --> 00:37:11,839
being off world for long periods of time

966
00:37:14,950 --> 00:37:13,440
and how you do that from an engineering

967
00:37:17,030 --> 00:37:14,960
solution your power

968
00:37:18,310 --> 00:37:17,040
your fuel your water your air your

969
00:37:20,829 --> 00:37:18,320
energy

970
00:37:22,950 --> 00:37:20,839
the temperature extreme you'll

971
00:37:24,390 --> 00:37:22,960
experience uh

972
00:37:25,829 --> 00:37:24,400
they all can be overcome and they'll all

973
00:37:27,670 --> 00:37:25,839
be and the solutions are going to be

974
00:37:30,069 --> 00:37:27,680
amazing yeah excellent you answered a

975
00:37:31,670 --> 00:37:30,079
question from pi day what are some new

976
00:37:33,270 --> 00:37:31,680
difficulties with artemis that were not

977
00:37:35,589 --> 00:37:33,280
present during the apollo missions yeah

978
00:37:37,349 --> 00:37:35,599
long duration moderation that's maybe

979
00:37:40,069 --> 00:37:37,359
one of the biggest ones is we are

980
00:37:43,349 --> 00:37:40,079
sending humans out there for much longer

981
00:37:44,230 --> 00:37:43,359
periods of time um and they're beyond

982
00:37:46,710 --> 00:37:44,240
the

983
00:37:48,870 --> 00:37:46,720
shielding from radiation that's afforded

984
00:37:50,310 --> 00:37:48,880
by earth's magnetosphere so when

985
00:37:52,390 --> 00:37:50,320
astronauts are on the international

986
00:37:56,230 --> 00:37:52,400
space station for long periods of time

987
00:37:58,150 --> 00:37:56,240
right up to a year as the record

988
00:37:59,589 --> 00:37:58,160

that that's a challenging environment

989
00:38:01,510 --> 00:37:59,599
but it doesn't

990
00:38:04,790 --> 00:38:01,520
have the same degree of exposure to

991
00:38:07,349 --> 00:38:04,800
radiation that going out away from earth

992
00:38:09,270 --> 00:38:07,359
has and so that's one of the big hurdles

993
00:38:11,589 --> 00:38:09,280
so nasa is going to need a lot of

994
00:38:13,510 --> 00:38:11,599
doctors and biologists and people who

995
00:38:15,990 --> 00:38:13,520
study human physiology to work on

996
00:38:17,670 --> 00:38:16,000
mitigation and also to help with how

997
00:38:19,670 --> 00:38:17,680
humans the fragile point of

998
00:38:21,829 --> 00:38:19,680
long-duration space direct you know

999
00:38:24,150 --> 00:38:21,839
space exploration exploration and how

1000
00:38:26,870 --> 00:38:24,160
the human body behaves and reacts and

1001
00:38:28,870 --> 00:38:26,880
recovers yeah yeah from a very very

1002
00:38:29,990 --> 00:38:28,880
right somebody it's going to happen at

1003
00:38:32,950 --> 00:38:30,000
mars too

1004
00:38:35,430 --> 00:38:32,960
yeah yeah um this question from uh

1005
00:38:37,510 --> 00:38:35,440
sleepy underscore gary um some of your

1006
00:38:39,589 --> 00:38:37,520
answers already answered his question uh

1007
00:38:41,270 --> 00:38:39,599
what are the main scientific goals of

1008
00:38:42,790 --> 00:38:41,280
the artemis moon mission and answering

1009
00:38:45,109 --> 00:38:42,800
those questions are scientific and kind

1010
00:38:47,910 --> 00:38:45,119
of also or things that we want to you

1011
00:38:49,750 --> 00:38:47,920
know find out right those are our goals

1012
00:38:51,589 --> 00:38:49,760
yeah scientifically i mean some of the

1013
00:38:53,750 --> 00:38:51,599

biggest unanswered questions even after

1014
00:38:55,270 --> 00:38:53,760
processing the wonderful lunar samples

1015
00:38:56,630 --> 00:38:55,280
from apollo

1016
00:38:57,750 --> 00:38:56,640
we still

1017
00:38:59,589 --> 00:38:57,760
don't really know what happened during

1018
00:39:01,589 --> 00:38:59,599
the early phases of the early times of

1019
00:39:03,109 --> 00:39:01,599
our solar system because the rock

1020
00:39:05,109 --> 00:39:03,119
samples that we have

1021
00:39:06,390 --> 00:39:05,119
might have have a bias in it they might

1022
00:39:08,390 --> 00:39:06,400
not have been sampling some of the

1023
00:39:09,910 --> 00:39:08,400
oldest places on the moon so looking for

1024
00:39:11,910 --> 00:39:09,920
older rocks

1025
00:39:13,430 --> 00:39:11,920
how the moon's interior looks like we

1026
00:39:15,109 --> 00:39:13,440
would like to have samples of the moon

1027
00:39:17,510 --> 00:39:15,119
from the mantle something below the

1028
00:39:18,870 --> 00:39:17,520
crust oh yeah um that that will take

1029
00:39:20,230 --> 00:39:18,880
service going to different parts of the

1030
00:39:22,310 --> 00:39:20,240
moon where we can actually get to the

1031
00:39:25,109 --> 00:39:22,320
mantle and perhaps we can understand how

1032
00:39:26,470 --> 00:39:25,119
that moon formed and how it cooled

1033
00:39:28,790 --> 00:39:26,480
um and

1034
00:39:30,550 --> 00:39:28,800
the moon also um potentially could tell

1035
00:39:32,470 --> 00:39:30,560
us what happened with our early sun

1036
00:39:33,910 --> 00:39:32,480
we're interested in how the sun behaved

1037
00:39:35,990 --> 00:39:33,920
during the early solar system and this

1038
00:39:37,829 --> 00:39:36,000

can help us understand extra solar

1039
00:39:39,829 --> 00:39:37,839
planet systems where we're looking at

1040
00:39:42,390 --> 00:39:39,839
planets around other stars today you

1041
00:39:43,990 --> 00:39:42,400
know more planets and stars out there so

1042
00:39:45,750 --> 00:39:44,000
our view of the universe is changing and

1043
00:39:49,109 --> 00:39:45,760
we have our solar system in our backyard

1044
00:39:51,109 --> 00:39:49,119
here the moon has um uh it has the

1045
00:39:52,950 --> 00:39:51,119
answers to some of these questions

1046
00:39:54,630 --> 00:39:52,960
awesome the early phases there's also

1047
00:39:57,190 --> 00:39:54,640
the basic science around you know human

1048
00:39:59,589 --> 00:39:57,200
physiology right which is as we said you

1049
00:40:02,150 --> 00:39:59,599
know how how does the human body respond

1050
00:40:04,309 --> 00:40:02,160
radiation exposure to you know long-term

1051
00:40:06,870 --> 00:40:04,319
deprivation of gravity uh all these

1052
00:40:09,430 --> 00:40:06,880
things i think those are really basic

1053
00:40:11,030 --> 00:40:09,440
questions that are important for our

1054
00:40:13,510 --> 00:40:11,040
eventual journey to mars but they're

1055
00:40:16,309 --> 00:40:13,520
also you know the the just the basic

1056
00:40:18,790 --> 00:40:16,319
knowledge that's often really helpful in

1057
00:40:19,910 --> 00:40:18,800
unexpected ways for improving life on

1058
00:40:22,550 --> 00:40:19,920
earth

1059
00:40:23,829 --> 00:40:22,560
and as a astrophysicist i would be amiss

1060
00:40:25,190 --> 00:40:23,839
if i didn't say i'm gonna would love to

1061
00:40:26,790 --> 00:40:25,200
put a telescope on the far side of the

1062
00:40:27,990 --> 00:40:26,800
moon

1063
00:40:29,430 --> 00:40:28,000

up a different range of the

1064
00:40:31,990 --> 00:40:29,440
electromagnetic spectrum that we have

1065
00:40:33,829 --> 00:40:32,000
not explored before because it shields

1066
00:40:35,750 --> 00:40:33,839
from the radio emissions from the earth

1067
00:40:37,589 --> 00:40:35,760
so it becomes a new window into the

1068
00:40:39,750 --> 00:40:37,599
universe just right in our backyard

1069
00:40:43,109 --> 00:40:39,760
because the far side is is facing away

1070
00:40:44,150 --> 00:40:43,119
from us and we can make it really big

1071
00:40:45,829 --> 00:40:44,160
nice

1072
00:40:48,870 --> 00:40:45,839
maybe you'll get your telescope i might

1073
00:40:52,390 --> 00:40:49,750
nice

1074
00:40:55,510 --> 00:40:52,400
speaking of human bodies what kind of

1075
00:40:58,550 --> 00:40:55,520
space suits should be used big and bulky

1076
00:40:59,829 --> 00:40:58,560
but safe or small tight but flexible

1077
00:41:02,069 --> 00:40:59,839
because there's actually been some

1078
00:41:03,670 --> 00:41:02,079
really exciting work uh done exactly in

1079
00:41:05,510 --> 00:41:03,680
this area

1080
00:41:07,270 --> 00:41:05,520
and there's a number of different

1081
00:41:09,430 --> 00:41:07,280
designs that are still being considered

1082
00:41:11,589 --> 00:41:09,440
but they kind of hit both ends of that

1083
00:41:14,150 --> 00:41:11,599
spectrum right so some of them look like

1084
00:41:15,910 --> 00:41:14,160
the more traditional little bulkier suit

1085
00:41:18,470 --> 00:41:15,920
because it offers a lot of protection

1086
00:41:20,710 --> 00:41:18,480
from the environment some of them are a

1087
00:41:22,069 --> 00:41:20,720
little more streamlined and sleeker

1088
00:41:23,910 --> 00:41:22,079

because they're just easier to walk

1089
00:41:25,670 --> 00:41:23,920
around in and do things

1090
00:41:27,030 --> 00:41:25,680
and get stuff done

1091
00:41:28,150 --> 00:41:27,040
and they just they just don't weigh as

1092
00:41:30,150 --> 00:41:28,160
much

1093
00:41:32,230 --> 00:41:30,160
but i think the jury's still out as to

1094
00:41:35,030 --> 00:41:32,240
which is the preferred one right now

1095
00:41:36,790 --> 00:41:35,040
there it's an area of ongoing research

1096
00:41:38,470 --> 00:41:36,800
and development yeah there's a cool idea

1097
00:41:39,910 --> 00:41:38,480
of a particular design of one of the

1098
00:41:41,349 --> 00:41:39,920
landers on the moon to deal with the

1099
00:41:43,109 --> 00:41:41,359
lunar dust which is a kind of a

1100
00:41:45,030 --> 00:41:43,119
hazardous glass like because there's no

1101
00:41:47,349 --> 00:41:45,040
wind or water on the moon flowing water

1102
00:41:49,109 --> 00:41:47,359
to to smooth it out and one of them has

1103
00:41:50,630 --> 00:41:49,119
you sort of you're in your your

1104
00:41:53,190 --> 00:41:50,640
spacesuit and you go in and you leave

1105
00:41:54,710 --> 00:41:53,200
your face spacesuit on the outside

1106
00:41:56,069 --> 00:41:54,720
you know you kind of

1107
00:41:57,510 --> 00:41:56,079
cloak or something and then yeah

1108
00:41:59,510 --> 00:41:57,520
therefore the dust doesn't get into your

1109
00:42:06,630 --> 00:41:59,520
habit it never comes in yeah

1110
00:42:11,109 --> 00:42:08,790
so your suit always stays on the outside

1111
00:42:13,349 --> 00:42:11,119
where all the dirt all the contaminants

1112
00:42:14,630 --> 00:42:13,359
stay cool out there so there's and

1113
00:42:16,230 --> 00:42:14,640

there's a lot of work ahead i mean

1114
00:42:18,150 --> 00:42:16,240
you're gonna when you're on the surface

1115
00:42:19,510 --> 00:42:18,160
doing things you're gonna learn oh like

1116
00:42:20,790 --> 00:42:19,520
like the apollo astronauts learned

1117
00:42:22,630 --> 00:42:20,800
they're gonna skip and hop to get

1118
00:42:24,790 --> 00:42:22,640
maneuvering with that bulky things

1119
00:42:26,309 --> 00:42:24,800
um the artemis astronauts are gonna find

1120
00:42:28,309 --> 00:42:26,319
new things with their spacesuits and

1121
00:42:30,309 --> 00:42:28,319
want things to change i can't drill as

1122
00:42:32,790 --> 00:42:30,319
much i can't climb i can't you know

1123
00:42:35,430 --> 00:42:32,800
repel down the crater in

1124
00:42:36,630 --> 00:42:35,440
yeah easiest way as i'd like you know so

1125
00:42:38,230 --> 00:42:36,640
there's there's gonna be a lot of

1126
00:42:40,069 --> 00:42:38,240
different suit designs for the

1127
00:42:42,230 --> 00:42:40,079
applications it needs and so we need

1128
00:42:43,990 --> 00:42:42,240
those we need those solutions and we

1129
00:42:46,790 --> 00:42:44,000
need to while we'll learn those as we

1130
00:42:48,710 --> 00:42:46,800
explore more yeah always learning

1131
00:42:51,030 --> 00:42:48,720
learning always learning

1132
00:42:53,109 --> 00:42:51,040
very good

1133
00:42:54,230 --> 00:42:53,119
do you have a question in mind i think i

1134
00:42:55,589 --> 00:42:54,240
do

1135
00:42:57,910 --> 00:42:55,599
um

1136
00:43:00,470 --> 00:42:57,920
well we have one here for chad uh it's

1137
00:43:02,230 --> 00:43:00,480
and it's about the sls so why

1138
00:43:04,150 --> 00:43:02,240

uh why are we

1139
00:43:05,670 --> 00:43:04,160
um designing a new system to get to the

1140
00:43:07,670 --> 00:43:05,680
moon and not just use the same apollo

1141
00:43:09,190 --> 00:43:07,680
equipment that we used last time yeah

1142
00:43:11,430 --> 00:43:09,200
well it's a great question do you maybe

1143
00:43:12,390 --> 00:43:11,440
want to tell everybody the what the full

1144
00:43:14,630 --> 00:43:12,400
system

1145
00:43:16,390 --> 00:43:14,640
consists of we talked about sls

1146
00:43:18,069 --> 00:43:16,400
well i mean there's i think that's the

1147
00:43:20,230 --> 00:43:18,079
the main one we're talking about but

1148
00:43:22,390 --> 00:43:20,240
there's also you know the equivalent to

1149
00:43:23,910 --> 00:43:22,400
all the apollo vehicles that kimberly

1150
00:43:25,510 --> 00:43:23,920
was showing with the little props right

1151
00:43:27,670 --> 00:43:25,520
there's a there's a command module which

1152
00:43:29,270 --> 00:43:27,680
now is the orion there's an equivalent

1153
00:43:31,670 --> 00:43:29,280
to the service module which actually the

1154
00:43:34,309 --> 00:43:31,680
europeans are providing there's a you

1155
00:43:35,990 --> 00:43:34,319
know lunar vehicle

1156
00:43:37,349 --> 00:43:36,000
that will be

1157
00:43:38,230 --> 00:43:37,359
you know putting the humans down on the

1158
00:43:40,470 --> 00:43:38,240
moon

1159
00:43:42,870 --> 00:43:40,480
what's different this time from apollo

1160
00:43:44,390 --> 00:43:42,880
is we also have the gateway uh which is

1161
00:43:45,270 --> 00:43:44,400
an orbiting space station around the

1162
00:43:46,069 --> 00:43:45,280
moon

1163
00:43:48,069 --> 00:43:46,079

um

1164
00:43:49,910 --> 00:43:48,079
and of course the big rocket so the

1165
00:43:52,150 --> 00:43:49,920
question is why don't we just use what

1166
00:43:54,150 --> 00:43:52,160
we had in the apollo era well in

1167
00:43:56,710 --> 00:43:54,160
principle you you could use those

1168
00:43:59,030 --> 00:43:56,720
designs right but

1169
00:44:01,430 --> 00:43:59,040
for one thing we'd like to carry um

1170
00:44:03,270 --> 00:44:01,440
additional people and the apollo capsule

1171
00:44:05,670 --> 00:44:03,280
is only big enough to carry three we'd

1172
00:44:10,470 --> 00:44:05,680
really like to carry four um

1173
00:44:13,589 --> 00:44:12,309
maybe i'll talk while we go right and

1174
00:44:16,710 --> 00:44:13,599
you can you can see it's pretty good

1175
00:44:18,790 --> 00:44:16,720
size one of the other reasons is that

1176
00:44:21,349 --> 00:44:18,800
all those designs haven't been produced

1177
00:44:23,829 --> 00:44:21,359
for 50 years and so to go back and

1178
00:44:24,710 --> 00:44:23,839
recover the design recover the tooling

1179
00:44:27,510 --> 00:44:24,720
um

1180
00:44:29,349 --> 00:44:27,520
it's basically as big a job as making a

1181
00:44:31,190 --> 00:44:29,359
new one

1182
00:44:34,309 --> 00:44:31,200
there's a story about how elm ames

1183
00:44:38,230 --> 00:44:34,319
participated in a 21st century detective

1184
00:44:40,470 --> 00:44:38,240
story on the re-entry the thermal uh

1185
00:44:42,230 --> 00:44:40,480
the tiles on the bottom of the

1186
00:44:43,829 --> 00:44:42,240
thermal protection system of the apollo

1187
00:44:46,069 --> 00:44:43,839
capsules they were made of

1188
00:44:48,710 --> 00:44:46,079

a chemical thing called avcode and they

1189
00:44:52,309 --> 00:44:48,720
had to re-engineer the chemical formula

1190
00:44:55,990 --> 00:44:52,319
and a 21st century version of that is on

1191
00:44:58,790 --> 00:44:56,000
the orion capsule so we thank you

1192
00:45:01,910 --> 00:44:58,800
we thank the apollo engineers for

1193
00:45:03,910 --> 00:45:01,920
providing that groundwork and uh we're

1194
00:45:06,390 --> 00:45:03,920
using that the research is still using

1195
00:45:08,550 --> 00:45:06,400
the learning the ideas uh if not the

1196
00:45:11,190 --> 00:45:08,560
actual specific designs are carried

1197
00:45:12,630 --> 00:45:11,200
along in the new program and

1198
00:45:13,990 --> 00:45:12,640
you know a lot of the elements of this

1199
00:45:15,670 --> 00:45:14,000
program have actually been in

1200
00:45:17,910 --> 00:45:15,680
development now for you know more than

1201
00:45:20,069 --> 00:45:17,920
10 years so we're not starting from

1202
00:45:21,829 --> 00:45:20,079
scratch today

1203
00:45:22,790 --> 00:45:21,839
this has been in development for some

1204
00:45:27,750 --> 00:45:22,800
time

1205
00:45:30,630 --> 00:45:27,760
literally the old design and reuse it

1206
00:45:32,630 --> 00:45:30,640
it can be just as much work as doing a

1207
00:45:35,030 --> 00:45:32,640
clean sheet of paper and doing the new

1208
00:45:37,190 --> 00:45:35,040
design also allows you to bring you know

1209
00:45:38,630 --> 00:45:37,200
all our latest and greatest technology

1210
00:45:41,829 --> 00:45:38,640
and ideas

1211
00:45:43,990 --> 00:45:41,839
which can make things lighter

1212
00:45:46,870 --> 00:45:44,000
more cost effective and in many cases a

1213
00:45:48,950 --> 00:45:46,880

lot safer so we're always looking at

1214
00:45:49,910 --> 00:45:48,960
those things as we come up with new new

1215
00:45:52,230 --> 00:45:49,920
pieces

1216
00:45:54,069 --> 00:45:52,240
i mean even the um orion capsule that we

1217
00:45:56,069 --> 00:45:54,079
were just looking at it's essentially

1218
00:45:57,750 --> 00:45:56,079
apollo on steroids because it has an

1219
00:46:00,470 --> 00:45:57,760
incredible amount of computing power

1220
00:46:02,230 --> 00:46:00,480
that the apollo capsule did not have

1221
00:46:05,030 --> 00:46:02,240
that makes and it can carry a lot more

1222
00:46:06,950 --> 00:46:05,040
payload and it is uh supports more

1223
00:46:09,430 --> 00:46:06,960
astronauts for very long durations in

1224
00:46:11,910 --> 00:46:09,440
space it's a very different um

1225
00:46:14,390 --> 00:46:11,920
design as similar as similar as the

1226
00:46:16,710 --> 00:46:14,400
artemis program is to apollo in that

1227
00:46:18,950 --> 00:46:16,720
we're going to the moon a lot of it ends

1228
00:46:21,190 --> 00:46:18,960
right there because the the basic

1229
00:46:23,030 --> 00:46:21,200
requirements for what it has to do for

1230
00:46:24,870 --> 00:46:23,040
how long it has to go for how many

1231
00:46:26,309 --> 00:46:24,880
people it's going to carry are all

1232
00:46:28,150 --> 00:46:26,319
different from a point

1233
00:46:30,069 --> 00:46:28,160
which leads you to you know somewhat

1234
00:46:33,190 --> 00:46:30,079
different solutions in the design makes

1235
00:46:35,910 --> 00:46:33,200
sense makes sense so we have the sls

1236
00:46:37,910 --> 00:46:35,920
rocket we have the orion spacecraft and

1237
00:46:39,589 --> 00:46:37,920
then we have gateway yeah we talk a

1238
00:46:42,309 --> 00:46:39,599

little more about gateway it is going to

1239
00:46:44,470 --> 00:46:42,319
be my next favorite species

1240
00:46:45,910 --> 00:46:44,480
i can't wait for daylight i think it is

1241
00:46:48,710 --> 00:46:45,920
fascinating

1242
00:46:51,109 --> 00:46:48,720
i i it's uh it's designed in mind to be

1243
00:46:53,750 --> 00:46:51,119
essentially our first interplanetary

1244
00:46:55,589 --> 00:46:53,760
space tug you know it's a spaceship that

1245
00:46:57,829 --> 00:46:55,599
could have would have the capability of

1246
00:47:01,670 --> 00:46:57,839
allowing us to maneuver things in space

1247
00:47:04,710 --> 00:47:01,680
and propelling other vehicles to mars

1248
00:47:06,870 --> 00:47:04,720
but it is a um orbiting uh ship around

1249
00:47:08,470 --> 00:47:06,880
the moon it gets us close to a thousand

1250
00:47:09,589 --> 00:47:08,480
miles of the moon surface and it goes as

1251
00:47:13,510 --> 00:47:09,599
far away as

1252
00:47:15,430 --> 00:47:13,520
40 000 miles it's in this uh rectilinear

1253
00:47:17,670 --> 00:47:15,440
orbit it allows

1254
00:47:19,510 --> 00:47:17,680
you to land on any place on them on the

1255
00:47:21,750 --> 00:47:19,520
moon wow which we didn't have with

1256
00:47:23,030 --> 00:47:21,760
apollo although the the orbit trajectory

1257
00:47:24,950 --> 00:47:23,040
was you know

1258
00:47:25,750 --> 00:47:24,960
on a specific place can only hand land

1259
00:47:27,990 --> 00:47:25,760
on the

1260
00:47:29,030 --> 00:47:28,000
equator this allows us to go to the

1261
00:47:30,390 --> 00:47:29,040
poles which we were talking about

1262
00:47:31,430 --> 00:47:30,400
earlier it allows us to go to the far

1263
00:47:33,510 --> 00:47:31,440

side

1264
00:47:35,750 --> 00:47:33,520
but it has a very unique uh propulsion

1265
00:47:37,190 --> 00:47:35,760
on it is solar electric propulsion and

1266
00:47:38,710 --> 00:47:37,200
it's more powerful than anything of that

1267
00:47:40,069 --> 00:47:38,720
type that we've seen before and that's

1268
00:47:42,950 --> 00:47:40,079
the type of propulsion we're going to

1269
00:47:44,549 --> 00:47:42,960
need when we're far from home like on

1270
00:47:46,230 --> 00:47:44,559
our journey to mars

1271
00:47:47,589 --> 00:47:46,240
and so that's going to be used and i

1272
00:47:49,670 --> 00:47:47,599
also love the fact that it's open

1273
00:47:51,349 --> 00:47:49,680
architecture all the ports are going to

1274
00:47:53,109 --> 00:47:51,359
be made available online because we want

1275
00:47:55,270 --> 00:47:53,119
uh it's going to have commercial and

1276
00:47:57,270 --> 00:47:55,280
international partners docking yeah

1277
00:47:58,790 --> 00:47:57,280
coming and going and having humans on it

1278
00:47:59,670 --> 00:47:58,800
and not having humans on it it's going

1279
00:48:02,069 --> 00:47:59,680
to be

1280
00:48:03,349 --> 00:48:02,079
a vacation home type thing you know the

1281
00:48:05,030 --> 00:48:03,359
astronauts will be there for a few weeks

1282
00:48:07,270 --> 00:48:05,040
or a month at a time and then then

1283
00:48:09,349 --> 00:48:07,280
they'll be empty for some time and um it

1284
00:48:11,109 --> 00:48:09,359
really is a way a different approach to

1285
00:48:12,790 --> 00:48:11,119
thinking about long-term human

1286
00:48:17,349 --> 00:48:12,800
exploration in space it's kind of like a

1287
00:48:21,430 --> 00:48:19,030
we're going it's kind of an outpost a

1288
00:48:24,630 --> 00:48:21,440

staging place uh we hang out there for a

1289
00:48:25,990 --> 00:48:24,640
while and then we leave and then you

1290
00:48:28,069 --> 00:48:26,000
know then we'll come back later and

1291
00:48:29,750 --> 00:48:28,079
we'll pick back up and we'll do things

1292
00:48:31,990 --> 00:48:29,760
this propulsion would be a tugboat it

1293
00:48:34,069 --> 00:48:32,000
also allows us to put biological or

1294
00:48:36,470 --> 00:48:34,079
other science experiments on it i'll put

1295
00:48:38,390 --> 00:48:36,480
a telescope on it why not yeah yeah

1296
00:48:40,710 --> 00:48:38,400
throw it in there control the rovers on

1297
00:48:41,910 --> 00:48:40,720
the surface from it i mean yeah yeah i

1298
00:48:43,990 --> 00:48:41,920
think it's got a lot of potential i

1299
00:48:46,230 --> 00:48:44,000
think we actually have an animation of

1300
00:48:47,829 --> 00:48:46,240
gateway to show oh yeah

1301
00:48:50,390 --> 00:48:47,839
there we go this is showing all the

1302
00:48:52,069 --> 00:48:50,400
different component modules uh

1303
00:48:54,309 --> 00:48:52,079
from both commercial and international

1304
00:48:56,549 --> 00:48:54,319
partners as well as nasa being assembled

1305
00:48:57,990 --> 00:48:56,559
to form you know eventually this this

1306
00:49:01,430 --> 00:48:58,000
really functional

1307
00:49:02,630 --> 00:49:01,440
outpost in orbit around the moon

1308
00:49:04,950 --> 00:49:02,640
and it also allows us to have constant

1309
00:49:06,309 --> 00:49:04,960
communication with earth which again is

1310
00:49:08,390 --> 00:49:06,319
you know something you won't have when

1311
00:49:09,910 --> 00:49:08,400
you go to mars but at least this time

1312
00:49:12,230 --> 00:49:09,920
while we're working out all the

1313
00:49:14,549 --> 00:49:12,240

interesting challenges of being away

1314
00:49:16,950 --> 00:49:14,559
from planet earth and being in this

1315
00:49:18,870 --> 00:49:16,960
environment for long periods of time

1316
00:49:21,670 --> 00:49:18,880
it truly is a proving ground

1317
00:49:24,150 --> 00:49:21,680
and it's it's flexible in terms of what

1318
00:49:26,710 --> 00:49:24,160
it can be used for awesome you guys

1319
00:49:28,950 --> 00:49:26,720
answered a question from uh

1320
00:49:31,109 --> 00:49:28,960
oh gosh i've lost it yoga fire is

1321
00:49:32,549 --> 00:49:31,119
artemis a joint venture the way that the

1322
00:49:34,069 --> 00:49:32,559
international space station is

1323
00:49:36,630 --> 00:49:34,079
international and you talked about that

1324
00:49:38,150 --> 00:49:36,640
very very much so partners yeah and and

1325
00:49:40,549 --> 00:49:38,160
more partners as well international

1326
00:49:42,870 --> 00:49:40,559
space station has about 15 partners wow

1327
00:49:44,630 --> 00:49:42,880
i mean now we have 89 nations on this

1328
00:49:46,630 --> 00:49:44,640
planet that have satellites in orbit we

1329
00:49:50,630 --> 00:49:46,640
are a very different species than we

1330
00:49:52,630 --> 00:49:50,640
were years ago yeah so as um you know uh

1331
00:49:54,790 --> 00:49:52,640
the future of space is for the whole

1332
00:49:55,510 --> 00:49:54,800
world and we have a lot of nations you

1333
00:49:57,270 --> 00:49:55,520
know

1334
00:50:00,309 --> 00:49:57,280
working in space in terms of their

1335
00:50:03,030 --> 00:50:00,319
economics or their communication um and

1336
00:50:04,870 --> 00:50:03,040
they'll be partnering with you know

1337
00:50:05,910 --> 00:50:04,880
this is what this um the honors program

1338
00:50:07,589 --> 00:50:05,920

is about

1339
00:50:09,670 --> 00:50:07,599
yeah outstanding uh we have a question

1340
00:50:13,190 --> 00:50:09,680
here from an easter egg uh is gateway

1341
00:50:14,870 --> 00:50:13,200
bigger than the iss no no it's iss is

1342
00:50:16,470 --> 00:50:14,880
really huge

1343
00:50:18,630 --> 00:50:16,480
and and gateway because it's so much

1344
00:50:20,710 --> 00:50:18,640
further away is going to be a much more

1345
00:50:21,589 --> 00:50:20,720
compact uh vehicle

1346
00:50:22,870 --> 00:50:21,599
um

1347
00:50:25,670 --> 00:50:22,880
you know it'll it'll have a lot of the

1348
00:50:27,109 --> 00:50:25,680
functionality that iss does just be you

1349
00:50:29,589 --> 00:50:27,119
know a little smaller

1350
00:50:31,910 --> 00:50:29,599
well a lot smaller

1351
00:50:33,349 --> 00:50:31,920
still need to be occupied not so the iss

1352
00:50:35,670 --> 00:50:33,359
an amazing achievement has been

1353
00:50:38,470 --> 00:50:35,680
continuously occupied for almost 20

1354
00:50:40,790 --> 00:50:38,480
years november of 2000 was the

1355
00:50:43,270 --> 00:50:40,800
the first occupants that's created

1356
00:50:45,750 --> 00:50:43,280
people in space yeah and uh you know

1357
00:50:47,030 --> 00:50:45,760
designed for that reason so art of so

1358
00:50:48,549 --> 00:50:47,040
gateway is going to be designed

1359
00:50:50,069 --> 00:50:48,559
differently because it has to be able to

1360
00:50:52,470 --> 00:50:50,079
support humans for periods of time in

1361
00:50:55,270 --> 00:50:52,480
the period where it doesn't have humans

1362
00:50:57,430 --> 00:50:55,280
and so um uh that can be done because of

1363
00:51:00,870 --> 00:50:57,440

our advancements in robotics and

1364
00:51:02,549 --> 00:51:00,880
autonomy and smart software i mean

1365
00:51:04,150 --> 00:51:02,559
i know it's a different vehicle but you

1366
00:51:06,390 --> 00:51:04,160
know we're starting to see self-driving

1367
00:51:08,069 --> 00:51:06,400
cars self-driving trucks our satellites

1368
00:51:09,829 --> 00:51:08,079
are a lot more autonomous we are a

1369
00:51:11,990 --> 00:51:09,839
smarter species now

1370
00:51:13,270 --> 00:51:12,000
and uh now space can take advantage of

1371
00:51:14,549 --> 00:51:13,280
the knowledge that we've gained in that

1372
00:51:16,470 --> 00:51:14,559
field

1373
00:51:18,069 --> 00:51:16,480
awesome yeah i think we have time for

1374
00:51:19,510 --> 00:51:18,079
like one more question yeah and then we

1375
00:51:21,670 --> 00:51:19,520
really want to go well the questions of

1376
00:51:25,109 --> 00:51:21,680
the past

1377
00:51:26,549 --> 00:51:25,119
maybe this one from a random clown

1378
00:51:29,270 --> 00:51:26,559
what are some of the design challenges

1379
00:51:31,190 --> 00:51:29,280
that have yet to be solved for this trip

1380
00:51:32,870 --> 00:51:31,200
can you identify there's so many i'm

1381
00:51:34,470 --> 00:51:32,880
sure there are many there's a lot of

1382
00:51:36,069 --> 00:51:34,480
work to do i mean if you just think

1383
00:51:37,990 --> 00:51:36,079
about we were just talking about apollo

1384
00:51:40,710 --> 00:51:38,000
earlier in this this show

1385
00:51:43,589 --> 00:51:40,720
when the charge came to go to the moon

1386
00:51:45,030 --> 00:51:43,599
in 61 it was only 20 days after they had

1387
00:51:46,309 --> 00:51:45,040
done a first suborbital flight they

1388
00:51:47,910 --> 00:51:46,319

hadn't even done an orbital flight they

1389
00:51:49,589 --> 00:51:47,920
hadn't figured out how to do

1390
00:51:51,589 --> 00:51:49,599
rendezvous two spacecraft that had been

1391
00:52:17,109 --> 00:51:51,599
a lot of they didn't do a space walk

1392
00:52:21,589 --> 00:52:18,630
no doubt about it there'll be new and

1393
00:52:23,750 --> 00:52:21,599
that's the beauty of it because when you

1394
00:52:25,910 --> 00:52:23,760
have a problem that has not been solved

1395
00:52:27,750 --> 00:52:25,920
that's when you get your creative

1396
00:52:29,349 --> 00:52:27,760
new solutions right you know you're

1397
00:52:30,390 --> 00:52:29,359
going to attack a problem and come back

1398
00:52:32,150 --> 00:52:30,400
with something that no one's ever

1399
00:52:35,190 --> 00:52:32,160
thought of before and then who knows

1400
00:52:40,150 --> 00:52:38,150
nicely said yeah

1401
00:52:43,589 --> 00:52:40,160
well i guess we can that's the perfect

1402
00:52:45,349 --> 00:52:43,599
way to end this huh it is

1403
00:52:48,150 --> 00:52:45,359
that's about all the time we have today

1404
00:52:50,069 --> 00:52:48,160
you guys a huge thanks to our guests

1405
00:52:52,470 --> 00:52:50,079
and everyone who joined us in the chat

1406
00:52:55,030 --> 00:52:52,480
today on twitch uh we will be back on

1407
00:52:57,030 --> 00:52:55,040
thursday july 25th talking about how to

1408
00:52:59,030 --> 00:52:57,040
get an internship at nasa that's how it

1409
00:53:00,150 --> 00:52:59,040
starts that's right that's right there

1410
00:53:02,630 --> 00:53:00,160
are a lot of people here today who

1411
00:53:05,430 --> 00:53:02,640
started as interns right so that's our

1412
00:53:07,510 --> 00:53:05,440
next show for this gang here but

1413
00:53:09,750 --> 00:53:07,520

remember to join us tomorrow in

1414
00:53:11,670 --> 00:53:09,760
celebrating the apollo 50th

1415
00:53:13,670 --> 00:53:11,680
and hearing about more about our future

1416
00:53:16,230 --> 00:53:13,680
plans to go to the moon and on to mars

1417
00:53:18,710 --> 00:53:16,240
so tune in to our special two hour live

1418
00:53:20,950 --> 00:53:18,720
nasa television broadcast tomorrow at 10

1419
00:53:22,630 --> 00:53:20,960
a.m pacific and you can learn more about

1420
00:53:25,190 --> 00:53:22,640
the show and how to watch it by going to

1421
00:53:28,470 --> 00:53:25,200
www.nasa.gov

1422
00:53:29,990 --> 00:53:28,480
apollo 50th and click on events so check

1423
00:53:45,100 --> 00:53:30,000
it out and we'll see you soon thanks for