
NASA
TECHRISE
STUDENT CHALLENGE

1
00:00:09,270 --> 00:00:07,190
hello

2
00:00:10,230 --> 00:00:09,280
and welcome to the nasa tech rice

3
00:00:13,749 --> 00:00:10,240
student challenge

4
00:00:15,669 --> 00:00:13,759
virtual event uh we are so excited to be

5
00:00:16,230 --> 00:00:15,679
here tonight as a part of the eighth

6
00:00:19,109 --> 00:00:16,240
annual

7
00:00:20,870 --> 00:00:19,119
ed games expo that's been coordinated by

8
00:00:23,109 --> 00:00:20,880
the department of education

9
00:00:24,790 --> 00:00:23,119
and we are so excited to be sharing this

10
00:00:27,589 --> 00:00:24,800
new challenge with all of you

11
00:00:29,109 --> 00:00:27,599
uh just last week nasa announced a brand

12
00:00:29,990 --> 00:00:29,119
new challenge which is going to start

13
00:00:31,910 --> 00:00:30,000

accepting entries

14
00:00:33,110 --> 00:00:31,920
next school year where students are

15
00:00:34,790 --> 00:00:33,120
going to be able to get hands-on

16
00:00:36,630 --> 00:00:34,800
designing flight experiments

17
00:00:37,990 --> 00:00:36,640
for either a suborbital rocket with

18
00:00:40,150 --> 00:00:38,000
microgravity time

19
00:00:42,150 --> 00:00:40,160
or at a high altitude balloon with with

20
00:00:44,470 --> 00:00:42,160
ability to sense the atmosphere and have

21
00:00:45,830 --> 00:00:44,480
line of sight down to earth for imaging

22
00:00:47,270 --> 00:00:45,840
and today we are going to have a

23
00:00:49,430 --> 00:00:47,280
kick-off event where we're going to hear

24
00:00:51,670 --> 00:00:49,440
from a number of nasa speakers

25
00:00:52,790 --> 00:00:51,680
to fill your head with inspiration of

26
00:00:54,150 --> 00:00:52,800
all the different great things that

27
00:00:56,389 --> 00:00:54,160
students can do

28
00:00:58,069 --> 00:00:56,399
and also give you um you know a teaser

29
00:00:59,510 --> 00:00:58,079
of some of the education resources we

30
00:01:01,590 --> 00:00:59,520
have coming up

31
00:01:04,149 --> 00:01:01,600
so my name is deanne bell i am the

32
00:01:05,910 --> 00:01:04,159
founder and ceo of future engineers

33
00:01:07,510 --> 00:01:05,920
this is a nasa challenge and future

34
00:01:08,550 --> 00:01:07,520
engineers is honored to be administering

35
00:01:10,230 --> 00:01:08,560
this challenge

36
00:01:12,710 --> 00:01:10,240
and i will be with you every step of the

37
00:01:14,149 --> 00:01:12,720
way as your host in nc and i am honored

38
00:01:16,710 --> 00:01:14,159

to pass it over

39
00:01:18,870 --> 00:01:16,720
to bob cabana bob cabana is a former

40
00:01:21,510 --> 00:01:18,880
nasa astronaut he currently serves as

41
00:01:23,350 --> 00:01:21,520
the agency's associate administrator

42
00:01:24,830 --> 00:01:23,360
and he was formerly the director of

43
00:01:27,830 --> 00:01:24,840
nasa's johnson

44
00:01:28,950 --> 00:01:27,840
nasa's kennedy space center so take it

45
00:01:30,710 --> 00:01:28,960
away bob

46
00:01:32,149 --> 00:01:30,720
oh thanks so much deanna and thank you

47
00:01:36,069 --> 00:01:32,159
all for taking part

48
00:01:36,870 --> 00:01:36,079
in this awesome nasa tech rise student

49
00:01:39,350 --> 00:01:36,880
challenge

50
00:01:40,789 --> 00:01:39,360
what a great thing for uh teachers and

51
00:01:42,389 --> 00:01:40,799
students alike

52
00:01:44,389 --> 00:01:42,399
so you know we got a lot of stuff going

53
00:01:45,990 --> 00:01:44,399
on at nasa and i also have to thank the

54
00:01:46,710 --> 00:01:46,000
department of education just like the

55
00:01:50,230 --> 00:01:46,720
end did for

56
00:01:54,389 --> 00:01:50,240
allowing us to be part of this uh ed

57
00:01:55,109 --> 00:01:54,399
ed games expo uh now from a stem point

58
00:01:57,270 --> 00:01:55,119
of view

59
00:01:58,230 --> 00:01:57,280
nasa's stem program is absolutely

60
00:02:01,190 --> 00:01:58,240
outstanding we have

61
00:02:01,990 --> 00:02:01,200
so many resources for all of you to use

62
00:02:04,550 --> 00:02:02,000
in uh

63
00:02:05,990 --> 00:02:04,560

motivating those next stem students out

64
00:02:07,749 --> 00:02:06,000
there right that are going to end up

65
00:02:07,990 --> 00:02:07,759
being engineers and who knows you might

66
00:02:09,510 --> 00:02:08,000
even

67
00:02:10,710 --> 00:02:09,520
end up being an astronaut one day you

68
00:02:11,270 --> 00:02:10,720
know i never dreamed i could be an

69
00:02:12,949 --> 00:02:11,280
astronaut

70
00:02:14,790 --> 00:02:12,959
i just wanted to fly jets when i was

71
00:02:16,470 --> 00:02:14,800
little and i love math and engineering

72
00:02:18,550 --> 00:02:16,480
but it's because of great teachers like

73
00:02:20,630 --> 00:02:18,560
all of you that instilled that in me

74
00:02:22,070 --> 00:02:20,640
when i was young and it allowed me to

75
00:02:24,710 --> 00:02:22,080
have an awesome career

76
00:02:25,910 --> 00:02:24,720
and reach my dreams now i want to i got

77
00:02:26,869 --> 00:02:25,920
to get this right so i'm going to read

78
00:02:30,070 --> 00:02:26,879
this okay

79
00:02:31,990 --> 00:02:30,080
i want all of you to make sure that you

80
00:02:35,589 --> 00:02:32,000
learn more about nasa's stems program

81
00:02:38,710 --> 00:02:35,599
i want you to go to nasa.gov

82
00:02:41,990 --> 00:02:38,720
stem all right nasa.gov stem

83
00:02:44,949 --> 00:02:42,000
and i want you to subscribe to the nasa

84
00:02:46,790 --> 00:02:44,959
express e-newsletter to stay informed on

85
00:02:48,390 --> 00:02:46,800
all the great stuff that we got going on

86
00:02:49,350 --> 00:02:48,400
the stem offerings for your schools and

87
00:02:51,589 --> 00:02:49,360
everything

88
00:02:52,710 --> 00:02:51,599

you guys we have so many resources and i

89
00:02:54,550 --> 00:02:52,720
just know you're going to love them

90
00:02:56,470 --> 00:02:54,560
there is so much going on at nasa

91
00:02:58,390 --> 00:02:56,480
we're we got the artemis program we're

92
00:03:00,070 --> 00:02:58,400
going to the moon we're going to put the

93
00:03:01,430 --> 00:03:00,080
the first woman and the first person of

94
00:03:03,110 --> 00:03:01,440
color on the moon with the artemis

95
00:03:04,949 --> 00:03:03,120
program we got a big test flight coming

96
00:03:07,430 --> 00:03:04,959
up the end of this year with our crew

97
00:03:09,270 --> 00:03:07,440
we're on mars that that perseverance

98
00:03:10,390 --> 00:03:09,280
rover with the ingenuity helicopter it

99
00:03:11,750 --> 00:03:10,400
is so dang cool

100
00:03:13,990 --> 00:03:11,760
there are so many things that we're

101
00:03:16,070 --> 00:03:14,000
doing and we can tie all that into your

102
00:03:17,589 --> 00:03:16,080
classroom too with great experiments for

103
00:03:20,390 --> 00:03:17,599
you to run so

104
00:03:21,110 --> 00:03:20,400
nasa's stem program education programs

105
00:03:22,309 --> 00:03:21,120
are great

106
00:03:24,390 --> 00:03:22,319
i want to thank you all for

107
00:03:25,830 --> 00:03:24,400
participating and with that i'm going to

108
00:03:27,589 --> 00:03:25,840
say goodbye and i'm going to turn you

109
00:03:32,070 --> 00:03:27,599
over for this great video coming up

110
00:03:34,149 --> 00:03:32,080
thanks everybody for participating

111
00:03:35,430 --> 00:03:34,159
you so much and with that kickoff we are

112
00:03:38,309 --> 00:03:35,440
going to show you a

113
00:03:39,910 --> 00:03:38,319

trailer teaser video of our new nasa

114
00:03:41,830 --> 00:03:39,920
tech right student challenge

115
00:03:43,430 --> 00:03:41,840
so i'm going to go ahead and share my

116
00:03:45,030 --> 00:03:43,440
screen and share that video while we

117
00:03:55,429 --> 00:03:45,040
bring on another speaker from nasa

118
00:04:02,470 --> 00:04:00,710
and we're off

119
00:04:05,350 --> 00:04:02,480
are you ready to build with nasa next

120
00:04:07,429 --> 00:04:05,360
year nasa is launching a new technology

121
00:04:09,270 --> 00:04:07,439
challenge for schools

122
00:04:11,589 --> 00:04:09,280
sixth to twelfth grade students can

123
00:04:17,270 --> 00:04:11,599
either launch an experiment on a rocket

124
00:04:32,150 --> 00:04:22,230
what will you see what will you change

125
00:04:35,590 --> 00:04:34,030
learn more and sign up now at

126
00:04:50,550 --> 00:04:35,600
futureengineers.org

127
00:04:53,990 --> 00:04:52,469
all right and you guys are in for a

128
00:04:55,749 --> 00:04:54,000
treat not only do we have one person

129
00:04:55,990 --> 00:04:55,759
from nasa headquarters tuning in tonight

130
00:04:58,310 --> 00:04:56,000
we

131
00:05:00,150 --> 00:04:58,320
also have another so next i'd like you

132
00:05:02,870 --> 00:05:00,160
to introduce you to

133
00:05:04,870 --> 00:05:02,880
jim reuter jim reuter is the associate

134
00:05:06,070 --> 00:05:04,880
administrator for the space technology

135
00:05:08,550 --> 00:05:06,080
mission directorate

136
00:05:09,350 --> 00:05:08,560
at nasa headquarters um he's been in

137
00:05:12,070 --> 00:05:09,360
this position

138
00:05:14,230 --> 00:05:12,080

since june 9 2019 and served in acting

139
00:05:15,830 --> 00:05:14,240
capacity since february 2017

140
00:05:17,830 --> 00:05:15,840
and he provides executive leadership and

141
00:05:18,230 --> 00:05:17,840
management of the technology programs

142
00:05:21,830 --> 00:05:18,240
within

143
00:05:23,830 --> 00:05:21,840
stmd and i'm very excited to turn it

144
00:05:25,270 --> 00:05:23,840
over to jim to give some opening remarks

145
00:05:27,430 --> 00:05:25,280
thanks for joining us jim

146
00:05:29,430 --> 00:05:27,440
well thank you deanna it's a pleasure to

147
00:05:31,189 --> 00:05:29,440
be here um it's really exciting

148
00:05:32,790 --> 00:05:31,199
you know as bob mentioned i'm also

149
00:05:35,270 --> 00:05:32,800
honored to welcome

150
00:05:36,469 --> 00:05:35,280
you to the kickoff at this nasa tech

151
00:05:38,550 --> 00:05:36,479
ride student challenge

152
00:05:39,830 --> 00:05:38,560
we're really excited to share what i

153
00:05:41,590 --> 00:05:39,840
think is an extremely

154
00:05:43,590 --> 00:05:41,600
exciting challenge with all of you i

155
00:05:46,310 --> 00:05:43,600
hope you'll and you'll agree

156
00:05:47,189 --> 00:05:46,320
uh tech prize offers students grades 6

157
00:05:49,350 --> 00:05:47,199
through 12

158
00:05:50,790 --> 00:05:49,360
the chance to design and build their own

159
00:05:52,390 --> 00:05:50,800
technology experiment

160
00:05:54,230 --> 00:05:52,400
then they can fly that experiment in

161
00:05:55,029 --> 00:05:54,240
suborbital space just like nasa

162
00:05:57,029 --> 00:05:55,039
engineers

163
00:05:59,270 --> 00:05:57,039

university researchers companies and so

164
00:06:00,950 --> 00:05:59,280
on nasa uses

165
00:06:03,110 --> 00:06:00,960
we like to use suborbital vehicles to

166
00:06:05,029 --> 00:06:03,120
test and mature technologies for future

167
00:06:06,629 --> 00:06:05,039
space exploration

168
00:06:08,070 --> 00:06:06,639
you kind of go towards what's referred

169
00:06:10,070 --> 00:06:08,080
to as the edge of space

170
00:06:11,350 --> 00:06:10,080
altitudes that replicate some of the

171
00:06:14,150 --> 00:06:11,360
conditions we'll see

172
00:06:16,150 --> 00:06:14,160
in space such as microgravity high

173
00:06:18,790 --> 00:06:16,160
altitude solar exposure

174
00:06:20,870 --> 00:06:18,800
radiation extreme temperatures in vacuum

175
00:06:23,189 --> 00:06:20,880
and intense spacecraft vibrations

176
00:06:25,189 --> 00:06:23,199
so by understanding in a sub-orbital

177
00:06:27,029 --> 00:06:25,199
when it's relatively low cost

178
00:06:28,469 --> 00:06:27,039
how the payloads respond then they can

179
00:06:30,390 --> 00:06:28,479
confirm their designs

180
00:06:31,909 --> 00:06:30,400
and make refinements and improvements

181
00:06:33,270 --> 00:06:31,919
before they go into the more expensive

182
00:06:35,749 --> 00:06:33,280
and more challenging

183
00:06:37,189 --> 00:06:35,759
areas of space where they they perform

184
00:06:39,590 --> 00:06:37,199
and so researchers are

185
00:06:41,510 --> 00:06:39,600
often preparing their experiments for

186
00:06:43,430 --> 00:06:41,520
things like orbital deployments

187
00:06:44,550 --> 00:06:43,440
small satellites on missions to the moon

188
00:06:45,990 --> 00:06:44,560

or mars

189
00:06:48,629 --> 00:06:46,000
and through techrize what we're going to

190
00:06:50,309 --> 00:06:48,639
try to do is is have the students

191
00:06:52,150 --> 00:06:50,319
directly participate in that same

192
00:06:54,629 --> 00:06:52,160
process so that can

193
00:06:55,749 --> 00:06:54,639
hopefully foster creativity and open

194
00:06:57,430 --> 00:06:55,759
their minds to the

195
00:06:59,110 --> 00:06:57,440
importance of testing when designing

196
00:07:01,589 --> 00:06:59,120
their experiments in

197
00:07:03,670 --> 00:07:01,599
but in order for this to be successful

198
00:07:04,469 --> 00:07:03,680
we really need the support of our of the

199
00:07:06,309 --> 00:07:04,479
educators

200
00:07:08,550 --> 00:07:06,319
uh you and this audience so it's such a

201
00:07:10,710 --> 00:07:08,560
pleasure to be here for it

202
00:07:12,550 --> 00:07:10,720
techrize requires student teams to work

203
00:07:15,350 --> 00:07:12,560
with an educator as a mentor

204
00:07:16,309 --> 00:07:15,360
at nasa we absolutely know your guidance

205
00:07:18,230 --> 00:07:16,319
is critical

206
00:07:19,350 --> 00:07:18,240
you're preparing our future skilled

207
00:07:22,309 --> 00:07:19,360
workforce and

208
00:07:23,909 --> 00:07:22,319
instilling in them values such core

209
00:07:25,510 --> 00:07:23,919
values like teamwork

210
00:07:27,430 --> 00:07:25,520
and ensuring equity among the

211
00:07:29,749 --> 00:07:27,440
participants and with you

212
00:07:31,749 --> 00:07:29,759
our educators we want to support all

213
00:07:34,390 --> 00:07:31,759

students and welcome them to stem

214
00:07:34,950 --> 00:07:34,400
aerospace and our growing community so

215
00:07:37,510 --> 00:07:34,960
for the

216
00:07:39,110 --> 00:07:37,520
next two hours you will learn from nasa

217
00:07:40,309 --> 00:07:39,120
subject matter experts in lunar

218
00:07:45,749 --> 00:07:40,319
exploration

219
00:07:47,589 --> 00:07:45,759
imaging and remote sensing technologies

220
00:07:50,710 --> 00:07:47,599
and microgravity research

221
00:07:52,629 --> 00:07:50,720
i really ask ask you to

222
00:07:54,469 --> 00:07:52,639
ask questions along the way and consider

223
00:07:56,469 --> 00:07:54,479
how students can

224
00:07:58,629 --> 00:07:56,479
experiment with and test technologies

225
00:08:01,990 --> 00:07:58,639
and concepts across a wide range of

226
00:08:02,629 --> 00:08:02,000
topics and you also hear in these two

227
00:08:04,950 --> 00:08:02,639
hours from

228
00:08:06,230 --> 00:08:04,960
fellow educators who supported student

229
00:08:07,670 --> 00:08:06,240
flight tests in the past

230
00:08:10,309 --> 00:08:07,680
to gain their insights and learn from

231
00:08:11,990 --> 00:08:10,319
this experience so i especially want to

232
00:08:15,029 --> 00:08:12,000
thank the department of education for

233
00:08:17,029 --> 00:08:15,039
inviting us here at nasa and our partner

234
00:08:17,909 --> 00:08:17,039
future engineers to participate in these

235
00:08:20,790 --> 00:08:17,919
21

236
00:08:22,710 --> 00:08:20,800
ed games expo and thank you to the

237
00:08:24,070 --> 00:08:22,720
dedicated educators who are joining us

238
00:08:26,150 --> 00:08:24,080

today

239
00:08:27,830 --> 00:08:26,160
i also want to thank our great nasa team

240
00:08:30,309 --> 00:08:27,840
that are pulling off this challenge

241
00:08:31,909 --> 00:08:30,319
including our stem engagement folks and

242
00:08:32,790 --> 00:08:31,919
armstrong flight research center who

243
00:08:34,709 --> 00:08:32,800
runs the

244
00:08:37,269 --> 00:08:34,719
flight opportunities program for us a

245
00:08:39,430 --> 00:08:37,279
special shout out to danielle mcculloch

246
00:08:42,630 --> 00:08:39,440
so diana back to you for an overview of

247
00:08:45,030 --> 00:08:42,640
the nasa tech rise challenge

248
00:08:46,230 --> 00:08:45,040
amazing thank you thank you so much jim

249
00:08:48,470 --> 00:08:46,240
uh thank you

250
00:08:49,430 --> 00:08:48,480
to jim and bob for those great welcome

251
00:08:52,310 --> 00:08:49,440
remarks

252
00:08:52,790 --> 00:08:52,320
um so now i am going to dive into what

253
00:08:55,670 --> 00:08:52,800
is this

254
00:08:57,350 --> 00:08:55,680
challenge all about so the nasa student

255
00:08:57,910 --> 00:08:57,360
the nasa techrice student challenge

256
00:08:59,430 --> 00:08:57,920
right we

257
00:09:00,790 --> 00:08:59,440
we touched a little bit at the beginning

258
00:09:02,389 --> 00:09:00,800
but i'm going to show some slides and

259
00:09:03,910 --> 00:09:02,399
i'm going to walk you through

260
00:09:05,509 --> 00:09:03,920
uh what this challenge is all about and

261
00:09:06,790 --> 00:09:05,519
what it's going to mean for you and your

262
00:09:09,030 --> 00:09:06,800
students to participate

263
00:09:09,910 --> 00:09:09,040

in this okay so bear with me one more

264
00:09:12,389 --> 00:09:09,920
second while i share

265
00:09:13,350 --> 00:09:12,399
screens i'm learning how to push lots of

266
00:09:18,150 --> 00:09:13,360
buttons in sync

267
00:09:25,990 --> 00:09:22,949
all right and i'm gonna present

268
00:09:28,389 --> 00:09:26,000
okay so as you know this is the name uh

269
00:09:30,150 --> 00:09:28,399
nasa decorate student challenge uh and

270
00:09:31,509 --> 00:09:30,160
i'm first gonna just dive into rockets

271
00:09:33,110 --> 00:09:31,519
and balloons so

272
00:09:34,710 --> 00:09:33,120
so when we think about this challenge

273
00:09:35,990 --> 00:09:34,720
it's really kind of like two challenges

274
00:09:38,070 --> 00:09:36,000
in one right so we have this

275
00:09:40,310 --> 00:09:38,080
umbrella where students can propose an

276
00:09:41,590 --> 00:09:40,320
experiment to fly on a suborbital flight

277
00:09:43,590 --> 00:09:41,600
but we've got two very different

278
00:09:44,870 --> 00:09:43,600
vehicles right so we've got rockets and

279
00:09:47,750 --> 00:09:44,880
we've got balloons

280
00:09:48,550 --> 00:09:47,760
and um the big thing to know is that the

281
00:09:50,150 --> 00:09:48,560
experiments

282
00:09:52,150 --> 00:09:50,160
they're not going gonna be huge they're

283
00:09:53,910 --> 00:09:52,160
gonna fit in a box that's four inches by

284
00:09:56,389 --> 00:09:53,920
four inches by eight inches so it's kind

285
00:09:58,230 --> 00:09:56,399
of like two cubes stuck together right

286
00:09:59,590 --> 00:09:58,240
so you're thinking about that volume and

287
00:10:00,470 --> 00:09:59,600
what kind of experiment you can do in

288
00:10:02,310 --> 00:10:00,480

that volume

289
00:10:04,069 --> 00:10:02,320
and when the students are thinking about

290
00:10:05,910 --> 00:10:04,079
what they want to propose

291
00:10:07,269 --> 00:10:05,920
for this challenge you really need to

292
00:10:08,389 --> 00:10:07,279
think about what vehicle you're going to

293
00:10:10,310 --> 00:10:08,399
propose for right

294
00:10:11,750 --> 00:10:10,320
so we've got suborbital rockets that um

295
00:10:13,430 --> 00:10:11,760
give you about three minutes of

296
00:10:15,430 --> 00:10:13,440
microgravity or zero g

297
00:10:17,030 --> 00:10:15,440
or weightlessness um so that's a really

298
00:10:18,389 --> 00:10:17,040
great opportunity for space exploration

299
00:10:19,910 --> 00:10:18,399
experiments and i know that

300
00:10:21,509 --> 00:10:19,920
um we're gonna we're gonna go into more

301
00:10:23,269 --> 00:10:21,519
detail about this later and then we've

302
00:10:24,710 --> 00:10:23,279
got the high altitude balloon right so

303
00:10:26,230 --> 00:10:24,720
we all know about balloons

304
00:10:28,150 --> 00:10:26,240
but this is a commercially operated

305
00:10:29,990 --> 00:10:28,160
balloon and and this experiment's gonna

306
00:10:31,670 --> 00:10:30,000
go up and it's gonna have at least four

307
00:10:32,949 --> 00:10:31,680
hours at seventy thousand feet so you

308
00:10:34,230 --> 00:10:32,959
can think about all the things you can

309
00:10:37,269 --> 00:10:34,240
see and all the things you can

310
00:10:39,670 --> 00:10:37,279
sense up there for your experiment and

311
00:10:41,750 --> 00:10:39,680
in a nutshell it means that it covers

312
00:10:43,750 --> 00:10:41,760
all kinds of areas of space exploration

313
00:10:44,870 --> 00:10:43,760

um from from thinking about microgravity

314
00:10:46,949 --> 00:10:44,880
and thinking about developing

315
00:10:48,870 --> 00:10:46,959
experiments related to the moon or mars

316
00:10:50,069 --> 00:10:48,880
and also thinking about earth science

317
00:10:51,590 --> 00:10:50,079
experiments as well

318
00:10:52,949 --> 00:10:51,600
right when we think about that balloon

319
00:10:53,670 --> 00:10:52,959
and how we can better understand our

320
00:10:55,829 --> 00:10:53,680
planet

321
00:10:57,110 --> 00:10:55,839
so this challenge is open for u.s

322
00:10:59,990 --> 00:10:57,120
schools it's open

323
00:11:00,470 --> 00:11:00,000
for students um attending 6th to 12th

324
00:11:02,949 --> 00:11:00,480
grade

325
00:11:03,990 --> 00:11:02,959
and at us public private and charter

326
00:11:06,230 --> 00:11:04,000
schools

327
00:11:07,670 --> 00:11:06,240
and when you put together a team to

328
00:11:09,829 --> 00:11:07,680
submit for this it's a little different

329
00:11:12,069 --> 00:11:09,839
than some of our previous challenges

330
00:11:14,150 --> 00:11:12,079
we need a team that has at least four

331
00:11:15,670 --> 00:11:14,160
students there's no maps you can have as

332
00:11:17,190 --> 00:11:15,680
many as you want

333
00:11:19,110 --> 00:11:17,200
but we need to have at least four and

334
00:11:21,190 --> 00:11:19,120
there needs to be one teacher or

335
00:11:22,230 --> 00:11:21,200
adult employee of the school attached to

336
00:11:24,230 --> 00:11:22,240
the team

337
00:11:25,350 --> 00:11:24,240
and um so when you think about like how

338
00:11:26,630 --> 00:11:25,360

you can participate with this it could

339
00:11:27,269 --> 00:11:26,640
be your whole class that submits a

340
00:11:29,350 --> 00:11:27,279
proposal

341
00:11:31,190 --> 00:11:29,360
it could be your whole grade it could be

342
00:11:31,590 --> 00:11:31,200
an after-school technology club that you

343
00:11:33,509 --> 00:11:31,600
have

344
00:11:35,670 --> 00:11:33,519
however you want to assemble a team

345
00:11:38,790 --> 00:11:35,680
within the students at that school

346
00:11:39,509 --> 00:11:38,800
we welcome those ideas and prizes of

347
00:11:41,030 --> 00:11:39,519
course it's a

348
00:11:43,269 --> 00:11:41,040
challenge so we need to have awesome

349
00:11:43,870 --> 00:11:43,279
prizes so we are excited that there are

350
00:11:47,750 --> 00:11:43,880
going to be

351
00:11:50,949 --> 00:11:47,760
to fly

352
00:11:52,470 --> 00:11:50,959
their experiments and and so as a winner

353
00:11:54,949 --> 00:11:52,480
uh you're going to receive fifteen

354
00:11:56,550 --> 00:11:54,959
hundred dollars

355
00:11:58,310 --> 00:11:56,560
you're also going to get a welcome kit

356
00:11:59,030 --> 00:11:58,320
inclusive of a flight box to build your

357
00:12:00,949 --> 00:11:59,040
experiment

358
00:12:02,470 --> 00:12:00,959
and you're going to get an assigned spot

359
00:12:04,150 --> 00:12:02,480
to test your experiment

360
00:12:05,509 --> 00:12:04,160
on the vehicle that you you submitted

361
00:12:07,030 --> 00:12:05,519
with your proposal so either that

362
00:12:09,350 --> 00:12:07,040
suborbital rocket or that

363
00:12:10,310 --> 00:12:09,360

high altitude balloon and these are nasa

364
00:12:13,430 --> 00:12:10,320
supported

365
00:12:14,150 --> 00:12:13,440
commercial sub-orbital flights and so

366
00:12:16,550 --> 00:12:14,160
when we think about

367
00:12:18,310 --> 00:12:16,560
well well what what are these things

368
00:12:20,150 --> 00:12:18,320
exactly well let's dive into it we have

369
00:12:20,790 --> 00:12:20,160
three flight providers that are that are

370
00:12:22,629 --> 00:12:20,800
going to be

371
00:12:24,710 --> 00:12:22,639
um operating the flights on this

372
00:12:26,150 --> 00:12:24,720
challenge two are on the rocket side and

373
00:12:28,230 --> 00:12:26,160
one is on the balloon side

374
00:12:29,590 --> 00:12:28,240
so we'll start with the balloon um we've

375
00:12:31,670 --> 00:12:29,600
got uh

376
00:12:32,790 --> 00:12:31,680
all those those experiments for the high

377
00:12:34,949 --> 00:12:32,800
altitude balloon

378
00:12:35,990 --> 00:12:34,959
are going up on a raven flight and then

379
00:12:38,310 --> 00:12:36,000
we've also got

380
00:12:41,190 --> 00:12:38,320
um two different sub-orbital rockets

381
00:12:42,790 --> 00:12:41,200
we've got up arrow space and blue origin

382
00:12:44,470 --> 00:12:42,800
and we are going to go into much more

383
00:12:45,750 --> 00:12:44,480
detail on that later on in this

384
00:12:48,230 --> 00:12:45,760
presentation

385
00:12:49,430 --> 00:12:48,240
and i i want to just make sure we

386
00:12:51,509 --> 00:12:49,440
illustrate the program

387
00:12:53,190 --> 00:12:51,519
dates so the challenge launched last

388
00:12:54,389 --> 00:12:53,200

week as you know but that's really just

389
00:12:56,310 --> 00:12:54,399
planning the seed

390
00:12:58,389 --> 00:12:56,320
letting it percolate in your head so

391
00:12:59,910 --> 00:12:58,399
that when we get to the next school year

392
00:13:01,269 --> 00:12:59,920
um we can start thinking about putting

393
00:13:01,750 --> 00:13:01,279
in those entries so the entries are

394
00:13:04,310 --> 00:13:01,760
going to open

395
00:13:06,310 --> 00:13:04,320
august 18th close november 3rd we're

396
00:13:07,829 --> 00:13:06,320
going to judge judge judge all these

397
00:13:09,910 --> 00:13:07,839
amazing entries and then we're gonna

398
00:13:11,350 --> 00:13:09,920
announce the winners january 21st

399
00:13:13,030 --> 00:13:11,360
and then that's when the education

400
00:13:13,829 --> 00:13:13,040
journey begins of building those

401
00:13:15,110 --> 00:13:13,839
experiments

402
00:13:17,030 --> 00:13:15,120
and we're gonna be there every step of

403
00:13:18,629 --> 00:13:17,040
the way helping you with curriculum

404
00:13:20,389 --> 00:13:18,639
and you're gonna launch those flights in

405
00:13:22,870 --> 00:13:20,399
early 2023

406
00:13:23,670 --> 00:13:22,880
so um the last thing i'll say is that in

407
00:13:25,190 --> 00:13:23,680
terms of

408
00:13:27,190 --> 00:13:25,200
participating in this challenge the

409
00:13:28,949 --> 00:13:27,200
first step is putting in a proposal

410
00:13:30,550 --> 00:13:28,959
you don't need to have ever flown

411
00:13:32,230 --> 00:13:30,560
anything before you don't need to have

412
00:13:32,790 --> 00:13:32,240
ever coded before i've done electronics

413
00:13:34,629 --> 00:13:32,800

before

414
00:13:36,230 --> 00:13:34,639
you need to have that good idea and you

415
00:13:37,990 --> 00:13:36,240
need to use our template which we are

416
00:13:40,629 --> 00:13:38,000
going to be launching later this summer

417
00:13:42,470 --> 00:13:40,639
put in your experiment idea upload it to

418
00:13:43,829 --> 00:13:42,480
our site and that's how it all begins

419
00:13:45,269 --> 00:13:43,839
and if you're selected

420
00:13:47,030 --> 00:13:45,279
then you get the money and the funding

421
00:13:48,389 --> 00:13:47,040
and the assigned spot to go and build

422
00:13:51,350 --> 00:13:48,399
that experiment

423
00:13:53,189 --> 00:13:51,360
so i'm going to go ahead and um now

424
00:13:55,590 --> 00:13:53,199
tease up the next session

425
00:13:57,110 --> 00:13:55,600
of of our of our um kick right of our

426
00:13:58,870 --> 00:13:57,120
tech rice kickoff event

427
00:14:00,230 --> 00:13:58,880
which is hearing from nasa experts right

428
00:14:02,069 --> 00:14:00,240
so you're thinking oh my gosh you could

429
00:14:03,829 --> 00:14:02,079
do anything space exploration earth

430
00:14:05,670 --> 00:14:03,839
science so we're going to hear with ex

431
00:14:06,470 --> 00:14:05,680
from experts related to exploring the

432
00:14:10,230 --> 00:14:06,480
moon

433
00:14:12,310 --> 00:14:10,240
mars imaging remote sensing climate

434
00:14:14,150 --> 00:14:12,320
uh microgravity research and we're going

435
00:14:16,710 --> 00:14:14,160
to just fill your heads with inspiration

436
00:14:18,150 --> 00:14:16,720
from hearing about how nasa is is

437
00:14:19,110 --> 00:14:18,160
conducting research in these different

438
00:14:21,509 --> 00:14:19,120

areas and how

439
00:14:22,790 --> 00:14:21,519
many of them have used flights to prove

440
00:14:23,750 --> 00:14:22,800
their technologies

441
00:14:25,990 --> 00:14:23,760
so i'm going to go ahead and stop

442
00:14:29,990 --> 00:14:26,000
sharing screens here and i

443
00:14:32,069 --> 00:14:30,000
am going to transition over to our very

444
00:14:33,509 --> 00:14:32,079
first speaker we have for our expert

445
00:14:36,150 --> 00:14:33,519
sessions tonight which is

446
00:14:37,670 --> 00:14:36,160
nikki workheiser i am so excited to

447
00:14:40,389 --> 00:14:37,680
introduce her

448
00:14:42,069 --> 00:14:40,399
so nikki werkheiser is the director of

449
00:14:44,870 --> 00:14:42,079
technology maturation

450
00:14:45,750 --> 00:14:44,880
at nasa's space technology mission

451
00:14:47,670 --> 00:14:45,760
directorate

452
00:14:49,910 --> 00:14:47,680
um she brings a wealth of experience

453
00:14:50,550 --> 00:14:49,920
managing complex projects across nasa

454
00:14:52,470 --> 00:14:50,560
centers

455
00:14:54,710 --> 00:14:52,480
and she's built and managed the agencies

456
00:14:57,590 --> 00:14:54,720
in space manufacturing efforts

457
00:14:58,629 --> 00:14:57,600
um including recycling and 3d printing

458
00:15:00,550 --> 00:14:58,639
in space

459
00:15:02,389 --> 00:15:00,560
and now she's going to talk to us about

460
00:15:04,790 --> 00:15:02,399
all the exciting technologies

461
00:15:05,670 --> 00:15:04,800
in store for the moon so nikki i know

462
00:15:06,949 --> 00:15:05,680
i'm going to be sharing i'm your

463
00:15:07,910 --> 00:15:06,959

co-pilot right i'm going to be sharing

464
00:15:09,030 --> 00:15:07,920
your slides

465
00:15:10,949 --> 00:15:09,040
all right i told you i'm getting good at

466
00:15:12,389 --> 00:15:10,959
these buttons i'm going to share share

467
00:15:14,069 --> 00:15:12,399
the screen and get your slides up so

468
00:15:16,389 --> 00:15:14,079
bear with me one second

469
00:15:19,910 --> 00:15:16,399
can you hear me okay just making sure i

470
00:15:23,509 --> 00:15:22,870
all right here we go just tell me when i

471
00:15:25,990 --> 00:15:23,519
need to

472
00:15:26,949 --> 00:15:26,000
press next will do and thank you very

473
00:15:29,590 --> 00:15:26,959
much

474
00:15:31,030 --> 00:15:29,600
okay good afternoon everyone and thank

475
00:15:32,949 --> 00:15:31,040
you for having me today

476
00:15:35,110 --> 00:15:32,959
i am absolutely thrilled to be here to

477
00:15:37,269 --> 00:15:35,120
share some of our exciting activities

478
00:15:38,870 --> 00:15:37,279
underway for our lunar surface

479
00:15:41,269 --> 00:15:38,880
technology development

480
00:15:42,949 --> 00:15:41,279
and how there's a real opportunity here

481
00:15:45,670 --> 00:15:42,959
to test some of these technologies

482
00:15:47,829 --> 00:15:45,680
on sub-orbital flights and put us one

483
00:15:51,590 --> 00:15:47,839
step closer to the moon

484
00:15:54,230 --> 00:15:51,600
so dan if we go to the next slide

485
00:15:55,110 --> 00:15:54,240
so as i'm sure everyone here knows these

486
00:15:57,550 --> 00:15:55,120
first steps

487
00:15:59,030 --> 00:15:57,560
on the moon took place on july 20th of

488
00:16:02,550 --> 00:15:59,040

1969

489
00:16:04,949 --> 00:16:02,560
and december of 1972 was the last time

490
00:16:06,870 --> 00:16:04,959
depaul was on the surface so that means

491
00:16:07,350 --> 00:16:06,880
that anyone really under the age of 50

492
00:16:09,350 --> 00:16:07,360
or so

493
00:16:10,710 --> 00:16:09,360
has never seen a human walk on the

494
00:16:12,470 --> 00:16:10,720
surface of the moon

495
00:16:14,470 --> 00:16:12,480
i just happen to be in that category

496
00:16:16,389 --> 00:16:14,480
just barely but but i'm there

497
00:16:18,389 --> 00:16:16,399
so i'm eager for us to go back and when

498
00:16:20,069 --> 00:16:18,399
we do we really want to stay

499
00:16:22,470 --> 00:16:20,079
but in order to do that we're going to

500
00:16:24,389 --> 00:16:22,480
need some very special technologies

501
00:16:26,790 --> 00:16:24,399
and i'm going to talk to you today about

502
00:16:28,550 --> 00:16:26,800
some of those that we're developing now

503
00:16:30,470 --> 00:16:28,560
and how we're using suborbital flights

504
00:16:33,430 --> 00:16:30,480
to help us get there so if we go to the

505
00:16:37,110 --> 00:16:35,269
so i work in the space technology

506
00:16:39,189 --> 00:16:37,120
directorate at nasa with jim ryder who

507
00:16:39,990 --> 00:16:39,199
you heard from earlier as our fierce

508
00:16:42,389 --> 00:16:40,000
leader

509
00:16:43,430 --> 00:16:42,399
and our mantra is technology drives

510
00:16:45,350 --> 00:16:43,440
exploration

511
00:16:46,710 --> 00:16:45,360
and our programs are actually aligned

512
00:16:47,990 --> 00:16:46,720
along what we call the technology

513
00:16:50,790 --> 00:16:48,000

readiness level

514
00:16:52,389 --> 00:16:50,800
um spectrum as starting with the low trl

515
00:16:53,269 --> 00:16:52,399
that's our early stage innovation

516
00:16:55,670 --> 00:16:53,279
programs

517
00:16:57,590 --> 00:16:55,680
and those really focus more on r d and

518
00:16:59,189 --> 00:16:57,600
primarily engage with universities

519
00:17:01,350 --> 00:16:59,199
across the nation

520
00:17:02,870 --> 00:17:01,360
then we have our mid trl areas which is

521
00:17:04,630 --> 00:17:02,880
technology maturation

522
00:17:06,630 --> 00:17:04,640
and which is admittedly i'm a little

523
00:17:09,189 --> 00:17:06,640
biased i'm the director for that area

524
00:17:10,309 --> 00:17:09,199
and this is my favorite part of tech dev

525
00:17:11,909 --> 00:17:10,319
um

526
00:17:13,429 --> 00:17:11,919
let's see here i got a message there

527
00:17:15,029 --> 00:17:13,439
it's my favorite part of tech dev

528
00:17:16,710 --> 00:17:15,039
because really it can be seen kind of as

529
00:17:19,189 --> 00:17:16,720
the bridge between that r

530
00:17:20,710 --> 00:17:19,199
d in early stage and then mission or

531
00:17:22,230 --> 00:17:20,720
commercial infusion

532
00:17:23,909 --> 00:17:22,240
so we get to work really across all of

533
00:17:26,630 --> 00:17:23,919
those stakeholders and to take those

534
00:17:28,390 --> 00:17:26,640
initial concepts um to prototypes

535
00:17:30,710 --> 00:17:28,400
and then finally the end goal of course

536
00:17:32,470 --> 00:17:30,720
is to evolve high trl technologies let

537
00:17:34,710 --> 00:17:32,480
out of our technology demonstration

538
00:17:36,549 --> 00:17:34,720

missions program so this area really

539
00:17:37,430 --> 00:17:36,559
works more with industry and engineering

540
00:17:39,029 --> 00:17:37,440
implementation

541
00:17:40,710 --> 00:17:39,039
into our nasa missions as well as

542
00:17:43,510 --> 00:17:40,720
commercial infusion

543
00:17:44,870 --> 00:17:43,520
so in 2019 shortly after the artemis

544
00:17:46,870 --> 00:17:44,880
program was announced

545
00:17:48,070 --> 00:17:46,880
the lunar surface innovation initiative

546
00:17:50,870 --> 00:17:48,080
was created

547
00:17:51,750 --> 00:17:50,880
lsi works across industry academia and

548
00:17:53,270 --> 00:17:51,760
government

549
00:17:55,110 --> 00:17:53,280
to develop the transformative

550
00:17:57,270 --> 00:17:55,120
technologies that we're going to need

551
00:17:59,430 --> 00:17:57,280
for lunar surface exploration

552
00:18:00,789 --> 00:17:59,440
so i'll be focusing on those today some

553
00:18:03,909 --> 00:18:00,799
of the key technologies

554
00:18:05,669 --> 00:18:03,919
include mitigating lunar dust excavating

555
00:18:07,990 --> 00:18:05,679
and extracting the in-situ

556
00:18:08,710 --> 00:18:08,000
resources on the surface for consumables

557
00:18:11,350 --> 00:18:08,720
production

558
00:18:13,110 --> 00:18:11,360
and construction and then obtaining

559
00:18:13,510 --> 00:18:13,120
access to different locations on the

560
00:18:15,190 --> 00:18:13,520
moon

561
00:18:17,270 --> 00:18:15,200
some of which can be quite dangerous for

562
00:18:18,789 --> 00:18:17,280
humans to explore so we use robotic

563
00:18:20,230 --> 00:18:18,799

scalps for example

564
00:18:22,150 --> 00:18:20,240
and then of course for all of these we

565
00:18:23,350 --> 00:18:22,160
have to survive the harsh environments

566
00:18:25,029 --> 00:18:23,360
of the moon

567
00:18:26,710 --> 00:18:25,039
so as you might imagine in order to

568
00:18:28,950 --> 00:18:26,720
ensure that we are developing the types

569
00:18:30,870 --> 00:18:28,960
of capabilities

570
00:18:32,710 --> 00:18:30,880
of and operate on the moon we really

571
00:18:34,549 --> 00:18:32,720
have to utilize the different types of

572
00:18:36,390 --> 00:18:34,559
flight opportunities out there

573
00:18:37,750 --> 00:18:36,400
to inform these key technology

574
00:18:39,590 --> 00:18:37,760
developments especially when you're

575
00:18:41,669 --> 00:18:39,600
talking about novel technologies

576
00:18:42,950 --> 00:18:41,679
so this includes suborbital flights as

577
00:18:44,710 --> 00:18:42,960
well as our early

578
00:18:46,310 --> 00:18:44,720
commercial lunar payload services

579
00:18:47,350 --> 00:18:46,320
missions which take us all the way to

580
00:18:50,470 --> 00:18:47,360
the moon

581
00:18:52,310 --> 00:18:50,480
so dean if we go to the next slide

582
00:18:54,630 --> 00:18:52,320
so how do some orbital flights help us

583
00:18:56,870 --> 00:18:54,640
get to the moon well as jim mentioned

584
00:18:58,870 --> 00:18:56,880
nasa uses suborbital vehicles to test

585
00:18:59,990 --> 00:18:58,880
and mature technologies for future space

586
00:19:02,310 --> 00:19:00,000
exploration

587
00:19:04,549 --> 00:19:02,320
so by understanding how these payloads

588
00:19:06,310 --> 00:19:04,559

respond to the unique conditions

589
00:19:08,070 --> 00:19:06,320
researchers are able to confirm their

590
00:19:09,990 --> 00:19:08,080
designs and then make the necessary

591
00:19:12,549 --> 00:19:10,000
refinements and improvements before

592
00:19:14,230 --> 00:19:12,559
we send them all the way to the moon

593
00:19:15,590 --> 00:19:14,240
which can be really expensive and even

594
00:19:17,110 --> 00:19:15,600
more challenging

595
00:19:18,789 --> 00:19:17,120
so for the technologies that we're

596
00:19:20,870 --> 00:19:18,799
developing as part of the lunar surface

597
00:19:22,870 --> 00:19:20,880
innovation initiative in some cases we

598
00:19:24,870 --> 00:19:22,880
have very fundamental questions that we

599
00:19:25,830 --> 00:19:24,880
really need to answer before we send

600
00:19:27,990 --> 00:19:25,840
that demonstration

601
00:19:28,950 --> 00:19:28,000
all the way to the moon and even one day

602
00:19:30,950 --> 00:19:28,960
mars

603
00:19:32,310 --> 00:19:30,960
so through tech rise students are able

604
00:19:34,789 --> 00:19:32,320
to directly participate

605
00:19:36,549 --> 00:19:34,799
in the same process um obviously this

606
00:19:38,310 --> 00:19:36,559
can really foster creativity and open

607
00:19:39,990 --> 00:19:38,320
their minds to the importance of testing

608
00:19:41,590 --> 00:19:40,000
when designing experiments

609
00:19:43,110 --> 00:19:41,600
and to be honest we get some really

610
00:19:44,870 --> 00:19:43,120
exciting ideas from students that

611
00:19:45,830 --> 00:19:44,880
sometimes even nasa engineers don't

612
00:19:47,750 --> 00:19:45,840
think about

613
00:19:49,830 --> 00:19:47,760

but in order to be successful we really

614
00:19:51,830 --> 00:19:49,840
need support of you the educators

615
00:19:53,029 --> 00:19:51,840
so for me this is a really fun topic i

616
00:19:54,789 --> 00:19:53,039
could go on and on about all the

617
00:19:56,870 --> 00:19:54,799
different areas we're using suborbital

618
00:19:58,150 --> 00:19:56,880
flights and different testing platforms

619
00:20:00,390 --> 00:19:58,160
but in the interest of time i've

620
00:20:01,909 --> 00:20:00,400
selected a few key areas i'd like to use

621
00:20:03,350 --> 00:20:01,919
as examples today

622
00:20:05,990 --> 00:20:03,360
of how we're using this suborbital

623
00:20:08,870 --> 00:20:06,000
flights including one um that actually

624
00:20:10,789 --> 00:20:08,880
spins the cabin um to create uh the the

625
00:20:13,510 --> 00:20:10,799
to recreate the moon's 1 6

626
00:20:15,909 --> 00:20:13,520
g environment so if we go to the next

627
00:20:17,830 --> 00:20:15,919
slide i'll talk a little about those

628
00:20:19,510 --> 00:20:17,840
so first let's talk about lunar dust

629
00:20:21,190 --> 00:20:19,520
mitigation

630
00:20:22,950 --> 00:20:21,200
there's a good reason that we call this

631
00:20:24,310 --> 00:20:22,960
dust mitigation rather than dust

632
00:20:26,390 --> 00:20:24,320
solutions

633
00:20:28,149 --> 00:20:26,400
dust issues are very real and they have

634
00:20:30,310 --> 00:20:28,159
impacts or effects on pretty much

635
00:20:32,549 --> 00:20:30,320
every single thing we do on the surface

636
00:20:33,110 --> 00:20:32,559
so for example during the apollo 17

637
00:20:34,870 --> 00:20:33,120
mission

638
00:20:37,029 --> 00:20:34,880

crew members jack schmidt and gene

639
00:20:39,190 --> 00:20:37,039
cernan they had trouble moving their

640
00:20:41,350 --> 00:20:39,200
arms during the moon walks because the

641
00:20:43,110 --> 00:20:41,360
dust had really gummed up the joints

642
00:20:44,950 --> 00:20:43,120
and it was so abrasive that it actually

643
00:20:47,750 --> 00:20:44,960
wore through three layers of the

644
00:20:49,510 --> 00:20:47,760
kevlar-like material on jack's boot

645
00:20:51,190 --> 00:20:49,520
so we actually have current technologies

646
00:20:53,110 --> 00:20:51,200
under development that use active

647
00:20:55,110 --> 00:20:53,120
passive and operational measures to

648
00:20:56,789 --> 00:20:55,120
address dust mitigation

649
00:20:58,789 --> 00:20:56,799
examples of some of these that underway

650
00:21:00,630 --> 00:20:58,799
that will be demonstrated on suborbital

651
00:21:03,190 --> 00:21:00,640
flights before being tested on the moon

652
00:21:05,350 --> 00:21:03,200
include one that's called low g

653
00:21:06,870 --> 00:21:05,360
transport of dust liberated from

654
00:21:09,430 --> 00:21:06,880
spacesuit fabric

655
00:21:10,630 --> 00:21:09,440
um this lunar dust contamination that's

656
00:21:13,669 --> 00:21:10,640
in the cabin environment

657
00:21:16,710 --> 00:21:13,679
after every eva is really inevitable

658
00:21:19,110 --> 00:21:16,720
so this demonstration contains a little

659
00:21:21,669 --> 00:21:19,120
mechanism called a cloth bot and it has

660
00:21:24,070 --> 00:21:21,679
a dc motor with an arm that holds fabric

661
00:21:25,990 --> 00:21:24,080
with simulated dust particles and so it

662
00:21:27,029 --> 00:21:26,000
shapes the fabric to see what sticks and

663
00:21:29,110 --> 00:21:27,039

what doesn't

664
00:21:30,789 --> 00:21:29,120
so it directly supports the modeling

665
00:21:32,390 --> 00:21:30,799
efforts that are under early stage

666
00:21:33,990 --> 00:21:32,400
innovation projects and i like this

667
00:21:34,950 --> 00:21:34,000
example because it's quite a simple

668
00:21:36,870 --> 00:21:34,960
mechanism

669
00:21:38,390 --> 00:21:36,880
but the truth is that without recreating

670
00:21:40,310 --> 00:21:38,400
that one-sixth lunar g

671
00:21:41,430 --> 00:21:40,320
there's really no other way to get this

672
00:21:42,950 --> 00:21:41,440
fundamental information

673
00:21:44,470 --> 00:21:42,960
and to compare it to the models that

674
00:21:44,870 --> 00:21:44,480
we're doing to see if we're on the right

675
00:21:47,430 --> 00:21:44,880
path

676
00:21:48,789 --> 00:21:47,440
right the next experiment will actually

677
00:21:51,590 --> 00:21:48,799
improve our understanding of

678
00:21:53,750 --> 00:21:51,600
electrostatic dust charging and lofting

679
00:21:55,590 --> 00:21:53,760
it will compare the low g results in the

680
00:21:56,830 --> 00:21:55,600
suborbital flight where we spin the

681
00:22:00,149 --> 00:21:56,840
cabin to create that 1

682
00:22:01,430 --> 00:22:00,159
6g to the charging and lofting model

683
00:22:02,710 --> 00:22:01,440
that's currently under development

684
00:22:05,190 --> 00:22:02,720
through our nasa

685
00:22:06,549 --> 00:22:05,200
early stage initiative innovation

686
00:22:08,710 --> 00:22:06,559
project

687
00:22:10,230 --> 00:22:08,720
and then we have another one it's called

688
00:22:11,990 --> 00:22:10,240

hermes linergy

689
00:22:14,549 --> 00:22:12,000
and it's a sub-orbital demonstration

690
00:22:16,070 --> 00:22:14,559
that leverages a previously flown iss

691
00:22:17,029 --> 00:22:16,080
flight hardware so they've already found

692
00:22:19,350 --> 00:22:17,039
this on iss

693
00:22:20,149 --> 00:22:19,360
and they got data on how the particles

694
00:22:22,950 --> 00:22:20,159
act um

695
00:22:24,070 --> 00:22:22,960
in micro g on space station this one

696
00:22:25,909 --> 00:22:24,080
will now look how

697
00:22:27,430 --> 00:22:25,919
at how dust particles settle in the

698
00:22:30,149 --> 00:22:27,440
lunar g environment

699
00:22:31,029 --> 00:22:30,159
and then compare that data to micro g so

700
00:22:32,390 --> 00:22:31,039
there will be four

701
00:22:34,789 --> 00:22:32,400
tubes laid out with a number of

702
00:22:37,110 --> 00:22:34,799
different dust experiments including

703
00:22:38,710 --> 00:22:37,120
some for dust settling size sorting and

704
00:22:40,470 --> 00:22:38,720
granular mechanics

705
00:22:42,390 --> 00:22:40,480
so all of this is going to provide key

706
00:22:44,390 --> 00:22:42,400
answers to characterizing how dust

707
00:22:46,230 --> 00:22:44,400
behaves in the energy environment

708
00:22:47,590 --> 00:22:46,240
and help inform those eclipse payloads

709
00:22:49,350 --> 00:22:47,600
that i mentioned earlier that will go

710
00:22:52,230 --> 00:22:49,360
all the way to the moon

711
00:22:53,990 --> 00:22:52,240
so if we go to the next slide i'm going

712
00:22:55,669 --> 00:22:54,000
to talk a little bit about in-situ

713
00:22:58,710 --> 00:22:55,679

resource utilization

714
00:23:01,110 --> 00:22:58,720
or isru this focuses on how we're going

715
00:23:03,110 --> 00:23:01,120
to use the resources on the moon surface

716
00:23:04,950 --> 00:23:03,120
to get consumables for the astronauts

717
00:23:06,789 --> 00:23:04,960
and propellants for our rockets

718
00:23:08,230 --> 00:23:06,799
and then how we can use those same

719
00:23:10,070 --> 00:23:08,240
resources in conjunction

720
00:23:11,830 --> 00:23:10,080
with additive construction techniques

721
00:23:13,909 --> 00:23:11,840
and excavation technologies

722
00:23:15,750 --> 00:23:13,919
to build structures like landing pads

723
00:23:17,909 --> 00:23:15,760
and possibly even habitats

724
00:23:19,990 --> 00:23:17,919
and many of these technologies actually

725
00:23:21,909 --> 00:23:20,000
feed forward to mars as well

726
00:23:23,590 --> 00:23:21,919
so a couple examples of suborbital

727
00:23:25,750 --> 00:23:23,600
demonstrations for isru

728
00:23:26,950 --> 00:23:25,760
include our vibratory lunar regolith

729
00:23:29,430 --> 00:23:26,960
conveyor

730
00:23:31,270 --> 00:23:29,440
this is a granular material transport

731
00:23:32,950 --> 00:23:31,280
system demonstration it studies the

732
00:23:35,029 --> 00:23:32,960
vertical transport

733
00:23:36,070 --> 00:23:35,039
of those lunar regular stimulants in

734
00:23:38,230 --> 00:23:36,080
vacuum

735
00:23:40,870 --> 00:23:38,240
under that reduced gravity environment

736
00:23:42,789 --> 00:23:40,880
so it contains two sets of conveyors

737
00:23:44,070 --> 00:23:42,799
that will test vibration on different

738
00:23:45,430 --> 00:23:44,080

types of stimulants

739
00:23:47,029 --> 00:23:45,440
and this really helps raise that

740
00:23:49,190 --> 00:23:47,039
technology readiness level i was talking

741
00:23:50,070 --> 00:23:49,200
about to a six and it buys down risk

742
00:23:51,510 --> 00:23:50,080
before we

743
00:23:53,190 --> 00:23:51,520
actually have these demonstrations on

744
00:23:55,110 --> 00:23:53,200
the lunar surface

745
00:23:57,190 --> 00:23:55,120
um another example is called the

746
00:23:59,750 --> 00:23:57,200
electrodynamic conveyor

747
00:24:02,070 --> 00:23:59,760
and this would actually provide nasa

748
00:24:03,510 --> 00:24:02,080
lunar surface operations like isru and

749
00:24:06,070 --> 00:24:03,520
construct

750
00:24:07,590 --> 00:24:06,080
power alternate um to the state of art

751
00:24:10,549 --> 00:24:07,600
conveying technology

752
00:24:12,070 --> 00:24:10,559
so edc could be more reliable for long

753
00:24:15,269 --> 00:24:12,080
duration missions due to

754
00:24:16,710 --> 00:24:15,279
a reduction of moving parts and the

755
00:24:18,630 --> 00:24:16,720
experimental edc

756
00:24:20,789 --> 00:24:18,640
involves what they call a re-duster

757
00:24:22,870 --> 00:24:20,799
component that allows the repeated

758
00:24:23,909 --> 00:24:22,880
testing of regolith transport from

759
00:24:25,990 --> 00:24:23,919
shallow beds

760
00:24:27,750 --> 00:24:26,000
of the regolith and this one's in

761
00:24:29,350 --> 00:24:27,760
conjunction with university of central

762
00:24:32,549 --> 00:24:29,360
florida

763
00:24:34,390 --> 00:24:32,559

now if we go to the next slide

764
00:24:35,990 --> 00:24:34,400
i just wanted to give an example of one

765
00:24:39,269 --> 00:24:36,000
of our eclipse payloads that all of

766
00:24:43,029 --> 00:24:39,279
these suborbital demos help to inform

767
00:24:44,549 --> 00:24:43,039
our first one is an isru demonstration

768
00:24:47,750 --> 00:24:44,559
demonstrations called the polar

769
00:24:49,830 --> 00:24:47,760
resources ice mining experiment or prime

770
00:24:51,590 --> 00:24:49,840
um you heard me mention how isd is

771
00:24:52,789 --> 00:24:51,600
extremely important because when we're

772
00:24:54,470 --> 00:24:52,799
so far from home

773
00:24:55,990 --> 00:24:54,480
we simply have to be able to use the

774
00:24:59,269 --> 00:24:56,000
local resources um

775
00:25:01,669 --> 00:24:59,279
for for our consumables in

776
00:25:02,549 --> 00:25:01,679
it was 2015 a lot of water at the main

777
00:25:04,149 --> 00:25:02,559
poles

778
00:25:06,470 --> 00:25:04,159
even some of the most conservative

779
00:25:07,510 --> 00:25:06,480
estimates suggest millions of metric

780
00:25:09,029 --> 00:25:07,520
tons there

781
00:25:11,590 --> 00:25:09,039
and that water as i mentioned is really

782
00:25:13,830 --> 00:25:11,600
critical for mission consumables

783
00:25:15,750 --> 00:25:13,840
so prime one will fly on an intuitive

784
00:25:18,230 --> 00:25:15,760
machine's clip slander to the lunar

785
00:25:19,909 --> 00:25:18,240
south pole in late 2022

786
00:25:21,909 --> 00:25:19,919
and it will assess the volatiles and

787
00:25:24,230 --> 00:25:21,919
determine water content

788
00:25:26,310 --> 00:25:24,240

and this demo consists of two high trl

789
00:25:27,909 --> 00:25:26,320
instruments one is a mass spectrometer

790
00:25:29,029 --> 00:25:27,919
and the other one is a drill called

791
00:25:31,269 --> 00:25:29,039
trident

792
00:25:32,870 --> 00:25:31,279
and these same components will actually

793
00:25:33,990 --> 00:25:32,880
um are common technologies that will

794
00:25:35,909 --> 00:25:34,000
also be used

795
00:25:37,750 --> 00:25:35,919
in the science mission directorates

796
00:25:39,590 --> 00:25:37,760
volatiles investigating polar

797
00:25:40,390 --> 00:25:39,600
exploration rover thank goodness for

798
00:25:43,269 --> 00:25:40,400
acronyms right

799
00:25:44,710 --> 00:25:43,279
or viper mission um so testing these on

800
00:25:46,710 --> 00:25:44,720
the moon will help to

801
00:25:48,870 --> 00:25:46,720
um test for viper before it goes and

802
00:25:49,350 --> 00:25:48,880
vipre will actually add a rover um as

803
00:25:52,149 --> 00:25:49,360
well

804
00:25:53,350 --> 00:25:52,159
to these uh to these um to the mass

805
00:25:54,830 --> 00:25:53,360
effect and to the drill

806
00:25:57,350 --> 00:25:54,840
and that will fly to the moon in late

807
00:25:57,830 --> 00:25:57,360
2023 so you can see how these different

808
00:25:59,990 --> 00:25:57,840
um

809
00:26:01,750 --> 00:26:00,000
test opportunities inform one another we

810
00:26:02,390 --> 00:26:01,760
have the early suborbital flights that i

811
00:26:04,390 --> 00:26:02,400
talked about

812
00:26:05,669 --> 00:26:04,400
all of those help to inform these this

813
00:26:07,990 --> 00:26:05,679

type of prime mission

814
00:26:10,070 --> 00:26:08,000
which goes to the moon early then prime

815
00:26:12,230 --> 00:26:10,080
helps to inform viper which then um

816
00:26:14,390 --> 00:26:12,240
adds a rover so all these lessons

817
00:26:16,070 --> 00:26:14,400
learned we kind of build on one another

818
00:26:17,430 --> 00:26:16,080
to buy down risk and to develop a

819
00:26:20,390 --> 00:26:17,440
technology

820
00:26:21,750 --> 00:26:20,400
so if we go to the next slide i was

821
00:26:24,870 --> 00:26:21,760
going to talk a little bit about

822
00:26:26,470 --> 00:26:24,880
excavation and construction so

823
00:26:28,950 --> 00:26:26,480
excavation and construction is really

824
00:26:31,029 --> 00:26:28,960
kind of a bridge between isru

825
00:26:32,230 --> 00:26:31,039
or excavation is a bridge between isru

826
00:26:34,230 --> 00:26:32,240
and construction

827
00:26:36,630 --> 00:26:34,240
as it's required for drilling as well as

828
00:26:39,110 --> 00:26:36,640
for digging into the regolith to extract

829
00:26:41,110 --> 00:26:39,120
resources and to gather up some of that

830
00:26:42,230 --> 00:26:41,120
same regolith material to be used for

831
00:26:45,350 --> 00:26:42,240
construction

832
00:26:47,430 --> 00:26:45,360
resources will be needed to provide

833
00:26:49,669 --> 00:26:47,440
landing pads as well as protection

834
00:26:50,870 --> 00:26:49,679
of crew members hardware and electronics

835
00:26:53,110 --> 00:26:50,880
on the surface

836
00:26:55,590 --> 00:26:53,120
so this is an area where we have a great

837
00:26:57,510 --> 00:26:55,600
industry and university involvement

838
00:26:59,190 --> 00:26:57,520

for both of these areas we're leveraging

839
00:27:01,350 --> 00:26:59,200
and learning a lot from companies that

840
00:27:02,870 --> 00:27:01,360
actually do these things terrestrially

841
00:27:04,870 --> 00:27:02,880
as well as those who want to do it in

842
00:27:06,789 --> 00:27:04,880
space and we're working with a great

843
00:27:08,310 --> 00:27:06,799
deal of universities to understand those

844
00:27:10,230 --> 00:27:08,320
regular properties that i've talked

845
00:27:13,190 --> 00:27:10,240
about in those suborbital demos

846
00:27:15,190 --> 00:27:13,200
and even to make the lunar simulants the

847
00:27:16,950 --> 00:27:15,200
fake moon dirt if you will

848
00:27:19,190 --> 00:27:16,960
that we can use to test the hardware

849
00:27:20,630 --> 00:27:19,200
here on earth before it flies

850
00:27:22,070 --> 00:27:20,640
but there are many challenges and there

851
00:27:23,590 --> 00:27:22,080
are differences and that we're working

852
00:27:25,269 --> 00:27:23,600
through for example

853
00:27:27,350 --> 00:27:25,279
excavation technologies will need to be

854
00:27:29,269 --> 00:27:27,360
lightweight yet capable of digging in a

855
00:27:31,190 --> 00:27:29,279
reduced gravity environment

856
00:27:32,870 --> 00:27:31,200
and large-scale construction systems

857
00:27:33,669 --> 00:27:32,880
really have to be autonomous and

858
00:27:35,590 --> 00:27:33,679
equipped

859
00:27:37,750 --> 00:27:35,600
to work without astronauts help on the

860
00:27:39,750 --> 00:27:37,760
moon so for all these systems working

861
00:27:41,669 --> 00:27:39,760
reliably in these extreme environments

862
00:27:43,350 --> 00:27:41,679
is particularly challenging

863
00:27:44,710 --> 00:27:43,360

a couple of experiments we'll be testing

864
00:27:47,430 --> 00:27:44,720
on suborbital flights

865
00:27:48,710 --> 00:27:47,440
include one that's called dune flow

866
00:27:51,430 --> 00:27:48,720
which is just a great name

867
00:27:53,750 --> 00:27:51,440
right um and this liberal demo addresses

868
00:27:55,990 --> 00:27:53,760
the flow ability of lunar regolith

869
00:27:58,470 --> 00:27:56,000
it pushes the simulant um through and

870
00:28:00,310 --> 00:27:58,480
extrudes i'm testing the stability of

871
00:28:02,070 --> 00:28:00,320
artificial slopes

872
00:28:04,070 --> 00:28:02,080
that are constructed in lunar surface

873
00:28:05,990 --> 00:28:04,080
material so they actually use that

874
00:28:07,669 --> 00:28:06,000
regolith and this one is actually slated

875
00:28:10,070 --> 00:28:07,679
to have an actual apollo sample

876
00:28:11,669 --> 00:28:10,080
as well as different regular stimulants

877
00:28:13,269 --> 00:28:11,679
to guide the development of more

878
00:28:16,710 --> 00:28:13,279
accurate geotechnical

879
00:28:18,149 --> 00:28:16,720
or mechanical for excavation and

880
00:28:20,950 --> 00:28:18,159
construction testing

881
00:28:22,310 --> 00:28:20,960
and it uses nikki i'm gonna chime in i

882
00:28:24,630 --> 00:28:22,320
think we're gonna have to

883
00:28:26,389 --> 00:28:24,640
to button up soon and i know you were

884
00:28:27,510 --> 00:28:26,399
talking about autonomous testing and

885
00:28:28,470 --> 00:28:27,520
everything which i'm super excited for

886
00:28:30,389 --> 00:28:28,480
kids to be doing that

887
00:28:32,230 --> 00:28:30,399
in in space so i just want to give you a

888
00:28:34,870 --> 00:28:32,240

heads up that okay

889
00:28:36,389 --> 00:28:34,880
we need to go to the next speaker cool

890
00:28:37,110 --> 00:28:36,399
we can go on to the next one actually if

891
00:28:39,269 --> 00:28:37,120
you just flip

892
00:28:40,870 --> 00:28:39,279
to the last slide the others in between

893
00:28:42,230 --> 00:28:40,880
here are just examples of how we're

894
00:28:43,430 --> 00:28:42,240
using some of those suborbital

895
00:28:45,430 --> 00:28:43,440
demonstrations

896
00:28:46,789 --> 00:28:45,440
so flip to the very last one um and i

897
00:28:47,590 --> 00:28:46,799
just wanted to say this is just a quick

898
00:28:49,510 --> 00:28:47,600
snapshot

899
00:28:50,710 --> 00:28:49,520
of all of our different planned clips

900
00:28:51,909 --> 00:28:50,720
demonstrations

901
00:28:53,909 --> 00:28:51,919
several of which we'll be using those

902
00:28:55,350 --> 00:28:53,919
sub-orbital flights to test before they

903
00:28:57,269 --> 00:28:55,360
fly as i discussed

904
00:28:59,190 --> 00:28:57,279
and i just can't wait to see um what the

905
00:28:59,590 --> 00:28:59,200
tech rise students will propose that we

906
00:29:06,470 --> 00:28:59,600
test

907
00:29:10,470 --> 00:29:09,029
i love that last image and i love the

908
00:29:11,909 --> 00:29:10,480
idea of students

909
00:29:13,669 --> 00:29:11,919
coming up with experiments to fly on

910
00:29:14,630 --> 00:29:13,679
these suborbital flights that are

911
00:29:16,789 --> 00:29:14,640
proving ground for

912
00:29:18,870 --> 00:29:16,799
for for technologies that can go on to

913
00:29:21,430 --> 00:29:18,880

the moon um we're going back to the moon

914
00:29:22,549 --> 00:29:21,440
it's so exciting and um you know there's

915
00:29:23,830 --> 00:29:22,559
there's all kinds of

916
00:29:26,070 --> 00:29:23,840
technologies that need to be uh

917
00:29:27,510 --> 00:29:26,080
developed related to lunar exploration

918
00:29:28,789 --> 00:29:27,520
and now we're going to pivot and go a

919
00:29:30,950 --> 00:29:28,799
totally different direction we're going

920
00:29:32,230 --> 00:29:30,960
to talk about imagery and remote sensing

921
00:29:34,230 --> 00:29:32,240
and we have a really

922
00:29:36,149 --> 00:29:34,240
uh great next guest we've got rodney

923
00:29:38,710 --> 00:29:36,159
grubbs thanks for joining us rodney

924
00:29:40,310 --> 00:29:38,720
um so rodney began his career as a co-op

925
00:29:41,830 --> 00:29:40,320
motion picture photographer at nasa's

926
00:29:43,510 --> 00:29:41,840
marshall space flight center

927
00:29:45,350 --> 00:29:43,520
and he's currently the nasa imagery

928
00:29:47,510 --> 00:29:45,360
experts program manager

929
00:29:49,590 --> 00:29:47,520
and chair at uh chairs the international

930
00:29:50,950 --> 00:29:49,600
space agency imagery standards group

931
00:29:52,950 --> 00:29:50,960
i can't think of a better person to talk

932
00:29:55,029 --> 00:29:52,960
about imaging um

933
00:29:56,710 --> 00:29:55,039
from from a balloon so take it away

934
00:29:58,389 --> 00:29:56,720
rodney i'm excited to hear what you got

935
00:30:00,870 --> 00:29:58,399
for us

936
00:30:02,470 --> 00:30:00,880
great i hope you can hear me okay and

937
00:30:03,350 --> 00:30:02,480
i'm going to share your slides as well

938
00:30:05,669 --> 00:30:03,360

is that correct

939
00:30:06,470 --> 00:30:05,679
thank you all right let's bring them up

940
00:30:08,950 --> 00:30:06,480
all righty

941
00:30:10,630 --> 00:30:08,960
so um i was very excited about this

942
00:30:13,190 --> 00:30:10,640
opportunity to

943
00:30:14,549 --> 00:30:13,200
talk to educators my father was an

944
00:30:18,870 --> 00:30:14,559
educator

945
00:30:20,389 --> 00:30:18,880
principal my sister-in-law is an

946
00:30:21,350 --> 00:30:20,399
educator and a principal so i've been

947
00:30:23,430 --> 00:30:21,360
around

948
00:30:26,149 --> 00:30:23,440
educators my whole life so i hope

949
00:30:27,350 --> 00:30:26,159
everybody's having a great time today

950
00:30:29,590 --> 00:30:27,360
and it's a pleasure to speak to

951
00:30:32,470 --> 00:30:29,600
everybody so when i was thinking about

952
00:30:35,669 --> 00:30:32,480
this topic i was thinking about

953
00:30:38,230 --> 00:30:35,679
for some reason i kept coming back to um

954
00:30:39,269 --> 00:30:38,240
scouting ahead you know how do we use

955
00:30:41,990 --> 00:30:39,279
imagery

956
00:30:43,830 --> 00:30:42,000
to look beyond the horizon what we can't

957
00:30:47,830 --> 00:30:43,840
see with our own eyes

958
00:30:49,830 --> 00:30:47,840
remote sensing is is allowing us to

959
00:30:51,909 --> 00:30:49,840
take a peek before we're able to put

960
00:30:55,029 --> 00:30:51,919
human eyes on something so

961
00:30:55,750 --> 00:30:55,039
think about the wagon trains uh heading

962
00:30:58,710 --> 00:30:55,760
west

963
00:30:59,350 --> 00:30:58,720

they would send scouts out ahead to look

964
00:31:02,630 --> 00:30:59,360
at

965
00:31:04,389 --> 00:31:02,640
didn't have

966
00:31:06,149 --> 00:31:04,399
cameras back then so they would come

967
00:31:09,269 --> 00:31:06,159
back and give a verbal

968
00:31:11,110 --> 00:31:09,279
um you know account of what they saw

969
00:31:11,590 --> 00:31:11,120
what was ahead what was over the next

970
00:31:15,190 --> 00:31:11,600
rim

971
00:31:16,789 --> 00:31:15,200
right um and i can only imagine

972
00:31:18,950 --> 00:31:16,799
i know they didn't have wagon trains

973
00:31:20,870 --> 00:31:18,960
probably in arizona and utah but can you

974
00:31:23,269 --> 00:31:20,880
imagine if you were the scout

975
00:31:24,630 --> 00:31:23,279
trying to explain the grand canyon and

976
00:31:26,470 --> 00:31:24,640
telling everybody you're going to have

977
00:31:27,430 --> 00:31:26,480
to turn around this isn't going to work

978
00:31:29,830 --> 00:31:27,440
right

979
00:31:33,669 --> 00:31:29,840
so uh that's that's kind of the way i

980
00:31:38,789 --> 00:31:36,470
uh you know how we might be able to use

981
00:31:39,350 --> 00:31:38,799
that technology to scout ahead to look

982
00:31:41,430 --> 00:31:39,360
ahead

983
00:31:45,269 --> 00:31:41,440
beyond the rim and the horizon uh next

984
00:31:51,350 --> 00:31:48,789
so early in my career i um

985
00:31:52,950 --> 00:31:51,360
we had the technology to freeze video

986
00:31:55,110 --> 00:31:52,960
and turn it into pictures and this is a

987
00:31:55,669 --> 00:31:55,120
long long time ago a really long time

988
00:31:57,990 --> 00:31:55,679

ago

989
00:31:59,269 --> 00:31:58,000
and there was a scientist who had spoken

990
00:32:02,789 --> 00:31:59,279
to pilots

991
00:32:06,149 --> 00:32:02,799
who had uh said that they had seen

992
00:32:09,269 --> 00:32:06,159
lightning in space going out into space

993
00:32:10,789 --> 00:32:09,279
and so uh he got permission to turn the

994
00:32:13,350 --> 00:32:10,799
video cameras on

995
00:32:14,389 --> 00:32:13,360
during space shuttle missions and to

996
00:32:17,830 --> 00:32:14,399
shoot video

997
00:32:20,470 --> 00:32:17,840
of the of the night side of the earth

998
00:32:21,990 --> 00:32:20,480
of thunderstorms and he would come into

999
00:32:25,029 --> 00:32:22,000
my lab after a mission

1000
00:32:27,029 --> 00:32:25,039
and have me freeze these little video

1001
00:32:28,789 --> 00:32:27,039
frames and the technology was very poor

1002
00:32:30,789 --> 00:32:28,799
we didn't have all these gopro cameras

1003
00:32:34,070 --> 00:32:30,799
and things like this back then

1004
00:32:34,870 --> 00:32:34,080
and he would uh have me freeze a frame

1005
00:32:37,350 --> 00:32:34,880
of video

1006
00:32:39,190 --> 00:32:37,360
that he felt showed lightning going into

1007
00:32:39,830 --> 00:32:39,200
space and he would do these research

1008
00:32:43,190 --> 00:32:39,840
pages

1009
00:32:45,669 --> 00:32:43,200
papers uh about you know i believe

1010
00:32:47,269 --> 00:32:45,679
lightning shoots out into space not not

1011
00:32:49,430 --> 00:32:47,279
just to the ground and

1012
00:32:50,870 --> 00:32:49,440
at first he was met with a great deal of

1013
00:32:52,630 --> 00:32:50,880

skepticism

1014
00:32:54,149 --> 00:32:52,640
but over time the technology got a

1015
00:32:56,870 --> 00:32:54,159
little bit better and now we

1016
00:32:58,149 --> 00:32:56,880
know these things as jets and sprites so

1017
00:33:00,389 --> 00:32:58,159
this is an image of

1018
00:33:02,549 --> 00:33:00,399
of what these things are and what they

1019
00:33:04,149 --> 00:33:02,559
look like over a thunderstorm shooting

1020
00:33:06,630 --> 00:33:04,159
out into space

1021
00:33:08,710 --> 00:33:06,640
um and this was shot from the

1022
00:33:10,789 --> 00:33:08,720
international space station so

1023
00:33:13,830 --> 00:33:10,799
just in my short lifetime we've gone

1024
00:33:16,230 --> 00:33:13,840
from a phenomenon that nobody knew about

1025
00:33:17,350 --> 00:33:16,240
but had only heard about from pilots

1026
00:33:19,590 --> 00:33:17,360
looking over the rim

1027
00:33:20,710 --> 00:33:19,600
seeing the tops of clouds and and during

1028
00:33:22,630 --> 00:33:20,720
thunderstorms

1029
00:33:23,750 --> 00:33:22,640
and saying hey something is shooting out

1030
00:33:26,149 --> 00:33:23,760
into space

1031
00:33:26,950 --> 00:33:26,159
and then the technology got better and

1032
00:33:30,470 --> 00:33:26,960
then they

1033
00:33:33,190 --> 00:33:30,480
uh they were able to finally

1034
00:33:34,870 --> 00:33:33,200
accept that yes these things do exist

1035
00:33:36,710 --> 00:33:34,880
and now if you go out on google and

1036
00:33:38,549 --> 00:33:36,720
google jets and sprites

1037
00:33:39,750 --> 00:33:38,559
lightning in space you'll see images

1038
00:33:42,789 --> 00:33:39,760

like this

1039
00:33:46,230 --> 00:33:42,799
uh and and so it's it was these

1040
00:33:49,269 --> 00:33:46,240
crude cameras and uh verbal

1041
00:33:50,630 --> 00:33:49,279
uh explanations of things that uh were

1042
00:33:56,389 --> 00:33:50,640
able to lead

1043
00:34:03,110 --> 00:34:00,470
so uh imaging uh allows us to see

1044
00:34:04,710 --> 00:34:03,120
things that we can see with the human

1045
00:34:06,230 --> 00:34:04,720
eye in a different way you know these

1046
00:34:09,669 --> 00:34:06,240
are images of the aurora

1047
00:34:12,710 --> 00:34:09,679
and cities at night um and the hue

1048
00:34:16,230 --> 00:34:12,720
of that thin little atmospheric layer um

1049
00:34:19,270 --> 00:34:16,240
um that protects us all right and so

1050
00:34:20,629 --> 00:34:19,280
uh as we think about uh imaging and

1051
00:34:22,869 --> 00:34:20,639
remote sensing

1052
00:34:23,750 --> 00:34:22,879
uh these kinds of things these kinds of

1053
00:34:25,669 --> 00:34:23,760
images

1054
00:34:27,990 --> 00:34:25,679
should prove to inspire the next

1055
00:34:31,270 --> 00:34:28,000
generation and maybe there are other

1056
00:34:33,109 --> 00:34:31,280
phenomena out there that are not yet

1057
00:34:33,990 --> 00:34:33,119
explained and we don't yet have the

1058
00:34:36,550 --> 00:34:34,000
technology to

1059
00:34:37,589 --> 00:34:36,560
see it as clearly just like in my short

1060
00:34:39,829 --> 00:34:37,599
career

1061
00:34:41,270 --> 00:34:39,839
uh well my short lifetime relative to

1062
00:34:43,750 --> 00:34:41,280
humanity anyway

1063
00:34:44,389 --> 00:34:43,760

uh we've gone from uh seeing these

1064
00:34:47,589 --> 00:34:44,399
sprites

1065
00:34:50,629 --> 00:34:47,599
to them being acknowledged as um

1066
00:34:53,669 --> 00:34:50,639
as as being accepted technology and so

1067
00:34:54,710 --> 00:34:53,679
um uh as you as you look at

1068
00:34:57,510 --> 00:34:54,720
opportunities for

1069
00:34:58,150 --> 00:34:57,520
perhaps to put an imager on a on a

1070
00:35:00,950 --> 00:34:58,160
balloon

1071
00:35:01,990 --> 00:35:00,960
or on a sounding rocket um maybe there

1072
00:35:04,310 --> 00:35:02,000
are other phenomena

1073
00:35:05,109 --> 00:35:04,320
that scientists are insisting exist out

1074
00:35:08,470 --> 00:35:05,119
there

1075
00:35:11,510 --> 00:35:08,480
that uh a camera at high altitude

1076
00:35:14,470 --> 00:35:11,520
uh might be able to to uh take just a

1077
00:35:15,349 --> 00:35:14,480
single frame from uh that might prove to

1078
00:35:17,430 --> 00:35:15,359
actually be

1079
00:35:18,470 --> 00:35:17,440
real something that is scientific and

1080
00:35:23,430 --> 00:35:18,480
unknown

1081
00:35:26,710 --> 00:35:25,430
so one of the things that's that's cool

1082
00:35:29,349 --> 00:35:26,720
about nasa is

1083
00:35:31,270 --> 00:35:29,359
you know we we go one step further and

1084
00:35:33,750 --> 00:35:31,280
beyond our imaginations right

1085
00:35:34,550 --> 00:35:33,760
so uh we have drones on earth why not

1086
00:35:37,030 --> 00:35:34,560
have one

1087
00:35:39,510 --> 00:35:37,040
on mars and so some of you may have been

1088
00:35:42,390 --> 00:35:39,520

following the ingenuity helicopter

1089
00:35:43,430 --> 00:35:42,400
um you know it's it's not audacious

1090
00:35:46,069 --> 00:35:43,440
enough

1091
00:35:47,349 --> 00:35:46,079
that we land something the size of a

1092
00:35:50,550 --> 00:35:47,359
mini rover

1093
00:35:51,589 --> 00:35:50,560
or mini cooper on mars but we fly a

1094
00:35:54,470 --> 00:35:51,599
drone

1095
00:35:56,390 --> 00:35:54,480
um and do do those kinds of crazy things

1096
00:35:57,589 --> 00:35:56,400
and take images of that and this is just

1097
00:36:00,870 --> 00:35:57,599
the beginning

1098
00:36:03,750 --> 00:36:00,880
and so the engineers and scientists

1099
00:36:05,030 --> 00:36:03,760
um that dreamed this up uh were the

1100
00:36:07,910 --> 00:36:05,040
students of yesterday

1101
00:36:08,470 --> 00:36:07,920
and so what what are the students of of

1102
00:36:11,109 --> 00:36:08,480
today

1103
00:36:12,230 --> 00:36:11,119
going to do in just another generation

1104
00:36:15,589 --> 00:36:12,240
or so

1105
00:36:18,310 --> 00:36:15,599
um and it's the imagery like from a

1106
00:36:18,630 --> 00:36:18,320
dro a drone like this there's no telling

1107
00:36:21,670 --> 00:36:18,640
uh

1108
00:36:25,190 --> 00:36:21,680
what we're going to find out before we

1109
00:36:26,310 --> 00:36:25,200
humans go to mars and this is just the

1110
00:36:29,030 --> 00:36:26,320
beginning um

1111
00:36:31,030 --> 00:36:29,040
i can only imagine what uh the the

1112
00:36:33,109 --> 00:36:31,040
current crop of young people who are

1113
00:36:34,710 --> 00:36:33,119

used to video games and all this

1114
00:36:37,990 --> 00:36:34,720
technology and playing

1115
00:36:39,670 --> 00:36:38,000
games with people all over the world uh

1116
00:36:41,589 --> 00:36:39,680
seeing and hearing all of that what are

1117
00:36:43,510 --> 00:36:41,599
they going to come up with if properly

1118
00:36:45,670 --> 00:36:43,520
inspired

1119
00:36:47,349 --> 00:36:45,680
the last generation came up with this

1120
00:36:50,630 --> 00:36:47,359
which is pretty amazing

1121
00:36:52,630 --> 00:36:50,640
uh the mind just boggles at what the

1122
00:36:55,750 --> 00:36:52,640
next generation might do

1123
00:36:58,790 --> 00:36:55,760
and uh it's imagery uh like this that

1124
00:37:02,310 --> 00:36:58,800
tends to inspire people um so

1125
00:37:05,349 --> 00:37:02,320
uh you know i i definitely

1126
00:37:06,870 --> 00:37:05,359
um obviously am an imagery guy uh i'm a

1127
00:37:10,230 --> 00:37:06,880
big believer in it and i

1128
00:37:12,150 --> 00:37:10,240
i feel like um

1129
00:37:13,990 --> 00:37:12,160
data is very important but if we can

1130
00:37:15,670 --> 00:37:14,000
just see it and just

1131
00:37:17,270 --> 00:37:15,680
you might see something that you didn't

1132
00:37:19,589 --> 00:37:17,280
expect right

1133
00:37:21,349 --> 00:37:19,599
um those are the kinds of things that

1134
00:37:22,470 --> 00:37:21,359
might inspire the next generation of

1135
00:37:24,790 --> 00:37:22,480
explorers

1136
00:37:25,670 --> 00:37:24,800
um i can't remember if i have one more

1137
00:37:28,790 --> 00:37:25,680
chart or not

1138
00:37:31,510 --> 00:37:28,800

um do i is that it no that's it

1139
00:37:32,390 --> 00:37:31,520
that's it okay all righty so uh i know

1140
00:37:34,710 --> 00:37:32,400
that was short

1141
00:37:36,390 --> 00:37:34,720
and sweet uh and maybe got you back on

1142
00:37:38,950 --> 00:37:36,400
schedule here but

1143
00:37:40,390 --> 00:37:38,960
um let's think about that uh we're

1144
00:37:41,430 --> 00:37:40,400
trying to take that peak over the

1145
00:37:45,349 --> 00:37:41,440
horizon

1146
00:37:48,069 --> 00:37:45,359
and imagery and cameras uh allow us that

1147
00:37:49,430 --> 00:37:48,079
that look that and you just never know

1148
00:37:51,910 --> 00:37:49,440
what you might find

1149
00:37:53,190 --> 00:37:51,920
but you've got to go looking yeah and i

1150
00:37:54,150 --> 00:37:53,200
think it's important to note that you

1151
00:37:56,550 --> 00:37:54,160
know we're talking about

1152
00:37:58,470 --> 00:37:56,560
imaging out to space and and and you

1153
00:38:00,150 --> 00:37:58,480
know obviously we've seen so much

1154
00:38:01,990 --> 00:38:00,160
great imagery coming out of mars but

1155
00:38:03,030 --> 00:38:02,000
that has to start somewhere right

1156
00:38:04,310 --> 00:38:03,040
and you think about all those people

1157
00:38:05,829 --> 00:38:04,320
that developed that that started when

1158
00:38:07,270 --> 00:38:05,839
they were in high school taking pictures

1159
00:38:08,790 --> 00:38:07,280
and think about this it can start with

1160
00:38:10,069 --> 00:38:08,800
your students taking a picture from a

1161
00:38:11,670 --> 00:38:10,079
balloon down to earth

1162
00:38:13,190 --> 00:38:11,680
and thinking about what do i want to see

1163
00:38:14,550 --> 00:38:13,200

is it in the visible spectrum is it not

1164
00:38:16,150 --> 00:38:14,560
invisible spectrum

1165
00:38:17,750 --> 00:38:16,160
uh do i want to compare it what was here

1166
00:38:18,870 --> 00:38:17,760
before so i learned something from it

1167
00:38:21,030 --> 00:38:18,880
like what is in

1168
00:38:22,550 --> 00:38:21,040
exactly what you said rodney a picture

1169
00:38:24,069 --> 00:38:22,560
is like a thousand words right

1170
00:38:25,750 --> 00:38:24,079
there's there's a famous phrase that i'm

1171
00:38:27,349 --> 00:38:25,760
not saying properly right now

1172
00:38:28,950 --> 00:38:27,359
but um but yeah there's i think there's

1173
00:38:30,710 --> 00:38:28,960
so much opportunity for students to

1174
00:38:32,950 --> 00:38:30,720
think about what they want to see

1175
00:38:35,510 --> 00:38:32,960
and what imagery they want to to take in

1176
00:38:38,790 --> 00:38:35,520
these experiments so thank you rodney

1177
00:38:39,670 --> 00:38:38,800
for sharing your insight and um and now

1178
00:38:42,310 --> 00:38:39,680
we're going to go to

1179
00:38:43,910 --> 00:38:42,320
another possible area of thinking about

1180
00:38:46,470 --> 00:38:43,920
what kind of experiments

1181
00:38:47,190 --> 00:38:46,480
to develop and this time we're going to

1182
00:38:49,030 --> 00:38:47,200
talk about

1183
00:38:50,950 --> 00:38:49,040
climate and so we've got a really

1184
00:38:53,589 --> 00:38:50,960
special speaker today we have

1185
00:38:54,230 --> 00:38:53,599
alejandra mundo so alejandro is an

1186
00:38:57,430 --> 00:38:54,240
educator

1187
00:38:58,310 --> 00:38:57,440
he is a teacher in the bronx at a public

1188
00:38:59,750 --> 00:38:58,320

school

1189
00:39:01,829 --> 00:38:59,760
at the kingsbridge international high

1190
00:39:05,910 --> 00:39:01,839
school a public school in the bronx

1191
00:39:07,589 --> 00:39:05,920
and alejandro is part of the nasa ccri

1192
00:39:09,910 --> 00:39:07,599
teacher program and he's an associate

1193
00:39:12,069 --> 00:39:09,920
researcher which is a program which

1194
00:39:13,510 --> 00:39:12,079
pairs teachers with researchers to

1195
00:39:15,190 --> 00:39:13,520
conduct research

1196
00:39:17,109 --> 00:39:15,200
um and so you've been getting your hands

1197
00:39:19,670 --> 00:39:17,119
dirty i know doing climate research

1198
00:39:20,470 --> 00:39:19,680
and are excited about the prospect of

1199
00:39:22,470 --> 00:39:20,480
students um

1200
00:39:24,550 --> 00:39:22,480
you know gathering data related to

1201
00:39:25,750 --> 00:39:24,560
climate so i'm going to pass it over to

1202
00:39:27,990 --> 00:39:25,760
you alejandro just to

1203
00:39:29,109 --> 00:39:28,000
share a little bit about your your

1204
00:39:30,870 --> 00:39:29,119
journey uh

1205
00:39:33,030 --> 00:39:30,880
you know with with climate research and

1206
00:39:33,990 --> 00:39:33,040
then also engaging students with that as

1207
00:39:37,910 --> 00:39:34,000
well

1208
00:39:38,390 --> 00:39:37,920
dionne i really appreciate it and hello

1209
00:39:41,589 --> 00:39:38,400
and

1210
00:39:44,069 --> 00:39:41,599
thanks a lot to everybody who's joining

1211
00:39:45,910 --> 00:39:44,079
today i'm super excited to be uh here

1212
00:39:48,790 --> 00:39:45,920
and just being able to

1213
00:39:50,550 --> 00:39:48,800

to be part of this especially lots of

1214
00:39:52,470 --> 00:39:50,560
excitement incredible this

1215
00:39:55,030 --> 00:39:52,480
world i'm so thrilled to be here with

1216
00:39:57,190 --> 00:39:55,040
you and just send a big shout out to

1217
00:39:59,430 --> 00:39:57,200
all of the students educators scientists

1218
00:40:01,589 --> 00:39:59,440
and just everybody joining today so

1219
00:40:03,190 --> 00:40:01,599
glad to have you here so my name is

1220
00:40:04,950 --> 00:40:03,200
alejandro mundo and

1221
00:40:06,230 --> 00:40:04,960
let me tell you about myself so i'm a

1222
00:40:09,109 --> 00:40:06,240
geophysicist and

1223
00:40:10,069 --> 00:40:09,119
earth science educator and some of my

1224
00:40:13,109 --> 00:40:10,079
hobbies actually

1225
00:40:16,230 --> 00:40:13,119
include to uh just traveling

1226
00:40:17,109 --> 00:40:16,240
hiking camping so baking stargazing so i

1227
00:40:18,470 --> 00:40:17,119
guess i'm i'm

1228
00:40:20,470 --> 00:40:18,480
it's also good to say that i'm an

1229
00:40:21,990 --> 00:40:20,480
outdoors right individual

1230
00:40:24,150 --> 00:40:22,000
i'm currently involved like you were

1231
00:40:25,670 --> 00:40:24,160
saying at nasa goddard institute for

1232
00:40:28,710 --> 00:40:25,680
space studies

1233
00:40:29,589 --> 00:40:28,720
known as nasa gis and i'm an educator

1234
00:40:31,829 --> 00:40:29,599
and associate

1235
00:40:34,230 --> 00:40:31,839
researcher there and i also leave the

1236
00:40:36,309 --> 00:40:34,240
science department and teach science at

1237
00:40:38,550 --> 00:40:36,319
kingsbridge international high school

1238
00:40:40,230 --> 00:40:38,560

in the bronx new york city so shout out

1239
00:40:41,589 --> 00:40:40,240
to colleagues joining us from these

1240
00:40:44,470 --> 00:40:41,599
communities as well

1241
00:40:45,430 --> 00:40:44,480
ever since i was a boy i found passion

1242
00:40:47,270 --> 00:40:45,440
towards

1243
00:40:48,550 --> 00:40:47,280
at the outside world like i had a

1244
00:40:52,069 --> 00:40:48,560
passion not only for

1245
00:40:52,790 --> 00:40:52,079
nature but on how things worked i as i

1246
00:40:54,150 --> 00:40:52,800
grew up

1247
00:40:55,829 --> 00:40:54,160
like you can see in the pictures here on

1248
00:40:57,670 --> 00:40:55,839
the left i discovered

1249
00:40:59,829 --> 00:40:57,680
that science was actually a passion

1250
00:41:01,750 --> 00:40:59,839
within me so thanks to raw

1251
00:41:04,230 --> 00:41:01,760
role models who inspire minority

1252
00:41:07,190 --> 00:41:04,240
students like me to do science i

1253
00:41:09,430 --> 00:41:07,200
decided and to pursue a career instead

1254
00:41:11,990 --> 00:41:09,440
that would focus on the geological

1255
00:41:14,710 --> 00:41:12,000
sciences and how the art formed how it

1256
00:41:15,349 --> 00:41:14,720
functioned so i went to college i got my

1257
00:41:16,950 --> 00:41:15,359
degree

1258
00:41:19,589 --> 00:41:16,960
and i continued to get involved in

1259
00:41:21,270 --> 00:41:19,599
scientific experiences um

1260
00:41:23,190 --> 00:41:21,280
basically like yellowstone geyser as

1261
00:41:24,390 --> 00:41:23,200
seen here on the left but then i wanted

1262
00:41:26,150 --> 00:41:24,400
to dive in closer

1263
00:41:28,309 --> 00:41:26,160

so i got a master's degree in earth

1264
00:41:29,589 --> 00:41:28,319
science education at the american museum

1265
00:41:31,510 --> 00:41:29,599
of natural history

1266
00:41:33,349 --> 00:41:31,520
because i mean informal learning has

1267
00:41:34,630 --> 00:41:33,359
been and will continue to be a place of

1268
00:41:37,670 --> 00:41:34,640
discovery

1269
00:41:39,510 --> 00:41:37,680
and success as well for all individuals

1270
00:41:41,349 --> 00:41:39,520
wanting to encounter science

1271
00:41:43,349 --> 00:41:41,359
but i discovered i wanted to do more

1272
00:41:45,829 --> 00:41:43,359
than just science so i wanted to also

1273
00:41:46,790 --> 00:41:45,839
inspired motivate and just feel that

1274
00:41:48,870 --> 00:41:46,800
passion

1275
00:41:51,109 --> 00:41:48,880
to younger and future generations about

1276
00:41:53,190 --> 00:41:51,119
the power of discovery

1277
00:41:54,230 --> 00:41:53,200
exploration and especially making sure

1278
00:41:57,030 --> 00:41:54,240
that students

1279
00:41:58,390 --> 00:41:57,040
from all backgrounds would get access to

1280
00:42:01,670 --> 00:41:58,400
role models in stem

1281
00:42:03,030 --> 00:42:01,680
like me so i became an educator but even

1282
00:42:05,430 --> 00:42:03,040
though that i've been involved in

1283
00:42:07,109 --> 00:42:05,440
research where and in the classroom i

1284
00:42:08,069 --> 00:42:07,119
have also been part of doing some

1285
00:42:10,230 --> 00:42:08,079
research

1286
00:42:11,670 --> 00:42:10,240
which uh for example if it's that you

1287
00:42:13,349 --> 00:42:11,680
can see here on the images

1288
00:42:14,950 --> 00:42:13,359

whether it's like learning about the

1289
00:42:17,510 --> 00:42:14,960
metamorphism rate of

1290
00:42:19,109 --> 00:42:17,520
formation in manhattan or finding some

1291
00:42:19,510 --> 00:42:19,119
fossils that you can see in the image

1292
00:42:21,990 --> 00:42:19,520
here

1293
00:42:24,390 --> 00:42:22,000
or being involved in climate research

1294
00:42:27,349 --> 00:42:24,400
although as an educator i wanted to pass

1295
00:42:27,990 --> 00:42:27,359
on this experiences in the classroom

1296
00:42:31,349 --> 00:42:28,000
that would

1297
00:42:34,150 --> 00:42:31,359
last forever and just create that impact

1298
00:42:34,870 --> 00:42:34,160
uh by role models through inquiry-based

1299
00:42:36,550 --> 00:42:34,880
models

1300
00:42:37,910 --> 00:42:36,560
so let me just tell you here for example

1301
00:42:40,150 --> 00:42:37,920
i've been uh an

1302
00:42:42,069 --> 00:42:40,160
asset educator for four years in new

1303
00:42:43,670 --> 00:42:42,079
york city also

1304
00:42:45,430 --> 00:42:43,680
this is my second year so you were

1305
00:42:46,390 --> 00:42:45,440
saying that climate change research

1306
00:42:48,550 --> 00:42:46,400
initiative

1307
00:42:50,470 --> 00:42:48,560
and i am so happy to tell you that i

1308
00:42:53,190 --> 00:42:50,480
just published this stem unit plan

1309
00:42:54,230 --> 00:42:53,200
on climate change as of this year so let

1310
00:42:56,630 --> 00:42:54,240
me tell you about my

1311
00:42:58,470 --> 00:42:56,640
the background here at school where i am

1312
00:43:02,069 --> 00:42:58,480
this is in bronx new york

1313
00:43:04,870 --> 00:43:02,079

i teach art science astronomy to junior

1314
00:43:05,190 --> 00:43:04,880
seniors it's a small school but um we

1315
00:43:07,349 --> 00:43:05,200
got

1316
00:43:09,190 --> 00:43:07,359
students from a title one school which

1317
00:43:11,910 --> 00:43:09,200
includes almost 100

1318
00:43:13,430 --> 00:43:11,920
of low-income families where the it's a

1319
00:43:15,349 --> 00:43:13,440
very diverse background

1320
00:43:16,950 --> 00:43:15,359
which involves about 90 percent of

1321
00:43:18,790 --> 00:43:16,960
hispanics but also we got some other

1322
00:43:19,510 --> 00:43:18,800
groups like asian black which is like

1323
00:43:22,470 --> 00:43:19,520
three percent

1324
00:43:23,190 --> 00:43:22,480
and of course white as well so even

1325
00:43:26,309 --> 00:43:23,200
though that

1326
00:43:27,990 --> 00:43:26,319
we are a population of minorities we

1327
00:43:28,390 --> 00:43:28,000
have made it to the news and just like i

1328
00:43:29,990 --> 00:43:28,400
really

1329
00:43:31,750 --> 00:43:30,000
i think it just connects to the previous

1330
00:43:35,270 --> 00:43:31,760
presentation because we have

1331
00:43:38,630 --> 00:43:35,280
made it to the news where as you we

1332
00:43:40,710 --> 00:43:38,640
get to send our names on the nasa mars

1333
00:43:42,309 --> 00:43:40,720
rover perseverance together with you

1334
00:43:43,030 --> 00:43:42,319
know this opportunity that opened up to

1335
00:43:44,710 --> 00:43:43,040
others

1336
00:43:46,710 --> 00:43:44,720
and uh so we decided to take that

1337
00:43:47,190 --> 00:43:46,720
challenge we sent our names we want part

1338
00:43:48,950 --> 00:43:47,200

of this

1339
00:43:51,109 --> 00:43:48,960
opportunity and we made it through

1340
00:43:52,710 --> 00:43:51,119
different local channels like bronx 12

1341
00:43:54,710 --> 00:43:52,720
pix11 the united

1342
00:43:56,550 --> 00:43:54,720
federation of teachers as well as even

1343
00:43:59,430 --> 00:43:56,560
nbc highlighting

1344
00:44:01,109 --> 00:43:59,440
the stories of our students minority

1345
00:44:03,030 --> 00:44:01,119
students who actually have made it

1346
00:44:05,270 --> 00:44:03,040
and decided and we were part and have

1347
00:44:07,829 --> 00:44:05,280
been part of scientific discovery and

1348
00:44:10,230 --> 00:44:07,839
research opportunities

1349
00:44:11,270 --> 00:44:10,240
where we are in their backgrounds even

1350
00:44:13,430 --> 00:44:11,280
if they are

1351
00:44:15,190 --> 00:44:13,440
new to the country because uh these are

1352
00:44:17,430 --> 00:44:15,200
newcomers that have arrived to the

1353
00:44:20,069 --> 00:44:17,440
country within a few months to a few

1354
00:44:20,870 --> 00:44:20,079
uh just very recent probably one to two

1355
00:44:22,790 --> 00:44:20,880
years

1356
00:44:24,950 --> 00:44:22,800
but let me tell you about the goddard

1357
00:44:27,030 --> 00:44:24,960
institute for space studies so this is a

1358
00:44:27,990 --> 00:44:27,040
climate change research initiative this

1359
00:44:29,990 --> 00:44:28,000
is a lab

1360
00:44:31,589 --> 00:44:30,000
from the goddard space flight center

1361
00:44:34,550 --> 00:44:31,599
located in new york city

1362
00:44:35,670 --> 00:44:34,560
which has the research in exoplanets

1363
00:44:37,829 --> 00:44:35,680

astrobiology

1364
00:44:39,030 --> 00:44:37,839
but also climate change so focusing on

1365
00:44:41,349 --> 00:44:39,040
the last one

1366
00:44:42,950 --> 00:44:41,359
the office of stem engagement at nasa

1367
00:44:45,030 --> 00:44:42,960
geez actually runs this

1368
00:44:46,390 --> 00:44:45,040
program which is the climate change

1369
00:44:47,990 --> 00:44:46,400
research initiative

1370
00:44:49,990 --> 00:44:48,000
this is actually an incredible model

1371
00:44:52,710 --> 00:44:50,000
because it focuses on having a

1372
00:44:53,430 --> 00:44:52,720
scientist like dr christian brannon my

1373
00:44:56,069 --> 00:44:53,440
mentor

1374
00:44:56,710 --> 00:44:56,079
also grad students an educator and later

1375
00:44:58,950 --> 00:44:56,720
during the

1376
00:45:00,470 --> 00:44:58,960
during summer the undergrad and also

1377
00:45:02,790 --> 00:45:00,480
high school students join

1378
00:45:04,710 --> 00:45:02,800
and this is as you can see the levels of

1379
00:45:08,069 --> 00:45:04,720
education are all together

1380
00:45:10,470 --> 00:45:08,079
it involves um a vertical model

1381
00:45:11,430 --> 00:45:10,480
that affects all every single aspect of

1382
00:45:13,670 --> 00:45:11,440
educator

1383
00:45:15,510 --> 00:45:13,680
and eventually i also developed an

1384
00:45:16,950 --> 00:45:15,520
applied research stem curriculum

1385
00:45:19,430 --> 00:45:16,960
portfolio so here's a picture for

1386
00:45:21,829 --> 00:45:19,440
example of our recent

1387
00:45:23,030 --> 00:45:21,839
group where we have all of this uh part

1388
00:45:25,270 --> 00:45:23,040

of our individuals

1389
00:45:27,109 --> 00:45:25,280
also we eventually leads into the

1390
00:45:29,750 --> 00:45:27,119
research aspect that is then

1391
00:45:32,870 --> 00:45:29,760
put into a paper scientific poster as

1392
00:45:34,790 --> 00:45:32,880
well this one was actually about our

1393
00:45:36,710 --> 00:45:34,800
research during last summer and was

1394
00:45:39,190 --> 00:45:36,720
presented at the american

1395
00:45:41,270 --> 00:45:39,200
meteorological society also some part of

1396
00:45:43,430 --> 00:45:41,280
research was presented at geophysical

1397
00:45:45,030 --> 00:45:43,440
american geophysical union so it has

1398
00:45:46,790 --> 00:45:45,040
been such a great opportunity to not

1399
00:45:49,349 --> 00:45:46,800
just do research

1400
00:45:50,309 --> 00:45:49,359
at this ccri but also being able to

1401
00:45:52,550 --> 00:45:50,319
transport it

1402
00:45:55,109 --> 00:45:52,560
and move on let me tell you a little bit

1403
00:45:57,910 --> 00:45:55,119
more about that research so our goal is

1404
00:45:58,790 --> 00:45:57,920
actually to use the earth observations

1405
00:46:00,790 --> 00:45:58,800
to inform

1406
00:46:03,109 --> 00:46:00,800
urban planning efforts in order to

1407
00:46:04,470 --> 00:46:03,119
mitigate the impacts of climate change

1408
00:46:06,390 --> 00:46:04,480
in cities

1409
00:46:07,829 --> 00:46:06,400
it actually focuses on this phenomenon

1410
00:46:10,230 --> 00:46:07,839
which is known as the urban heat

1411
00:46:11,430 --> 00:46:10,240
island and this phenomenon pretty much

1412
00:46:13,349 --> 00:46:11,440
says that in

1413
00:46:14,550 --> 00:46:13,359

locations such as like big cities and

1414
00:46:17,750 --> 00:46:14,560
like urban settings

1415
00:46:19,270 --> 00:46:17,760
uh pretty much downtown in big cities

1416
00:46:20,309 --> 00:46:19,280
the temperature for like the land

1417
00:46:22,870 --> 00:46:20,319
surface temperature

1418
00:46:23,910 --> 00:46:22,880
is actually higher than in other

1419
00:46:26,390 --> 00:46:23,920
localities

1420
00:46:28,230 --> 00:46:26,400
like urban or rural and that's because

1421
00:46:29,910 --> 00:46:28,240
of the materials the buildings and

1422
00:46:30,710 --> 00:46:29,920
everything that it acts like a black

1423
00:46:33,589 --> 00:46:30,720
body

1424
00:46:35,109 --> 00:46:33,599
and those um temperatures would actually

1425
00:46:37,589 --> 00:46:35,119
be trapped and create

1426
00:46:39,109 --> 00:46:37,599
what we call the urban heat islands so

1427
00:46:40,790 --> 00:46:39,119
how do we actually keep track of them

1428
00:46:42,390 --> 00:46:40,800
although you can go outside and

1429
00:46:43,510 --> 00:46:42,400
temperature and get some temperatures

1430
00:46:45,670 --> 00:46:43,520
with thermometers

1431
00:46:47,670 --> 00:46:45,680
we actually have this instrument

1432
00:46:48,390 --> 00:46:47,680
satellite so we use satellite imagery

1433
00:46:51,349 --> 00:46:48,400
for example

1434
00:46:52,790 --> 00:46:51,359
landsat 8 which is about the distance

1435
00:46:53,750 --> 00:46:52,800
between the earth and the sun is about

1436
00:46:55,990 --> 00:46:53,760
150

1437
00:46:57,270 --> 00:46:56,000
000 kilometers we use landsat 8 as you

1438
00:47:00,230 --> 00:46:57,280

can see here

1439
00:47:00,630 --> 00:47:00,240
which is it goes around and gives orbit

1440
00:47:03,510 --> 00:47:00,640
so

1441
00:47:04,670 --> 00:47:03,520
every 99 minutes it goes around moving

1442
00:47:08,069 --> 00:47:04,680
at about 20

1443
00:47:11,670 --> 00:47:08,079
350 kilometers per hour and

1444
00:47:12,630 --> 00:47:11,680
landsat 8 captures about 185 kilometers

1445
00:47:14,870 --> 00:47:12,640
per swat

1446
00:47:15,910 --> 00:47:14,880
so eventually i imagine it's going

1447
00:47:17,910 --> 00:47:15,920
around making

1448
00:47:20,549 --> 00:47:17,920
you know going different orbits and just

1449
00:47:21,990 --> 00:47:20,559
again traveling thousands and millions

1450
00:47:25,589 --> 00:47:22,000
of kilometers

1451
00:47:26,470 --> 00:47:25,599
um in a 16-day cycle the idea is that

1452
00:47:30,230 --> 00:47:26,480
within this

1453
00:47:32,790 --> 00:47:30,240
16 days uh we will have the whole earth

1454
00:47:33,670 --> 00:47:32,800
it's actually going to be um every 16

1455
00:47:35,910 --> 00:47:33,680
day we got

1456
00:47:37,510 --> 00:47:35,920
the whole earth tracked and eventually

1457
00:47:38,950 --> 00:47:37,520
we can get for example land surface

1458
00:47:40,309 --> 00:47:38,960
temperatures which by the way we're

1459
00:47:42,790 --> 00:47:40,319
looking forward to the

1460
00:47:44,069 --> 00:47:42,800
the release of landsat 9 which is

1461
00:47:47,510 --> 00:47:44,079
actually happening

1462
00:47:50,150 --> 00:47:47,520
on um just the fall of 2021

1463
00:47:51,589 --> 00:47:50,160

but when we have this imagery from

1464
00:47:55,030 --> 00:47:51,599
satellites we actually use

1465
00:47:57,910 --> 00:47:55,040
bands like 10 4 and 5 where

1466
00:47:58,549 --> 00:47:57,920
using 10 converting radians from those

1467
00:48:00,549 --> 00:47:58,559
images

1468
00:48:02,390 --> 00:48:00,559
from add satellite brightness and also

1469
00:48:05,030 --> 00:48:02,400
using we calculate the

1470
00:48:07,109 --> 00:48:05,040
normalized vegetation index which pretty

1471
00:48:09,430 --> 00:48:07,119
much measures the vegetation

1472
00:48:10,470 --> 00:48:09,440
health and the density then to lead some

1473
00:48:12,790 --> 00:48:10,480
calculation of the

1474
00:48:13,990 --> 00:48:12,800
emissivity and when you calculate all of

1475
00:48:15,589 --> 00:48:14,000
those and put them together

1476
00:48:17,829 --> 00:48:15,599
you get something that it's like the

1477
00:48:19,190 --> 00:48:17,839
final land surface temperature

1478
00:48:21,109 --> 00:48:19,200
and if we know the land surface

1479
00:48:23,190 --> 00:48:21,119
temperature for example for

1480
00:48:25,349 --> 00:48:23,200
the past but also we can do some pre

1481
00:48:28,069 --> 00:48:25,359
some models for the future

1482
00:48:29,270 --> 00:48:28,079
and um we move so we get this imagery

1483
00:48:32,069 --> 00:48:29,280
from earth explorer

1484
00:48:32,790 --> 00:48:32,079
but then we bring it into arc gis we

1485
00:48:35,430 --> 00:48:32,800
create some

1486
00:48:35,829 --> 00:48:35,440
masks for example we got this mask from

1487
00:48:40,309 --> 00:48:35,839
the

1488
00:48:42,870 --> 00:48:40,319

can predict and we can put this

1489
00:48:44,549 --> 00:48:42,880
the vegetation index as well as the land

1490
00:48:46,630 --> 00:48:44,559
surface temperature map

1491
00:48:49,190 --> 00:48:46,640
and once we have this we can actually

1492
00:48:50,630 --> 00:48:49,200
run variables like of interest such as

1493
00:48:53,270 --> 00:48:50,640
the mean the median

1494
00:48:54,630 --> 00:48:53,280
the trends just percentiles as a whole

1495
00:48:56,630 --> 00:48:54,640
so here for example we got some

1496
00:48:58,630 --> 00:48:56,640
percentile ranges and we can focus on

1497
00:49:01,109 --> 00:48:58,640
different aspects so for example

1498
00:49:02,950 --> 00:49:01,119
um the lowest ones and we can create

1499
00:49:05,030 --> 00:49:02,960
some type of

1500
00:49:06,950 --> 00:49:05,040
maps whether if we want the true color

1501
00:49:08,790 --> 00:49:06,960
image or we also want the 80th

1502
00:49:09,670 --> 00:49:08,800
percentile that gives us the urban

1503
00:49:12,630 --> 00:49:09,680
coverage

1504
00:49:14,230 --> 00:49:12,640
or we want the 50th percentile which

1505
00:49:16,950 --> 00:49:14,240
gives us the green spaces

1506
00:49:17,990 --> 00:49:16,960
or the land surface temperatures that's

1507
00:49:20,950 --> 00:49:18,000
the focus that we

1508
00:49:21,589 --> 00:49:20,960
have been wanting to do that can give us

1509
00:49:23,109 --> 00:49:21,599
um

1510
00:49:25,270 --> 00:49:23,119
one of these land surface temperatures

1511
00:49:27,750 --> 00:49:25,280
so this is for example from durban

1512
00:49:29,589 --> 00:49:27,760
south africa which helps to identify

1513
00:49:31,430 --> 00:49:29,599

just the land surface temperatures

1514
00:49:32,630 --> 00:49:31,440
so this actually i brought it into a

1515
00:49:35,910 --> 00:49:32,640
curriculum which

1516
00:49:37,910 --> 00:49:35,920
has four different lessons so the unit

1517
00:49:39,589 --> 00:49:37,920
plan that focuses on climate change

1518
00:49:41,589 --> 00:49:39,599
remote sensing

1519
00:49:43,030 --> 00:49:41,599
the urban heat island as well as land

1520
00:49:44,950 --> 00:49:43,040
surface temperatures

1521
00:49:46,549 --> 00:49:44,960
and i'm actually happy to tell you you

1522
00:49:48,630 --> 00:49:46,559
were asking about how students actually

1523
00:49:50,950 --> 00:49:48,640
get involved students have been able to

1524
00:49:51,670 --> 00:49:50,960
go outside even in pandemic times by the

1525
00:49:54,150 --> 00:49:51,680
way

1526
00:49:54,710 --> 00:49:54,160
to go out there and just be getting some

1527
00:49:57,270 --> 00:49:54,720
through

1528
00:49:57,750 --> 00:49:57,280
this infrared thermometers and get data

1529
00:49:59,670 --> 00:49:57,760
from

1530
00:50:01,670 --> 00:49:59,680
whether like different materials whether

1531
00:50:04,710 --> 00:50:01,680
it's like vegetated area or

1532
00:50:06,390 --> 00:50:04,720
um cement and other locations

1533
00:50:07,910 --> 00:50:06,400
and they get bigger i love this i'm

1534
00:50:08,549 --> 00:50:07,920
gonna i'm gonna have to cut you short a

1535
00:50:10,549 --> 00:50:08,559
little bit

1536
00:50:12,069 --> 00:50:10,559
but i think what you're talking about is

1537
00:50:12,470 --> 00:50:12,079
exactly what we're talking about which

1538
00:50:14,870 --> 00:50:12,480

is

1539
00:50:15,589 --> 00:50:14,880
a inspiring awesome teacher like

1540
00:50:16,950 --> 00:50:15,599
yourself

1541
00:50:18,870 --> 00:50:16,960
engaging students in this kind of

1542
00:50:20,549 --> 00:50:18,880
research but then as well

1543
00:50:22,390 --> 00:50:20,559
like how do we take this how do we take

1544
00:50:24,230 --> 00:50:22,400
the idea of landsat data and bring it

1545
00:50:25,829 --> 00:50:24,240
back to how students can engage right

1546
00:50:27,270 --> 00:50:25,839
you saw them starting there with taking

1547
00:50:29,030 --> 00:50:27,280
temperature on the sidewalk

1548
00:50:30,230 --> 00:50:29,040
but then how do we take that even higher

1549
00:50:31,589 --> 00:50:30,240
like how do we take that to the next

1550
00:50:32,710 --> 00:50:31,599
level right and thinking about high

1551
00:50:34,870 --> 00:50:32,720
altitude balloons

1552
00:50:36,950 --> 00:50:34,880
and how you can um you know collect data

1553
00:50:38,309 --> 00:50:36,960
in the atmosphere and collect imagery

1554
00:50:40,390 --> 00:50:38,319
and tell a lot of these stories that

1555
00:50:41,270 --> 00:50:40,400
you're telling right so i'm sorry to cut

1556
00:50:43,829 --> 00:50:41,280
you off but i

1557
00:50:44,950 --> 00:50:43,839
um i i wanted to just give you a little

1558
00:50:46,950 --> 00:50:44,960
like 30 second

1559
00:50:48,630 --> 00:50:46,960
timer so keep going and and we'll wrap

1560
00:50:50,870 --> 00:50:48,640
it up and then go to the next okay

1561
00:50:52,710 --> 00:50:50,880
well sure definitely so eventually this

1562
00:50:54,390 --> 00:50:52,720
leads into data like you're saying

1563
00:50:57,030 --> 00:50:54,400

and the analysis of data is such

1564
00:50:58,470 --> 00:50:57,040
importance so as we conclude in this uh

1565
00:51:00,630 --> 00:50:58,480
because like we create some

1566
00:51:01,589 --> 00:51:00,640
some modeling as well uh i do want to

1567
00:51:03,349 --> 00:51:01,599
say that you know

1568
00:51:05,510 --> 00:51:03,359
after all if you're a student i want to

1569
00:51:07,589 --> 00:51:05,520
encourage you to keep up building on the

1570
00:51:09,349 --> 00:51:07,599
bright future that you have ahead of you

1571
00:51:10,630 --> 00:51:09,359
and also for educators then let's

1572
00:51:12,870 --> 00:51:10,640
continue to inspire

1573
00:51:13,829 --> 00:51:12,880
our younger generation of scientists to

1574
00:51:16,390 --> 00:51:13,839
continue

1575
00:51:18,390 --> 00:51:16,400
to move on more diverse stem fields and

1576
00:51:19,030 --> 00:51:18,400
provide these opportunities of doing

1577
00:51:21,270 --> 00:51:19,040
data

1578
00:51:23,510 --> 00:51:21,280
and analysis and just the generation of

1579
00:51:25,430 --> 00:51:23,520
explorers in a world to continue to do

1580
00:51:28,230 --> 00:51:25,440
scientific discoveries

1581
00:51:29,109 --> 00:51:28,240
and take science action uh to impact our

1582
00:51:32,710 --> 00:51:29,119
planet

1583
00:51:36,309 --> 00:51:32,720
and beyond thank you thank you so

1584
00:51:37,589 --> 00:51:36,319
much alejandro all right great uh thank

1585
00:51:40,309 --> 00:51:37,599
you thank you so much

1586
00:51:40,870 --> 00:51:40,319
and um we are next we're gonna change it

1587
00:51:42,790 --> 00:51:40,880
up based

1588
00:51:44,309 --> 00:51:42,800

uh uh we were originally gonna go to

1589
00:51:44,710 --> 00:51:44,319
george but next we're gonna go to swathi

1590
00:51:47,190 --> 00:51:44,720
and i'm

1591
00:51:48,630 --> 00:51:47,200
so so so excited to introduce you to

1592
00:51:50,470 --> 00:51:48,640
swathi and we've been talking about

1593
00:51:51,750 --> 00:51:50,480
what experiments could you make for for

1594
00:51:53,829 --> 00:51:51,760
climate what experiments could you make

1595
00:51:54,710 --> 00:51:53,839
for imaging for the moon and mars is a

1596
00:51:57,910 --> 00:51:54,720
big one

1597
00:51:58,549 --> 00:51:57,920
so uh we have sweaty and um she's kind

1598
00:51:59,750 --> 00:51:58,559
of famous

1599
00:52:01,589 --> 00:51:59,760
you might have seen her at the

1600
00:52:03,750 --> 00:52:01,599
perseverance landing

1601
00:52:05,030 --> 00:52:03,760
um so i'm gonna go ahead and introduce

1602
00:52:06,710 --> 00:52:05,040
you to swati sweaty

1603
00:52:08,790 --> 00:52:06,720
is the guidance navigation control

1604
00:52:10,309 --> 00:52:08,800
systems engineering group supervisor at

1605
00:52:13,430 --> 00:52:10,319
nasa jpl

1606
00:52:15,670 --> 00:52:13,440
uh she joined jpl in 2004 after uh

1607
00:52:16,630 --> 00:52:15,680
completing her bs and cornell um at

1608
00:52:19,510 --> 00:52:16,640
cornell and

1609
00:52:20,990 --> 00:52:19,520
mechanical and aerospace and has worked

1610
00:52:24,230 --> 00:52:21,000
on a number of different programs

1611
00:52:26,470 --> 00:52:24,240
including a flight to develop

1612
00:52:28,069 --> 00:52:26,480
uh navigation systems from ours i'm told

1613
00:52:28,870 --> 00:52:28,079

so i'm excited to hear all about it

1614
00:52:31,990 --> 00:52:28,880
swathi

1615
00:52:33,829 --> 00:52:32,000
so go ahead and uh inspire us about uh

1616
00:52:36,790 --> 00:52:33,839
how to design for mars

1617
00:52:37,109 --> 00:52:36,800
hi everyone i'm super excited to be here

1618
00:52:38,710 --> 00:52:37,119
so

1619
00:52:41,430 --> 00:52:38,720
today i'm going to tell you a little bit

1620
00:52:42,069 --> 00:52:41,440
about the piece of the perseverance

1621
00:52:45,270 --> 00:52:42,079
rover

1622
00:52:45,990 --> 00:52:45,280
that i worked on over the past um eight

1623
00:52:48,309 --> 00:52:46,000
years

1624
00:52:49,589 --> 00:52:48,319
and it's super cool because although we

1625
00:52:53,270 --> 00:52:49,599
uh you may have seen

1626
00:52:54,549 --> 00:52:53,280
a lot of the videos from uh the landing

1627
00:52:56,710 --> 00:52:54,559
you kind of never

1628
00:52:57,910 --> 00:52:56,720
really feel what we did over the last

1629
00:53:01,109 --> 00:52:57,920
eight years to actually

1630
00:53:04,790 --> 00:53:01,119
get to that point so back in

1631
00:53:07,349 --> 00:53:04,800
2013 when i joined the project

1632
00:53:08,790 --> 00:53:07,359
we were given a task and they said okay

1633
00:53:12,069 --> 00:53:08,800
you have to fly

1634
00:53:13,349 --> 00:53:12,079
in 2020 and land in 2021 and we want you

1635
00:53:17,109 --> 00:53:13,359
to reuse

1636
00:53:19,510 --> 00:53:17,119
as much of curiosity as you can so just

1637
00:53:21,829 --> 00:53:19,520
build it to print and you should be fine

1638
00:53:22,470 --> 00:53:21,839

the problem came with that perseverance

1639
00:53:25,190 --> 00:53:22,480
has

1640
00:53:26,710 --> 00:53:25,200
a new science objective from curiosity

1641
00:53:29,910 --> 00:53:26,720
and in order to

1642
00:53:31,750 --> 00:53:29,920
to do that to be the first rover to seek

1643
00:53:33,510 --> 00:53:31,760
the signs of past life

1644
00:53:35,270 --> 00:53:33,520
the community and the engineering

1645
00:53:38,630 --> 00:53:35,280
community decided to send perseverance

1646
00:53:41,589 --> 00:53:38,640
to jezreel crater which was a much

1647
00:53:42,630 --> 00:53:41,599
much more hazardous place than curiosity

1648
00:53:45,190 --> 00:53:42,640
went to

1649
00:53:46,630 --> 00:53:45,200
so when i in order to actually land

1650
00:53:49,109 --> 00:53:46,640
safely at jezreel equator

1651
00:53:50,390 --> 00:53:49,119
we needed a brand new technology that

1652
00:53:53,910 --> 00:53:50,400
would actually

1653
00:53:55,430 --> 00:53:53,920
let us land safely and to do this we had

1654
00:53:58,710 --> 00:53:55,440
to actually be able to

1655
00:54:00,390 --> 00:53:58,720
see where we were coming down as we were

1656
00:54:02,470 --> 00:54:00,400
doing the entry descent and landing so

1657
00:54:05,510 --> 00:54:02,480
all previous missions to mars have

1658
00:54:08,549 --> 00:54:05,520
actually used radar to

1659
00:54:09,990 --> 00:54:08,559
basically feel where they were going

1660
00:54:11,750 --> 00:54:10,000
and to kind of close their eyes and

1661
00:54:13,030 --> 00:54:11,760
touch the ground once they felt where

1662
00:54:15,190 --> 00:54:13,040
they were they would stop

1663
00:54:16,470 --> 00:54:15,200

but for perseverance we added a brand

1664
00:54:18,470 --> 00:54:16,480
new technology called

1665
00:54:20,309 --> 00:54:18,480
terrain relative navigation now what

1666
00:54:20,630 --> 00:54:20,319
terrain relative navigation allows us to

1667
00:54:24,150 --> 00:54:20,640
do

1668
00:54:25,430 --> 00:54:24,160
is actually land with the eyes open so

1669
00:54:27,990 --> 00:54:25,440
as we're coming down

1670
00:54:29,109 --> 00:54:28,000
on the parachute we're actually taking

1671
00:54:31,910 --> 00:54:29,119
images

1672
00:54:32,630 --> 00:54:31,920
of the ground with the lander vision

1673
00:54:35,270 --> 00:54:32,640
system

1674
00:54:36,309 --> 00:54:35,280
camera and by taking these images and

1675
00:54:39,190 --> 00:54:36,319
comparing it to

1676
00:54:40,950 --> 00:54:39,200
a map that we've created and loaded on

1677
00:54:41,750 --> 00:54:40,960
board we can compare the images to the

1678
00:54:44,549 --> 00:54:41,760
map

1679
00:54:44,870 --> 00:54:44,559
and orient them to figure out where we

1680
00:54:47,589 --> 00:54:44,880
are

1681
00:54:49,030 --> 00:54:47,599
with respect to the martian surface once

1682
00:54:50,950 --> 00:54:49,040
we know where we are

1683
00:54:53,589 --> 00:54:50,960
we're able to look down and we have

1684
00:54:56,470 --> 00:54:53,599
another map called the safe targets map

1685
00:54:57,829 --> 00:54:56,480
and we find given where we are where can

1686
00:55:00,069 --> 00:54:57,839
we get to

1687
00:55:01,910 --> 00:55:00,079
on the safe targets map and what's the

1688
00:55:02,950 --> 00:55:01,920

safest spot in that region that we can

1689
00:55:05,910 --> 00:55:02,960
get to

1690
00:55:07,510 --> 00:55:05,920
that we can land in this allows us to go

1691
00:55:08,870 --> 00:55:07,520
to jezreel equator which is filled with

1692
00:55:11,430 --> 00:55:08,880
cliffs and rocks

1693
00:55:11,990 --> 00:55:11,440
and actually see them as we're landing

1694
00:55:14,390 --> 00:55:12,000
and

1695
00:55:16,390 --> 00:55:14,400
be able to pick a spot in between all

1696
00:55:17,190 --> 00:55:16,400
the cliffs and rocks and slopes and sand

1697
00:55:21,030 --> 00:55:17,200
pits

1698
00:55:23,670 --> 00:55:21,040
and land exactly where we want to land

1699
00:55:25,270 --> 00:55:23,680
now the the super challenging thing

1700
00:55:27,750 --> 00:55:25,280
about entry descent and landing

1701
00:55:29,109 --> 00:55:27,760
is that there is absolutely no way to

1702
00:55:31,750 --> 00:55:29,119
test the whole thing

1703
00:55:32,230 --> 00:55:31,760
here on earth so we have to break it

1704
00:55:35,990 --> 00:55:32,240
down

1705
00:55:37,750 --> 00:55:36,000
into pieces so we try to test

1706
00:55:39,430 --> 00:55:37,760
like we fly and test all the different

1707
00:55:40,150 --> 00:55:39,440
things that we're worried about and we

1708
00:55:42,549 --> 00:55:40,160
have

1709
00:55:43,430 --> 00:55:42,559
three different ways that we do this so

1710
00:55:47,349 --> 00:55:43,440
the first one

1711
00:55:49,990 --> 00:55:47,359
is using simulations and analysis we run

1712
00:55:51,270 --> 00:55:50,000
uh software simulations that model the

1713
00:55:53,349 --> 00:55:51,280

environment

1714
00:55:55,510 --> 00:55:53,359
in order to figure out what we think is

1715
00:55:58,470 --> 00:55:55,520
going to happen and this allows us to

1716
00:56:00,390 --> 00:55:58,480
span all sorts of scenarios you know a

1717
00:56:03,109 --> 00:56:00,400
really windy day on mars a very sunny

1718
00:56:04,789 --> 00:56:03,119
day on mars what if it's you know

1719
00:56:06,230 --> 00:56:04,799
landing on this part right over the

1720
00:56:06,789 --> 00:56:06,240
cliff what if it's going to land on this

1721
00:56:08,789 --> 00:56:06,799
part

1722
00:56:11,030 --> 00:56:08,799
and by spreading the space around and

1723
00:56:13,430 --> 00:56:11,040
running lots and lots and lots like

1724
00:56:15,030 --> 00:56:13,440
tens and hundreds of thousands of runs

1725
00:56:16,630 --> 00:56:15,040
we're able to kind of see

1726
00:56:18,549 --> 00:56:16,640
all the different scenarios including

1727
00:56:22,150 --> 00:56:18,559
the the very

1728
00:56:24,150 --> 00:56:22,160
corner cases off nominal scenarios

1729
00:56:26,230 --> 00:56:24,160
the second aspect is hardware testing

1730
00:56:27,910 --> 00:56:26,240
you know we have mock-ups of all these

1731
00:56:29,829 --> 00:56:27,920
hardwares in our lab we

1732
00:56:31,349 --> 00:56:29,839
hook them up together and turn them on

1733
00:56:33,910 --> 00:56:31,359
and run the software through them

1734
00:56:35,910 --> 00:56:33,920
and feed inputs to have them pretend

1735
00:56:37,190 --> 00:56:35,920
like they are in mars and see

1736
00:56:39,190 --> 00:56:37,200
make sure that the computer doesn't

1737
00:56:41,510 --> 00:56:39,200
reset make sure that it can actually

1738
00:56:42,950 --> 00:56:41,520

uh do all the processing fast enough for

1739
00:56:46,630 --> 00:56:42,960
what we needed to do

1740
00:56:49,190 --> 00:56:46,640
on mars on landing day the third aspect

1741
00:56:50,069 --> 00:56:49,200
is field testing so this is where we

1742
00:56:51,750 --> 00:56:50,079
take

1743
00:56:53,349 --> 00:56:51,760
real hardware the mock is for the real

1744
00:56:55,829 --> 00:56:53,359
hardware and we put it into

1745
00:56:57,430 --> 00:56:55,839
a representative environment in order to

1746
00:57:00,950 --> 00:56:57,440
really validate

1747
00:57:03,990 --> 00:57:00,960
what we're doing because you know

1748
00:57:04,630 --> 00:57:04,000
we can design tests we can think of

1749
00:57:06,710 --> 00:57:04,640
things

1750
00:57:08,230 --> 00:57:06,720
but at the end of the day the other two

1751
00:57:09,109 --> 00:57:08,240
the simulation the hardware testing are

1752
00:57:12,390 --> 00:57:09,119
only as good

1753
00:57:13,910 --> 00:57:12,400
as we can imagine them to be what field

1754
00:57:15,829 --> 00:57:13,920
testing allows us to do

1755
00:57:17,589 --> 00:57:15,839
is to actually put it in a real world

1756
00:57:20,630 --> 00:57:17,599
scenario where we can't control

1757
00:57:21,910 --> 00:57:20,640
all the variables and see if the system

1758
00:57:25,510 --> 00:57:21,920
that we designed

1759
00:57:27,190 --> 00:57:25,520
can handle the real world when we're not

1760
00:57:28,710 --> 00:57:27,200
actually able to control all the

1761
00:57:29,510 --> 00:57:28,720
different things this allows us to say

1762
00:57:31,670 --> 00:57:29,520
that

1763
00:57:33,030 --> 00:57:31,680

even if we haven't thought of something

1764
00:57:35,270 --> 00:57:33,040
even if we haven't

1765
00:57:36,950 --> 00:57:35,280
uh designed specifically with that

1766
00:57:39,030 --> 00:57:36,960
particular thing in mind

1767
00:57:40,789 --> 00:57:39,040
that we've built a system that's robust

1768
00:57:43,829 --> 00:57:40,799
enough to

1769
00:57:45,990 --> 00:57:43,839
make it through in a real world scenario

1770
00:57:47,990 --> 00:57:46,000
so all these uh three different aspects

1771
00:57:49,829 --> 00:57:48,000
are called the vnv trifecta

1772
00:57:52,230 --> 00:57:49,839
we use all of these during the

1773
00:57:54,309 --> 00:57:52,240
development in order to piece together

1774
00:57:55,510 --> 00:57:54,319
the land revision system as part of the

1775
00:57:59,030 --> 00:57:55,520
terrain relative

1776
00:58:02,309 --> 00:57:59,040
navigation so i wanted to give two um

1777
00:58:03,910 --> 00:58:02,319
stories and share with you about how

1778
00:58:07,270 --> 00:58:03,920
this really helped us

1779
00:58:10,309 --> 00:58:07,280
to get to landing day successfully

1780
00:58:11,349 --> 00:58:10,319
so the first one is on this hardware

1781
00:58:15,190 --> 00:58:11,359
testing

1782
00:58:17,190 --> 00:58:15,200
uh blue box down here so we had

1783
00:58:18,950 --> 00:58:17,200
a simulation mockup that we had

1784
00:58:20,870 --> 00:58:18,960
inherited from curiosity and it was

1785
00:58:23,589 --> 00:58:20,880
capable of doing the full

1786
00:58:24,710 --> 00:58:23,599
curiosity end-to-end entry descent and

1787
00:58:28,630 --> 00:58:24,720
landing simulation

1788
00:58:30,870 --> 00:58:28,640

on the hardware at jpl now in order to

1789
00:58:32,870 --> 00:58:30,880
really show that perseverance could land

1790
00:58:33,750 --> 00:58:32,880
though we had to add terrain relative

1791
00:58:36,150 --> 00:58:33,760
navigation

1792
00:58:36,789 --> 00:58:36,160
and this involved integrating the whole

1793
00:58:39,589 --> 00:58:36,799
new

1794
00:58:41,349 --> 00:58:39,599
computer into the existing system

1795
00:58:43,430 --> 00:58:41,359
hooking them up so all

1796
00:58:45,270 --> 00:58:43,440
the new computer is talking to the old

1797
00:58:47,349 --> 00:58:45,280
computer it's saying the right things

1798
00:58:48,950 --> 00:58:47,359
we needed the new aspect of the

1799
00:58:51,990 --> 00:58:48,960
simulation to actually

1800
00:58:52,870 --> 00:58:52,000
um real time render the images of what

1801
00:58:55,910 --> 00:58:52,880
it would look like

1802
00:58:57,349 --> 00:58:55,920
as it was descending to feed that to

1803
00:58:59,349 --> 00:58:57,359
the land division system so it could

1804
00:59:01,910 --> 00:58:59,359
pretend that it was actually seeing

1805
00:59:03,750 --> 00:59:01,920
the descent on mars and we went back and

1806
00:59:06,710 --> 00:59:03,760
forth and we're trying to get all these

1807
00:59:07,990 --> 00:59:06,720
pieces together and it's not working and

1808
00:59:09,030 --> 00:59:08,000
it's not working because we're trying to

1809
00:59:10,470 --> 00:59:09,040
build it up

1810
00:59:12,230 --> 00:59:10,480
uh incrementally because we're first

1811
00:59:14,069 --> 00:59:12,240
testing this piece and we're first

1812
00:59:16,309 --> 00:59:14,079
testing the next layer and the next

1813
00:59:18,069 --> 00:59:16,319

layer uh eventually we got to one layer

1814
00:59:20,230 --> 00:59:18,079
and it wasn't working uh

1815
00:59:21,510 --> 00:59:20,240
spent weeks trying to figure out why it

1816
00:59:23,510 --> 00:59:21,520
wasn't working um

1817
00:59:24,789 --> 00:59:23,520
i couldn't get past it we kept the

1818
00:59:27,990 --> 00:59:24,799
simulation

1819
00:59:29,270 --> 00:59:28,000
uh kept showing the the rover

1820
00:59:31,910 --> 00:59:29,280
crashing because it couldn't figure out

1821
00:59:33,990 --> 00:59:31,920
where it was so in the end we decided to

1822
00:59:35,510 --> 00:59:34,000
uh skip a few steps and see that if we

1823
00:59:38,150 --> 00:59:35,520
just went to the whole

1824
00:59:40,069 --> 00:59:38,160
entry descent landing and didn't uh have

1825
00:59:42,150 --> 00:59:40,079
the steps in between because

1826
00:59:43,910 --> 00:59:42,160
um each step had its own assumptions it

1827
00:59:45,589 --> 00:59:43,920
had its own interfaces that weren't

1828
00:59:47,109 --> 00:59:45,599
necessarily the final one

1829
00:59:49,109 --> 00:59:47,119
would we find something would we find

1830
00:59:49,990 --> 00:59:49,119
that maybe that bug was just associated

1831
00:59:52,710 --> 00:59:50,000
with that level

1832
00:59:53,190 --> 00:59:52,720
so uh we gave it our go where we just

1833
00:59:55,589 --> 00:59:53,200
said

1834
00:59:56,789 --> 00:59:55,599
okay let's let's just see if it's

1835
01:00:00,230 --> 00:59:56,799
working enough

1836
01:00:03,030 --> 01:00:00,240
that we can do the whole thing um and we

1837
01:00:04,069 --> 01:00:03,040
tried it and it landed on our uh on our

1838
01:00:05,910 --> 01:00:04,079

attempts after

1839
01:00:07,829 --> 01:00:05,920
a month or two months of trying

1840
01:00:09,910 --> 01:00:07,839
incrementally fixing all the bugs

1841
01:00:10,870 --> 01:00:09,920
uh getting to block and then like

1842
01:00:12,710 --> 01:00:10,880
jumping a step

1843
01:00:14,150 --> 01:00:12,720
we were actually able to get it to work

1844
01:00:16,710 --> 01:00:14,160
and about

1845
01:00:17,349 --> 01:00:16,720
a week before the christmas holiday

1846
01:00:19,190 --> 01:00:17,359
break

1847
01:00:21,270 --> 01:00:19,200
so that was our first time that

1848
01:00:25,030 --> 01:00:21,280
perseverance landed

1849
01:00:27,430 --> 01:00:25,040
uh in any form whether simulated or real

1850
01:00:29,030 --> 01:00:27,440
um and this was at back in the winter of

1851
01:00:30,789 --> 01:00:29,040
2018 so that was our first

1852
01:00:32,150 --> 01:00:30,799
first glimpse that yes we could

1853
01:00:35,829 --> 01:00:32,160
potentially actually

1854
01:00:37,750 --> 01:00:35,839
do this on mars so after this we

1855
01:00:39,190 --> 01:00:37,760
we learned from these mistakes uh learn

1856
01:00:42,309 --> 01:00:39,200
from the bugs and the testing

1857
01:00:45,190 --> 01:00:42,319
and then we created a mock-up of

1858
01:00:45,910 --> 01:00:45,200
the land or vision system that we flew

1859
01:00:49,030 --> 01:00:45,920
out in

1860
01:00:52,789 --> 01:00:49,040
the mojave desert in order to

1861
01:00:55,990 --> 01:00:52,799
get that real world aspect

1862
01:00:58,630 --> 01:00:56,000
to the testing to be able to be

1863
01:01:00,309 --> 01:00:58,640

sure that whatever we had designed we

1864
01:01:01,750 --> 01:01:00,319
knew that it would work so i'm going to

1865
01:01:04,549 --> 01:01:01,760
play a little video here

1866
01:01:06,870 --> 01:01:04,559
that describes our field testing for

1867
01:01:08,950 --> 01:01:06,880
mars 2020 terrain relative navigation

1868
01:01:09,990 --> 01:01:08,960
uh why we took it into the desert what

1869
01:01:13,670 --> 01:01:10,000
we learned from that

1870
01:01:18,710 --> 01:01:13,680
testing and then how it relates to

1871
01:01:22,630 --> 01:01:21,270
we are in death valley testing terrain

1872
01:01:25,990 --> 01:01:22,640
relative navigation

1873
01:01:29,109 --> 01:01:26,000
the new technology for march 2020

1874
01:01:29,910 --> 01:01:29,119
the terrain in death valley is very much

1875
01:01:32,630 --> 01:01:29,920
like mars

1876
01:01:33,510 --> 01:01:32,640
it has a lot of sand dunes and steep

1877
01:01:35,430 --> 01:01:33,520
slopes

1878
01:01:37,589 --> 01:01:35,440
it's quite similar to the landing site

1879
01:01:41,430 --> 01:01:37,599
that mars 2020 will be going to

1880
01:01:43,829 --> 01:01:41,440
we're taking a copy of the system that

1881
01:01:46,630 --> 01:01:43,839
will be on the spacecraft

1882
01:01:47,430 --> 01:01:46,640
and we're testing it in the way that it

1883
01:01:49,430 --> 01:01:47,440
would be used

1884
01:01:51,109 --> 01:01:49,440
during the flight mission terrain

1885
01:01:51,990 --> 01:01:51,119
relative navigation gives the vehicle

1886
01:01:53,750 --> 01:01:52,000
the ability to

1887
01:01:55,349 --> 01:01:53,760
figure out where it is this is kind of

1888
01:01:56,549 --> 01:01:55,359

along the same lines of what the apollo

1889
01:01:58,230 --> 01:01:56,559
astronauts did

1890
01:01:59,670 --> 01:01:58,240
with people in the loop uh back in the

1891
01:02:01,589 --> 01:01:59,680
day those guys

1892
01:02:02,950 --> 01:02:01,599
were looking out the window and looking

1893
01:02:03,750 --> 01:02:02,960
for different craters and other features

1894
01:02:05,349 --> 01:02:03,760
on the moon

1895
01:02:06,230 --> 01:02:05,359
that they knew of from the maps we had

1896
01:02:07,190 --> 01:02:06,240
in the movie so that way they could

1897
01:02:08,870 --> 01:02:07,200
figure out where they are

1898
01:02:11,190 --> 01:02:08,880
and figure out where they needed to land

1899
01:02:11,990 --> 01:02:11,200
to be safe so for the first time here on

1900
01:02:13,270 --> 01:02:12,000
mars we

1901
01:02:14,870 --> 01:02:13,280
were automating that what terrain

1902
01:02:16,230 --> 01:02:14,880
relative navigation gives you is the

1903
01:02:18,789 --> 01:02:16,240
ability to avoid

1904
01:02:19,990 --> 01:02:18,799
hazards that you already know about so

1905
01:02:21,990 --> 01:02:20,000
large hazards

1906
01:02:24,390 --> 01:02:22,000
hills craters things that you've seen

1907
01:02:25,589 --> 01:02:24,400
before with the camera we take images as

1908
01:02:28,870 --> 01:02:25,599
we're descending

1909
01:02:31,109 --> 01:02:28,880
and we match pieces of the image to

1910
01:02:32,069 --> 01:02:31,119
orbital imagery that we have stored on

1911
01:02:34,710 --> 01:02:32,079
board

1912
01:02:35,750 --> 01:02:34,720
and if we make many of these matches

1913
01:02:37,910 --> 01:02:35,760

we're able to

1914
01:02:40,230 --> 01:02:37,920
figure out where we are relative to the

1915
01:02:41,029 --> 01:02:40,240
map if we didn't have terrain relative

1916
01:02:42,870 --> 01:02:41,039
navigation

1917
01:02:44,630 --> 01:02:42,880
the probability of landing safely at

1918
01:02:48,230 --> 01:02:44,640
jezra crater is about

1919
01:02:49,270 --> 01:02:48,240
80 to 85 but with mars 2020 we can

1920
01:02:51,190 --> 01:02:49,280
actually bring

1921
01:02:52,710 --> 01:02:51,200
that probability of success of landing

1922
01:02:55,510 --> 01:02:52,720
safely at jezreel crater

1923
01:02:55,910 --> 01:02:55,520
all the way up to 99 safe every single

1924
01:02:57,029 --> 01:02:55,920
time

1925
01:02:59,349 --> 01:02:57,039
we don't have an astronaut that we can

1926
01:03:00,549 --> 01:02:59,359
put on board mars 2020 uh but we can put

1927
01:03:02,390 --> 01:03:00,559
this uh this system this training

1928
01:03:03,990 --> 01:03:02,400
relative navigation system so that the

1929
01:03:04,630 --> 01:03:04,000
the spacecraft can figure it out on its

1930
01:03:06,789 --> 01:03:04,640
own

1931
01:03:08,710 --> 01:03:06,799
i could see it being used on lunar

1932
01:03:09,990 --> 01:03:08,720
missions science missions as well as

1933
01:03:11,670 --> 01:03:10,000
human missions

1934
01:03:13,990 --> 01:03:11,680
future mars missions of course mars

1935
01:03:15,910 --> 01:03:14,000
sample return europa lander

1936
01:03:17,190 --> 01:03:15,920
landing on a comet pretty much

1937
01:03:18,230 --> 01:03:17,200
everywhere you want to land

1938
01:03:36,230 --> 01:03:18,240

you're going to want to have terrain

1939
01:03:40,069 --> 01:03:39,510
so these uh two stories are a kind of a

1940
01:03:42,230 --> 01:03:40,079
glimpse

1941
01:03:44,470 --> 01:03:42,240
of how we did the testing for the mars

1942
01:03:46,230 --> 01:03:44,480
2020 lander vision system

1943
01:03:47,670 --> 01:03:46,240
with the field test we were able to get

1944
01:03:50,230 --> 01:03:47,680
a real world scenario

1945
01:03:51,109 --> 01:03:50,240
of how well the land of vision system

1946
01:03:53,589 --> 01:03:51,119
performed

1947
01:03:54,870 --> 01:03:53,599
and by going across all the different

1948
01:03:58,710 --> 01:03:54,880
terrain and sunlight

1949
01:03:59,430 --> 01:03:58,720
conditions and you know bland terrain

1950
01:04:01,510 --> 01:03:59,440
versus

1951
01:04:02,470 --> 01:04:01,520
really funky terrain we thought we were

1952
01:04:04,470 --> 01:04:02,480
getting about

1953
01:04:06,069 --> 01:04:04,480
you know 30 meters performance and that

1954
01:04:08,470 --> 01:04:06,079
was great that was in the family of what

1955
01:04:11,430 --> 01:04:08,480
we expected across all of the different

1956
01:04:13,190 --> 01:04:11,440
um accuracies and environments that we

1957
01:04:14,390 --> 01:04:13,200
could potentially see when landing at

1958
01:04:18,390 --> 01:04:14,400
jezera crater

1959
01:04:21,510 --> 01:04:18,400
uh in on february 18th

1960
01:04:23,510 --> 01:04:21,520
on the day of landing our targeted

1961
01:04:24,710 --> 01:04:23,520
accuracy that we wanted to pick a spot

1962
01:04:27,750 --> 01:04:24,720
and land within it

1963
01:04:29,190 --> 01:04:27,760

was about 60 meters this was what we had

1964
01:04:32,390 --> 01:04:29,200
designed to

1965
01:04:33,910 --> 01:04:32,400
before that our best estimate on landing

1966
01:04:34,470 --> 01:04:33,920
day that we thought we could get to was

1967
01:04:37,349 --> 01:04:34,480
around

1968
01:04:39,270 --> 01:04:37,359
45 meters what actually happened on

1969
01:04:40,870 --> 01:04:39,280
landing day was that we picked a target

1970
01:04:43,910 --> 01:04:40,880
and we got to within

1971
01:04:45,109 --> 01:04:43,920
five meters of that targeted spot on the

1972
01:04:48,150 --> 01:04:45,119
surface of mars

1973
01:04:50,950 --> 01:04:48,160
so after traveling 300 million miles

1974
01:04:51,829 --> 01:04:50,960
after doing this test campaign that

1975
01:04:54,870 --> 01:04:51,839
really put

1976
01:04:56,069 --> 01:04:54,880
had to lego this testing all together

1977
01:04:59,029 --> 01:04:56,079
between simulation

1978
01:05:00,150 --> 01:04:59,039
hardware testing and flight testing uh

1979
01:05:02,630 --> 01:05:00,160
we were able to

1980
01:05:04,150 --> 01:05:02,640
pick a target after 300 million miles

1981
01:05:06,870 --> 01:05:04,160
and get to it within

1982
01:05:08,230 --> 01:05:06,880
five meters on the surface of mars i

1983
01:05:10,390 --> 01:05:08,240
just wanted to come back on camera just

1984
01:05:11,589 --> 01:05:10,400
to give you an applause for that

1985
01:05:13,510 --> 01:05:11,599
because i know i'm the only one that can

1986
01:05:15,109 --> 01:05:13,520
do that but it's amazing amazing and it

1987
01:05:17,109 --> 01:05:15,119
was such a moment it was such a moment

1988
01:05:19,190 --> 01:05:17,119

to experience and to see

1989
01:05:20,470 --> 01:05:19,200
congrats to you and your team for all of

1990
01:05:23,190 --> 01:05:20,480
that and

1991
01:05:24,950 --> 01:05:23,200
it all started with with a flight right

1992
01:05:25,589 --> 01:05:24,960
so you gotta you gotta start small to

1993
01:05:28,950 --> 01:05:25,599
dream big

1994
01:05:30,789 --> 01:05:28,960
and you gotta stay small absolutely

1995
01:05:32,230 --> 01:05:30,799
and um you know and and you know when

1996
01:05:34,309 --> 01:05:32,240
you think about that first flight

1997
01:05:35,990 --> 01:05:34,319
it just it could be just making that

1998
01:05:38,630 --> 01:05:36,000
simple software algorithm to

1999
01:05:39,910 --> 01:05:38,640
know like what's a field and what's

2000
01:05:41,670 --> 01:05:39,920
what's a mountain you know

2001
01:05:43,029 --> 01:05:41,680
you have to think about those kinds of

2002
01:05:45,829 --> 01:05:43,039
things with your students

2003
01:05:46,950 --> 01:05:45,839
to start thinking about how one day

2004
01:05:48,630 --> 01:05:46,960
they're going to be swathy

2005
01:05:50,950 --> 01:05:48,640
calling out the landing successful

2006
01:05:54,150 --> 01:05:50,960
landing of perseverance on mars right

2007
01:05:55,670 --> 01:05:54,160
um so super inspiring stuff swathi um

2008
01:05:57,990 --> 01:05:55,680
we are actually now gonna you're gonna

2009
01:05:59,990 --> 01:05:58,000
stay we're gonna bring on a whole bunch

2010
01:06:01,190 --> 01:06:00,000
of nasa folks and we're gonna go into a

2011
01:06:02,630 --> 01:06:01,200
q a

2012
01:06:04,789 --> 01:06:02,640
um and we have another guest that's

2013
01:06:07,349 --> 01:06:04,799

actually joining us george um who has

2014
01:06:09,589 --> 01:06:07,359
flown a lot of microgravity experiments

2015
01:06:11,270 --> 01:06:09,599
starting from space shuttle uh onwards

2016
01:06:12,789 --> 01:06:11,280
to a lot of zero g flights as well and

2017
01:06:15,029 --> 01:06:12,799
he's gonna come on board so

2018
01:06:16,789 --> 01:06:15,039
um at this point why don't we go ahead

2019
01:06:17,990 --> 01:06:16,799
and get a bunch of nasa folks on board

2020
01:06:19,910 --> 01:06:18,000
and while we're doing

2021
01:06:21,109 --> 01:06:19,920
that for everyone in our audience this

2022
01:06:22,150 --> 01:06:21,119
is the time where we're going to take

2023
01:06:24,870 --> 01:06:22,160
your questions

2024
01:06:26,470 --> 01:06:24,880
so um just load up the q a with all

2025
01:06:28,150 --> 01:06:26,480
kinds of questions that you have

2026
01:06:29,990 --> 01:06:28,160
it could just be about anything that

2027
01:06:32,390 --> 01:06:30,000
you're curious about at nasa

2028
01:06:33,829 --> 01:06:32,400
um you know you could you know whatever

2029
01:06:34,789 --> 01:06:33,839
you want to ask we're going to address

2030
01:06:38,470 --> 01:06:34,799
these questions

2031
01:06:40,069 --> 01:06:38,480
now and um and then after this q a

2032
01:06:41,670 --> 01:06:40,079
we're going to dive into some education

2033
01:06:42,789 --> 01:06:41,680
lessons that take some of these big pie

2034
01:06:44,470 --> 01:06:42,799
in the sky ideas

2035
01:06:45,990 --> 01:06:44,480
and think about how you can get started

2036
01:06:48,630 --> 01:06:46,000
with your students doing

2037
01:06:49,589 --> 01:06:48,640
their very first flight experiment so

2038
01:06:54,230 --> 01:06:49,599

come on in

2039
01:06:55,670 --> 01:06:54,240
squares of nasa we're bringing them in

2040
01:06:58,150 --> 01:06:55,680
i'm the only one that knows that i guess

2041
01:07:01,029 --> 01:06:58,160
does anyone know hollywood squares

2042
01:07:02,630 --> 01:07:01,039
okay all right good so we're gonna bring

2043
01:07:05,510 --> 01:07:02,640
some in we've got alejandro

2044
01:07:07,510 --> 01:07:05,520
we've got nikki coming in and of course

2045
01:07:09,829 --> 01:07:07,520
we've got swati here

2046
01:07:10,549 --> 01:07:09,839
and i think we have some other folks

2047
01:07:13,990 --> 01:07:10,559
coming in

2048
01:07:17,430 --> 01:07:14,000
and i am going to flip over to our

2049
01:07:25,260 --> 01:07:21,910
uh we've got some hellos and highs

2050
01:07:26,829 --> 01:07:25,270
and everything here and i'm in the q a

2051
01:07:29,510 --> 01:07:26,839
[Music]

2052
01:07:34,710 --> 01:07:29,520
section

2053
01:07:36,230 --> 01:07:34,720
bear with us we're using a new platform

2054
01:07:38,630 --> 01:07:36,240
here so we're starting the q a

2055
01:07:39,990 --> 01:07:38,640
section so go ahead and type your

2056
01:07:43,190 --> 01:07:40,000
questions

2057
01:07:44,549 --> 01:07:43,200
and um and i'm gonna actually just kick

2058
01:07:44,950 --> 01:07:44,559
off while we're getting some of our

2059
01:07:47,829 --> 01:07:44,960
other

2060
01:07:48,470 --> 01:07:47,839
uh folks on board here i'm gonna start

2061
01:07:50,710 --> 01:07:48,480
uh

2062
01:07:52,069 --> 01:07:50,720
with a question i really for nikki and

2063
01:07:54,710 --> 01:07:52,079

swathi first

2064
01:07:55,670 --> 01:07:54,720
about um when you were a student did you

2065
01:07:59,190 --> 01:07:55,680
always

2066
01:08:04,710 --> 01:08:02,150
just just curious about it no we've got

2067
01:08:07,430 --> 01:08:04,720
to know and we've got a 100

2068
01:08:09,349 --> 01:08:07,440
we've got the polar opposite okay so who

2069
01:08:11,270 --> 01:08:09,359
should we start with first um nikki why

2070
01:08:15,109 --> 01:08:11,280
don't we start with you

2071
01:08:16,229 --> 01:08:15,119
um yes i actually um grew up in a family

2072
01:08:17,990 --> 01:08:16,239
that had no

2073
01:08:19,829 --> 01:08:18,000
nasa background or experience and i

2074
01:08:21,669 --> 01:08:19,839
think they thought i was a little crazy

2075
01:08:24,709 --> 01:08:21,679
but completely supported me

2076
01:08:27,269 --> 01:08:24,719
um and uh yeah i actually

2077
01:08:28,630 --> 01:08:27,279
went to space camp and the whole thing

2078
01:08:30,950 --> 01:08:28,640
saved up all my money to go

2079
01:08:32,309 --> 01:08:30,960
and it's all i thought about um and was

2080
01:08:33,510 --> 01:08:32,319
really interested of course this makes

2081
01:08:37,030 --> 01:08:33,520
me sound really old

2082
01:08:40,149 --> 01:08:37,040
it was before the internet existed

2083
01:08:42,070 --> 01:08:40,159
so trying to find information um you

2084
01:08:43,669 --> 01:08:42,080
know about nasa nasa's missions the

2085
01:08:44,789 --> 01:08:43,679
different types of jobs you know i

2086
01:08:46,870 --> 01:08:44,799
really just thought

2087
01:08:48,070 --> 01:08:46,880
you know i knew scientists and engineers

2088
01:08:49,430 --> 01:08:48,080

right and i thought well maybe i want to

2089
01:08:51,829 --> 01:08:49,440
be an inventor

2090
01:08:54,229 --> 01:08:51,839
um i didn't know what a technologist was

2091
01:08:56,149 --> 01:08:54,239
or what technology development was

2092
01:08:57,349 --> 01:08:56,159
um and so i kind of stumbled into that

2093
01:08:59,590 --> 01:08:57,359
and fell in love but

2094
01:09:01,030 --> 01:08:59,600
but yeah i would say um definitely a

2095
01:09:04,229 --> 01:09:01,040
space nerd from way back

2096
01:09:04,550 --> 01:09:04,239
yeah great all right swathi how about

2097
01:09:06,630 --> 01:09:04,560
you

2098
01:09:07,829 --> 01:09:06,640
and then alejandra will we'll hear about

2099
01:09:09,749 --> 01:09:07,839
whether you thought about

2100
01:09:11,030 --> 01:09:09,759
ever working with nasa as well all right

2101
01:09:13,590 --> 01:09:11,040
go ahead swathi

2102
01:09:15,749 --> 01:09:13,600
so i totally echo the space nerd i was

2103
01:09:16,950 --> 01:09:15,759
always a a space nerd from as long as i

2104
01:09:19,110 --> 01:09:16,960
can remember but

2105
01:09:20,870 --> 01:09:19,120
uh it for the longest time it didn't

2106
01:09:23,910 --> 01:09:20,880
connect that it was

2107
01:09:25,910 --> 01:09:23,920
a profession that i could pursue so i

2108
01:09:27,269 --> 01:09:25,920
was like okay i'll be a physician i'll

2109
01:09:29,749 --> 01:09:27,279
be a pediatrician because that's

2110
01:09:31,669 --> 01:09:29,759
you know a profession that you can

2111
01:09:33,030 --> 01:09:31,679
easily relate to as a child you know you

2112
01:09:34,870 --> 01:09:33,040
go to the doctors like oh they make me

2113
01:09:37,910 --> 01:09:34,880

feel better i can i can do that

2114
01:09:38,470 --> 01:09:37,920
it wasn't until i took my first physics

2115
01:09:40,709 --> 01:09:38,480
class

2116
01:09:42,470 --> 01:09:40,719
in high school towards the end of high

2117
01:09:44,390 --> 01:09:42,480
school actually that it started to dawn

2118
01:09:45,590 --> 01:09:44,400
like oh okay maybe this is what

2119
01:09:47,910 --> 01:09:45,600
engineering is

2120
01:09:49,110 --> 01:09:47,920
and this seems like fun and i can do

2121
01:09:51,749 --> 01:09:49,120
this and uh

2122
01:09:53,269 --> 01:09:51,759
started to connect the dots of well i

2123
01:09:54,709 --> 01:09:53,279
really like space and physics is easy

2124
01:09:55,430 --> 01:09:54,719
for me so maybe i should go do that

2125
01:09:58,470 --> 01:09:55,440
instead of

2126
01:10:00,709 --> 01:09:58,480
you know slogging over biology terms and

2127
01:10:01,990 --> 01:10:00,719
uh and trying to go that route i did

2128
01:10:04,149 --> 01:10:02,000
always love space though i

2129
01:10:07,910 --> 01:10:04,159
i loved space camp too when i went as a

2130
01:10:11,910 --> 01:10:09,750
awesome we have some more joining

2131
01:10:13,350 --> 01:10:11,920
alejandra why don't you talk about uh

2132
01:10:14,870 --> 01:10:13,360
did you grow up thinking that you were

2133
01:10:16,149 --> 01:10:14,880
gonna collaborate with nasa and work

2134
01:10:19,189 --> 01:10:16,159
with nasa

2135
01:10:21,270 --> 01:10:19,199
so it no it but i always had that

2136
01:10:22,790 --> 01:10:21,280
you know that sense of like just

2137
01:10:25,430 --> 01:10:22,800
interest to do science like

2138
01:10:25,830 --> 01:10:25,440

it's i think that's the common here uh

2139
01:10:28,070 --> 01:10:25,840
and

2140
01:10:29,030 --> 01:10:28,080
uh the support of family in support of

2141
01:10:31,590 --> 01:10:29,040
of leaders

2142
01:10:33,030 --> 01:10:31,600
educators uh in high school that's also

2143
01:10:35,030 --> 01:10:33,040
i found a role model that

2144
01:10:36,950 --> 01:10:35,040
led me through that development of

2145
01:10:39,189 --> 01:10:36,960
getting a career in science and

2146
01:10:41,189 --> 01:10:39,199
guided me to that process and i always

2147
01:10:43,350 --> 01:10:41,199
was asking myself okay what else can i

2148
01:10:46,470 --> 01:10:43,360
do so yeah i can you know i got my

2149
01:10:47,350 --> 01:10:46,480
my my degree what else can i do so i got

2150
01:10:51,270 --> 01:10:47,360
my

2151
01:10:52,950 --> 01:10:51,280
can i do so i became an educator and

2152
01:10:53,270 --> 01:10:52,960
then what else can i do well let's let's

2153
01:10:56,070 --> 01:10:53,280
do

2154
01:10:58,310 --> 01:10:56,080
nasa and uh it has been a journey has

2155
01:11:01,350 --> 01:10:58,320
been very exciting to to be part of this

2156
01:11:02,229 --> 01:11:01,360
great family great all right and now we

2157
01:11:05,430 --> 01:11:02,239
have chris

2158
01:11:07,830 --> 01:11:05,440
us here um

2159
01:11:09,270 --> 01:11:07,840
a new face we have uh christopher baker

2160
01:11:10,950 --> 01:11:09,280
is the program executive for flight

2161
01:11:12,229 --> 01:11:10,960
opportunities and small spacecraft

2162
01:11:14,149 --> 01:11:12,239
technology programs

2163
01:11:15,750 --> 01:11:14,159

and we have jim a familiar face who's

2164
01:11:17,590 --> 01:11:15,760
come on aboard and we have some of our

2165
01:11:19,189 --> 01:11:17,600
first questions so we're gonna start

2166
01:11:21,110 --> 01:11:19,199
and i think this is a really good first

2167
01:11:22,149 --> 01:11:21,120
question which is it's a little

2168
01:11:24,390 --> 01:11:22,159
overwhelming

2169
01:11:26,310 --> 01:11:24,400
but can you break it down for us how to

2170
01:11:29,590 --> 01:11:26,320
start with a small project

2171
01:11:30,870 --> 01:11:29,600
that would be great and uh i think chris

2172
01:11:32,310 --> 01:11:30,880
maybe you would be a good person to

2173
01:11:33,350 --> 01:11:32,320
start with this because when we're

2174
01:11:35,590 --> 01:11:33,360
thinking about uh

2175
01:11:36,950 --> 01:11:35,600
nasa tech rise you know we know that

2176
01:11:38,870 --> 01:11:36,960
we're not like

2177
01:11:40,390 --> 01:11:38,880
building a mars rover that we're sending

2178
01:11:41,830 --> 01:11:40,400
to mars but we're thinking about those

2179
01:11:43,430 --> 01:11:41,840
first little steps and i always tell

2180
01:11:45,350 --> 01:11:43,440
people as an engineer

2181
01:11:46,870 --> 01:11:45,360
one of the greatest skills is how to

2182
01:11:47,590 --> 01:11:46,880
think about something big and how to

2183
01:11:49,590 --> 01:11:47,600
think about

2184
01:11:51,189 --> 01:11:49,600
the very first step of it right so when

2185
01:11:54,070 --> 01:11:51,199
you think about microgravity it's like

2186
01:11:55,590 --> 01:11:54,080
well does it float i mean there's like

2187
01:11:57,110 --> 01:11:55,600
some really basic first steps so chris

2188
01:11:59,430 --> 01:11:57,120

why don't you take that question

2189
01:12:01,189 --> 01:11:59,440
and give maybe some examples of um some

2190
01:12:04,229 --> 01:12:01,199
small projects

2191
01:12:06,149 --> 01:12:04,239
that you've seen on plates sure yeah so

2192
01:12:08,149 --> 01:12:06,159
one of the very interesting things about

2193
01:12:11,350 --> 01:12:08,159
you know microgravity environment is

2194
01:12:13,830 --> 01:12:11,360
um is when you remove that

2195
01:12:15,590 --> 01:12:13,840
that kind of dominant force that we of

2196
01:12:16,149 --> 01:12:15,600
gravity that we're all used to dealing

2197
01:12:19,830 --> 01:12:16,159
with

2198
01:12:23,590 --> 01:12:19,840
things behave a bit unexpected so

2199
01:12:26,390 --> 01:12:23,600
something as simple as um

2200
01:12:28,470 --> 01:12:26,400
you've got uh some uh water and you've

2201
01:12:29,510 --> 01:12:28,480
got a balloon full of gas and you let

2202
01:12:31,430 --> 01:12:29,520
you know the

2203
01:12:32,950 --> 01:12:31,440
balloon full of gas go into the water

2204
01:12:33,350 --> 01:12:32,960
you kind of expect the bubbles to come

2205
01:12:35,910 --> 01:12:33,360
up

2206
01:12:36,709 --> 01:12:35,920
well in microgravity they don't there's

2207
01:12:39,830 --> 01:12:36,719
there's no

2208
01:12:42,390 --> 01:12:39,840
heavier water

2209
01:12:43,270 --> 01:12:42,400
uh stays down and the lighter gas go

2210
01:12:45,669 --> 01:12:43,280
goes up

2211
01:12:47,990 --> 01:12:45,679
so you get these really weird kind of

2212
01:12:50,790 --> 01:12:48,000
two phase flow mixing problems

2213
01:12:52,630 --> 01:12:50,800

and this causes all kinds of issues for

2214
01:12:55,270 --> 01:12:52,640
you know technology for for nasa

2215
01:12:56,390 --> 01:12:55,280
things uh as simple as uh you know

2216
01:12:59,590 --> 01:12:56,400
refrigerators

2217
01:13:01,750 --> 01:12:59,600
um you know mechanisms to separate out

2218
01:13:02,870 --> 01:13:01,760
uh particulate and other things just

2219
01:13:05,590 --> 01:13:02,880
don't work

2220
01:13:06,630 --> 01:13:05,600
the way they work on earth so something

2221
01:13:08,790 --> 01:13:06,640
as simple as

2222
01:13:09,910 --> 01:13:08,800
a two-phase flow experiment with water

2223
01:13:11,669 --> 01:13:09,920
and gas

2224
01:13:13,189 --> 01:13:11,679
that's something that professional you

2225
01:13:15,750 --> 01:13:13,199
know nasa uh

2226
01:13:17,590 --> 01:13:15,760
and university and uh corporate

2227
01:13:18,870 --> 01:13:17,600
researchers are spending time on

2228
01:13:21,430 --> 01:13:18,880
microgravity flights

2229
01:13:22,790 --> 01:13:21,440
uh doing and it's usually it's pretty

2230
01:13:24,870 --> 01:13:22,800
basic it's a it's a tube

2231
01:13:26,790 --> 01:13:24,880
full of water and you introduce gas on

2232
01:13:28,310 --> 01:13:26,800
one end and you watch what happens and

2233
01:13:28,790 --> 01:13:28,320
we're still learning a lot about that

2234
01:13:30,870 --> 01:13:28,800
and

2235
01:13:32,550 --> 01:13:30,880
just that um also that opportunity from

2236
01:13:33,430 --> 01:13:32,560
the high altitude balloons being able to

2237
01:13:36,149 --> 01:13:33,440
look down

2238
01:13:37,030 --> 01:13:36,159

uh at the earth or look up um you get

2239
01:13:39,510 --> 01:13:37,040
four hours

2240
01:13:40,630 --> 01:13:39,520
of time at an altitude there that's just

2241
01:13:44,070 --> 01:13:40,640
um

2242
01:13:45,189 --> 01:13:44,080
uh exposes uh the the sensors you might

2243
01:13:47,189 --> 01:13:45,199
bring up there and those could be

2244
01:13:48,950 --> 01:13:47,199
you know simple as cameras uh as as was

2245
01:13:51,189 --> 01:13:48,960
stated earlier to some really

2246
01:13:53,270 --> 01:13:51,199
interesting opportunities to um

2247
01:13:54,790 --> 01:13:53,280
get a view of the earth that that few

2248
01:13:57,750 --> 01:13:54,800
have have ever seen so

2249
01:13:59,669 --> 01:13:57,760
i there are some really simple uh simple

2250
01:14:02,630 --> 01:13:59,679
experiments that are still a challenge

2251
01:14:03,030 --> 01:14:02,640
nikki mentioned dust mitigation um we've

2252
01:14:05,430 --> 01:14:03,040
got

2253
01:14:07,270 --> 01:14:05,440
experiments where we've you know have

2254
01:14:09,270 --> 01:14:07,280
university researchers with

2255
01:14:11,189 --> 01:14:09,280
rocks at the bottom of a tube and they

2256
01:14:11,750 --> 01:14:11,199
fire a little tiny projectile into it

2257
01:14:14,149 --> 01:14:11,760
just

2258
01:14:14,790 --> 01:14:14,159
to carefully measure how everything

2259
01:14:17,110 --> 01:14:14,800
moves

2260
01:14:19,030 --> 01:14:17,120
in that microgravity environment because

2261
01:14:22,149 --> 01:14:19,040
we just don't have that

2262
01:14:26,149 --> 01:14:22,159
um understanding

2263
01:14:28,149 --> 01:14:26,159

yet of of how that how physics behaves

2264
01:14:31,590 --> 01:14:28,159
when you remove that dominant force that

2265
01:14:35,110 --> 01:14:33,669
great answers great answers all around

2266
01:14:36,870 --> 01:14:35,120
and i and i should emphasize

2267
01:14:38,310 --> 01:14:36,880
too that it's all about the education

2268
01:14:41,030 --> 01:14:38,320
journey of feeling like

2269
01:14:41,590 --> 01:14:41,040
i i set out to do something and even if

2270
01:14:43,350 --> 01:14:41,600
you

2271
01:14:45,030 --> 01:14:43,360
set that goal of i set out to take a

2272
01:14:47,830 --> 01:14:45,040
picture

2273
01:14:49,350 --> 01:14:47,840
from a balloon of a certain thing right

2274
01:14:50,630 --> 01:14:49,360
and at the end you go through that

2275
01:14:51,750 --> 01:14:50,640
journey and you have that sense of

2276
01:14:55,189 --> 01:14:51,760
completion

2277
01:14:56,950 --> 01:14:55,199
that's such a that's such an education

2278
01:14:58,630 --> 01:14:56,960
lesson right there right to like go

2279
01:14:59,669 --> 01:14:58,640
through that process to launch it and

2280
01:15:01,270 --> 01:14:59,679
when you launch it

2281
01:15:03,270 --> 01:15:01,280
you know you don't get a second try you

2282
01:15:05,270 --> 01:15:03,280
guys know this at nasa right

2283
01:15:07,189 --> 01:15:05,280
you you got you launch it you got your

2284
01:15:09,430 --> 01:15:07,199
one shot and you're one shot only so

2285
01:15:10,229 --> 01:15:09,440
it's all about really preparing for that

2286
01:15:11,910 --> 01:15:10,239
moment

2287
01:15:13,590 --> 01:15:11,920
and and i should add we're going to talk

2288
01:15:15,110 --> 01:15:13,600

about this later but one of the cool

2289
01:15:16,310 --> 01:15:15,120
things about this challenge is that all

2290
01:15:18,070 --> 01:15:16,320
of these vehicles

2291
01:15:19,750 --> 01:15:18,080
that are flying are sending data to

2292
01:15:21,590 --> 01:15:19,760
these payloads so

2293
01:15:23,750 --> 01:15:21,600
for example you'll get a little signal

2294
01:15:25,270 --> 01:15:23,760
that says oh microgravity started

2295
01:15:27,030 --> 01:15:25,280
and so it's a really great way to get

2296
01:15:28,709 --> 01:15:27,040
get hands-on with coding and we're going

2297
01:15:30,390 --> 01:15:28,719
to go into that right after this

2298
01:15:32,070 --> 01:15:30,400
about how to use that trigger to make

2299
01:15:33,430 --> 01:15:32,080
something happen you know maybe it just

2300
01:15:35,350 --> 01:15:33,440
pops open something and something

2301
01:15:36,870 --> 01:15:35,360
happens right so so there's ways to

2302
01:15:37,990 --> 01:15:36,880
think about it small and ways to think

2303
01:15:41,590 --> 01:15:38,000
about it really big

2304
01:15:43,189 --> 01:15:41,600
um so next question um is one of the

2305
01:15:44,870 --> 01:15:43,199
objectives of the lunar exploration

2306
01:15:48,149 --> 01:15:44,880
experiments to prep the lunar

2307
01:15:49,910 --> 01:15:48,159
for future return missions that's a good

2308
01:15:52,950 --> 01:15:49,920
one for nikki and i think that's a

2309
01:15:56,390 --> 01:15:52,960
a general question about uh nasa

2310
01:16:00,149 --> 01:15:56,400
lunar exploration um

2311
01:16:02,310 --> 01:16:00,159
uh are you guys interested in doing um

2312
01:16:04,550 --> 01:16:02,320
i i guess i'm gonna interpret this one

2313
01:16:06,390 --> 01:16:04,560

kenza for future return missions i'm not

2314
01:16:08,310 --> 01:16:06,400
thinking sample return i'm thinking

2315
01:16:09,830 --> 01:16:08,320
uh humans going back to the moon that's

2316
01:16:11,910 --> 01:16:09,840
that's how i'm going to interpret that

2317
01:16:13,430 --> 01:16:11,920
in terms of return so nikki talk to us

2318
01:16:15,350 --> 01:16:13,440
about the role of technology and getting

2319
01:16:17,990 --> 01:16:15,360
humans back to the moon

2320
01:16:19,510 --> 01:16:18,000
so what i would say firstly is we're

2321
01:16:21,030 --> 01:16:19,520
very excited about get human back

2322
01:16:23,270 --> 01:16:21,040
humans back to the moon but there is a

2323
01:16:24,790 --> 01:16:23,280
lot of work um and a lot of flight

2324
01:16:26,550 --> 01:16:24,800
opportunities that we can take advantage

2325
01:16:28,709 --> 01:16:26,560
of between now and then

2326
01:16:30,390 --> 01:16:28,719
so about i mean the question that just

2327
01:16:31,590 --> 01:16:30,400
came up right about how do you start

2328
01:16:33,510 --> 01:16:31,600
where do you start

2329
01:16:35,510 --> 01:16:33,520
um how i usually start is thinking about

2330
01:16:37,350 --> 01:16:35,520
just kind of real world scenarios and i

2331
01:16:38,709 --> 01:16:37,360
found that students are the best ones to

2332
01:16:39,990 --> 01:16:38,719
have these conversations with because

2333
01:16:41,990 --> 01:16:40,000
you sit down and you say

2334
01:16:43,830 --> 01:16:42,000
you know just think about um what do we

2335
01:16:45,510 --> 01:16:43,840
need to know before the humans go well i

2336
01:16:47,830 --> 01:16:45,520
talked a lot about the regolith there's

2337
01:16:49,590 --> 01:16:47,840
so many questions right even though

2338
01:16:51,830 --> 01:16:49,600

we went to the moon during apollo and we

2339
01:16:53,590 --> 01:16:51,840
went to you know specific places the the

2340
01:16:55,110 --> 01:16:53,600
lunar regulated properties are very

2341
01:16:56,070 --> 01:16:55,120
different depending on the landing sites

2342
01:16:58,870 --> 01:16:56,080
you go to

2343
01:17:00,070 --> 01:16:58,880
um we've done a lot of flights where we

2344
01:17:01,910 --> 01:17:00,080
have imagery and data

2345
01:17:03,590 --> 01:17:01,920
where we think we feel very strongly

2346
01:17:05,510 --> 01:17:03,600
where the water would be and how to get

2347
01:17:07,590 --> 01:17:05,520
to the water and the other consumables

2348
01:17:09,669 --> 01:17:07,600
but we haven't actually done that right

2349
01:17:12,229 --> 01:17:09,679
so until you've actually done it it's a

2350
01:17:14,070 --> 01:17:12,239
theory and so we really need to get

2351
01:17:15,910 --> 01:17:14,080
there on the surface and test it and so

2352
01:17:17,110 --> 01:17:15,920
we have a lot of work to do before

2353
01:17:18,470 --> 01:17:17,120
humans show up

2354
01:17:20,149 --> 01:17:18,480
and that's why i was mentioning in the

2355
01:17:22,229 --> 01:17:20,159
suborbital flights and some of the demos

2356
01:17:23,990 --> 01:17:22,239
we're doing there before we do our clips

2357
01:17:25,669 --> 01:17:24,000
our commercial lunar payload services

2358
01:17:27,830 --> 01:17:25,679
flights to the moon those are

2359
01:17:28,709 --> 01:17:27,840
uncrewed flights um that are starting up

2360
01:17:30,709 --> 01:17:28,719
here

2361
01:17:31,990 --> 01:17:30,719
very very soon in the next year i

2362
01:17:33,990 --> 01:17:32,000
mentioned prime was going

2363
01:17:35,750 --> 01:17:34,000

that we go before the humans go and we

2364
01:17:37,510 --> 01:17:35,760
kind of scout out things to be quite

2365
01:17:40,070 --> 01:17:37,520
honest we go and prove that we can

2366
01:17:41,590 --> 01:17:40,080
find and collect and assess water we go

2367
01:17:43,270 --> 01:17:41,600
and we send these little scouts we have

2368
01:17:44,310 --> 01:17:43,280
these little autonomous scouts they're

2369
01:17:45,830 --> 01:17:44,320
so cute

2370
01:17:47,669 --> 01:17:45,840
and they carry payloads about the size

2371
01:17:49,270 --> 01:17:47,679
of a bar of soap and we did

2372
01:17:50,790 --> 01:17:49,280
crowdsourcing challenges for those

2373
01:17:52,390 --> 01:17:50,800
payloads to do all kinds of neat

2374
01:17:54,390 --> 01:17:52,400
instruments and tools

2375
01:17:56,310 --> 01:17:54,400
and they rove around so for example you

2376
01:17:56,950 --> 01:17:56,320
have the permanently shadowed regions on

2377
01:17:58,870 --> 01:17:56,960
the moon

2378
01:18:00,790 --> 01:17:58,880
where we think there really is water and

2379
01:18:02,310 --> 01:18:00,800
valuable resources well those areas are

2380
01:18:03,430 --> 01:18:02,320
always going to be dangerous for humans

2381
01:18:04,790 --> 01:18:03,440
to go down into

2382
01:18:06,470 --> 01:18:04,800
but we could certainly send these little

2383
01:18:08,149 --> 01:18:06,480
scalps down with cameras and with

2384
01:18:09,990 --> 01:18:08,159
different tools and instrumentation

2385
01:18:12,310 --> 01:18:10,000
and check it out before the humans even

2386
01:18:13,910 --> 01:18:12,320
arrive so what i would say um

2387
01:18:16,229 --> 01:18:13,920
for this question and for the other one

2388
01:18:17,510 --> 01:18:16,239

on how do you start with a small project

2389
01:18:19,510 --> 01:18:17,520
idea is really to

2390
01:18:21,750 --> 01:18:19,520
kind of think out those basic scenarios

2391
01:18:23,270 --> 01:18:21,760
is what is that fundamental foundational

2392
01:18:24,229 --> 01:18:23,280
information that we need

2393
01:18:25,990 --> 01:18:24,239
you don't want to make too many

2394
01:18:27,590 --> 01:18:26,000
assumptions because like chris said

2395
01:18:28,870 --> 01:18:27,600
things that you just assume on earth and

2396
01:18:30,390 --> 01:18:28,880
you're just don't even give a second

2397
01:18:32,550 --> 01:18:30,400
thought anymore are so

2398
01:18:34,310 --> 01:18:32,560
different um it was lack of gravity

2399
01:18:36,630 --> 01:18:34,320
right or less gravity

2400
01:18:38,149 --> 01:18:36,640
so i have found that students are not

2401
01:18:40,630 --> 01:18:38,159
quite don't have quite the

2402
01:18:42,310 --> 01:18:40,640
think that us adults do so if you throw

2403
01:18:43,110 --> 01:18:42,320
out some of these scenarios to them and

2404
01:18:45,030 --> 01:18:43,120
really kind of

2405
01:18:46,310 --> 01:18:45,040
say let's break that scenario down and

2406
01:18:47,910 --> 01:18:46,320
where would the scout go and what would

2407
01:18:49,430 --> 01:18:47,920
the scout do and what would it gather

2408
01:18:51,030 --> 01:18:49,440
and what kind of questions would it ask

2409
01:18:51,750 --> 01:18:51,040
and need to know what kind of data would

2410
01:18:53,189 --> 01:18:51,760
we need

2411
01:18:54,790 --> 01:18:53,199
um those are the same things that we're

2412
01:18:59,270 --> 01:18:54,800
thinking about now on how to use those

2413
01:19:02,790 --> 01:19:01,189

really great answer um we have a

2414
01:19:04,149 --> 01:19:02,800
question here from tony which is will

2415
01:19:06,550 --> 01:19:04,159
the experiment need to be powered by a

2416
01:19:08,229 --> 01:19:06,560
battery contained inside the box

2417
01:19:09,590 --> 01:19:08,239
um if so is there a limitation on

2418
01:19:11,189 --> 01:19:09,600
voltage or the type of battery

2419
01:19:13,110 --> 01:19:11,199
really really great question because

2420
01:19:15,110 --> 01:19:13,120
it's a great segue for me to say

2421
01:19:17,350 --> 01:19:15,120
um we're gonna put the link to the

2422
01:19:18,470 --> 01:19:17,360
website on here and if you go to the

2423
01:19:20,229 --> 01:19:18,480
challenge page

2424
01:19:22,070 --> 01:19:20,239
there are tech sheets for each of the

2425
01:19:24,630 --> 01:19:22,080
vehicles um

2426
01:19:26,229 --> 01:19:24,640
boom on cue chris look at you putting

2427
01:19:27,430 --> 01:19:26,239
those out there are tech sheets for each

2428
01:19:29,669 --> 01:19:27,440
of the vehicles

2429
01:19:31,750 --> 01:19:29,679
and um it tells you some of the specs

2430
01:19:33,350 --> 01:19:31,760
and the limitations of what we have

2431
01:19:35,110 --> 01:19:33,360
but what's exciting remember i told you

2432
01:19:37,110 --> 01:19:35,120
that we're going to be streaming data to

2433
01:19:39,270 --> 01:19:37,120
all of the payloads from the vehicle

2434
01:19:40,709 --> 01:19:39,280
um as well there's gonna be power so

2435
01:19:42,790 --> 01:19:40,719
when you think about like oh

2436
01:19:44,149 --> 01:19:42,800
i'm gonna be on a four hour flight and

2437
01:19:45,430 --> 01:19:44,159
it's gonna be cold and how are my

2438
01:19:47,110 --> 01:19:45,440

batteries gonna do you're gonna be able

2439
01:19:49,110 --> 01:19:47,120
to tap into the vehicle power

2440
01:19:50,950 --> 01:19:49,120
um to be able to run those experiments

2441
01:19:51,430 --> 01:19:50,960
so go ahead and check out those tech

2442
01:19:55,110 --> 01:19:51,440
sheets

2443
01:19:56,950 --> 01:19:55,120
um on on the uh on the future engineers

2444
01:19:58,149 --> 01:19:56,960
website you can learn more about that i

2445
01:19:58,790 --> 01:19:58,159
have another great question from tony

2446
01:20:01,510 --> 01:19:58,800
which is

2447
01:20:02,950 --> 01:20:01,520
um can you please provide some of the

2448
01:20:04,630 --> 01:20:02,960
limitations or parameters for what's

2449
01:20:05,189 --> 01:20:04,640
possible to be done in the four by four

2450
01:20:07,669 --> 01:20:05,199
by eight

2451
01:20:08,550 --> 01:20:07,679
cubesat type module um i think this is

2452
01:20:09,910 --> 01:20:08,560
really just like

2453
01:20:11,669 --> 01:20:09,920
okay we've got four inches by four

2454
01:20:13,030 --> 01:20:11,679
inches it's kind of it's this size right

2455
01:20:14,550 --> 01:20:13,040
here

2456
01:20:16,310 --> 01:20:14,560
so we've got four inches by four inches

2457
01:20:18,390 --> 01:20:16,320
by eight inches and try to think like

2458
01:20:19,910 --> 01:20:18,400
how much can you really pack into this

2459
01:20:21,990 --> 01:20:19,920
and what you what some of you might not

2460
01:20:23,669 --> 01:20:22,000
know is that nasa is flying satellites

2461
01:20:25,750 --> 01:20:23,679
half this size

2462
01:20:27,189 --> 01:20:25,760
all around you all the time right now

2463
01:20:28,229 --> 01:20:27,199

and they pack a lot of punch

2464
01:20:29,830 --> 01:20:28,239
so you know there's definitely weight

2465
01:20:30,950 --> 01:20:29,840
limitations and different limitations

2466
01:20:33,430 --> 01:20:30,960
but i don't know if

2467
01:20:34,310 --> 01:20:33,440
jim or chris or anyone else wants to

2468
01:20:35,830 --> 01:20:34,320
talk about

2469
01:20:37,669 --> 01:20:35,840
um how there's great things that come in

2470
01:20:40,709 --> 01:20:37,679
small packages in space flight

2471
01:20:44,870 --> 01:20:40,719
uh why don't you chime in on that

2472
01:20:49,750 --> 01:20:48,950
okay sure um yeah um it's it's amazing

2473
01:20:51,510 --> 01:20:49,760
uh

2474
01:20:53,030 --> 01:20:51,520
what the changes that are taking place

2475
01:20:54,629 --> 01:20:53,040
right now um and

2476
01:20:56,550 --> 01:20:54,639
and especially in the electronics field

2477
01:20:58,310 --> 01:20:56,560
we're seeing it in spacecraft

2478
01:21:00,390 --> 01:20:58,320
we never used to think that you could do

2479
01:21:01,270 --> 01:21:00,400
a valid science or technology

2480
01:21:03,270 --> 01:21:01,280
demonstrations

2481
01:21:04,310 --> 01:21:03,280
on something unless it was a table size

2482
01:21:06,149 --> 01:21:04,320
or something like that

2483
01:21:08,790 --> 01:21:06,159
and and now what we're finding is as you

2484
01:21:09,510 --> 01:21:08,800
said the what we call the 1u unit 4x4 by

2485
01:21:11,270 --> 01:21:09,520
4 inch

2486
01:21:13,110 --> 01:21:11,280
and when you do we do these challenges

2487
01:21:15,030 --> 01:21:13,120
like honey i shrunk the

2488
01:21:16,550 --> 01:21:15,040

payload we're finding there's a lot that

2489
01:21:19,270 --> 01:21:16,560
can get done there and done

2490
01:21:19,590 --> 01:21:19,280
very quickly and so a big advantage of

2491
01:21:23,110 --> 01:21:19,600
of

2492
01:21:25,510 --> 01:21:23,120
think more quickly

2493
01:21:27,430 --> 01:21:25,520
and and enable things much more quickly

2494
01:21:30,470 --> 01:21:27,440
so like one example we have is

2495
01:21:31,590 --> 01:21:30,480
it's um it's a little a bit bigger maybe

2496
01:21:34,070 --> 01:21:31,600
twice that size

2497
01:21:34,709 --> 01:21:34,080
is we're we're flying a small spacecraft

2498
01:21:41,030 --> 01:21:34,719
to

2499
01:21:42,550 --> 01:21:41,040
we said you know

2500
01:21:44,390 --> 01:21:42,560
about two years ago we said well why

2501
01:21:45,750 --> 01:21:44,400
don't we try to do something in a small

2502
01:21:47,270 --> 01:21:45,760
package that gets to there

2503
01:21:48,950 --> 01:21:47,280
and actually try out the orbit we've

2504
01:21:51,510 --> 01:21:48,960
never actually flown in before

2505
01:21:53,350 --> 01:21:51,520
that the gateway would fly and and then

2506
01:21:54,830 --> 01:21:53,360
we also challenged chris and his team

2507
01:21:56,709 --> 01:21:54,840
to say okay we want you to do that

2508
01:21:58,709 --> 01:21:56,719
quickly um

2509
01:22:00,390 --> 01:21:58,719
as as we go through it and so what we've

2510
01:22:02,790 --> 01:22:00,400
done and it's it's about

2511
01:22:04,149 --> 01:22:02,800
uh uh we started then it was just an

2512
01:22:07,110 --> 01:22:04,159
idea in around august of

2513
01:22:08,390 --> 01:22:07,120

or september of 2019 and uh we said

2514
01:22:10,390 --> 01:22:08,400
let's try to get there in

2515
01:22:11,830 --> 01:22:10,400
a couple two years time or something

2516
01:22:13,830 --> 01:22:11,840
like that and now um

2517
01:22:15,189 --> 01:22:13,840
our payload is going to be ready and

2518
01:22:17,030 --> 01:22:15,199
that was like a

2519
01:22:18,870 --> 01:22:17,040
clean sheet of paper we didn't have a

2520
01:22:21,669 --> 01:22:18,880
contract um

2521
01:22:22,709 --> 01:22:21,679
and uh but we were able to get there um

2522
01:22:24,229 --> 01:22:22,719
and we're

2523
01:22:25,669 --> 01:22:24,239
by july of this year it's gonna be ready

2524
01:22:26,709 --> 01:22:25,679
to fly and then sometimes this fall

2525
01:22:28,070 --> 01:22:26,719
it'll probably fly

2526
01:22:30,870 --> 01:22:28,080
so there's lots you can do in small

2527
01:22:34,149 --> 01:22:33,030
if you're not you know if you're worried

2528
01:22:36,950 --> 01:22:34,159
about how much space

2529
01:22:38,629 --> 01:22:36,960
the the electronics today's you only

2530
01:22:40,629 --> 01:22:38,639
need about this much of the box for the

2531
01:22:41,910 --> 01:22:40,639
electronics and and the future future

2532
01:22:45,110 --> 01:22:41,920
engineers team will have some

2533
01:22:46,470 --> 01:22:45,120
um some kind of tutorials uh available

2534
01:22:50,310 --> 01:22:46,480
uh later and and a

2535
01:22:52,870 --> 01:22:50,320
um a couple of uh workshops um

2536
01:22:54,709 --> 01:22:52,880
throughout the summer but um you know

2537
01:22:56,870 --> 01:22:54,719
like jim was saying we're we're uh

2538
01:22:57,990 --> 01:22:56,880

we're using stuff not that much bigger

2539
01:23:00,629 --> 01:22:58,000
to go to the moon

2540
01:23:02,550 --> 01:23:00,639
and um there's a there's a thing about

2541
01:23:05,110 --> 01:23:02,560
half that size flying around mars

2542
01:23:07,110 --> 01:23:05,120
right now on occasion so there's a lot

2543
01:23:07,430 --> 01:23:07,120
you can fit in there and i think we've

2544
01:23:11,270 --> 01:23:07,440
all

2545
01:23:14,229 --> 01:23:11,280
the past few years um

2546
01:23:15,350 --> 01:23:14,239
hopefully you will too um but um yeah

2547
01:23:18,310 --> 01:23:15,360
that 2u package

2548
01:23:20,149 --> 01:23:18,320
uh hopefully uh uh will provide you

2549
01:23:22,229 --> 01:23:20,159
enough room to do something really cool

2550
01:23:23,830 --> 01:23:22,239
and we we certainly uh think think it

2551
01:23:25,430 --> 01:23:23,840
does so um

2552
01:23:27,430 --> 01:23:25,440
we'll uh we'll look forward to uh seeing

2553
01:23:28,790 --> 01:23:27,440
what you guys all come up with

2554
01:23:30,470 --> 01:23:28,800
i like to think like this i like to

2555
01:23:32,950 --> 01:23:30,480
think um you know that

2556
01:23:34,310 --> 01:23:32,960
that this the suborbital flights are

2557
01:23:36,149 --> 01:23:34,320
kind of a testing ground right you get

2558
01:23:37,669 --> 01:23:36,159
three minutes of microgravity to make

2559
01:23:39,590 --> 01:23:37,679
sure it works before you give it

2560
01:23:40,709 --> 01:23:39,600
a lot of microgravity time right and i

2561
01:23:42,550 --> 01:23:40,719
like to think about that

2562
01:23:44,470 --> 01:23:42,560
it's a proving ground for developing

2563
01:23:45,669 --> 01:23:44,480

technology but for these students

2564
01:23:46,709 --> 01:23:45,679
that's that's the end goal of this

2565
01:23:48,070 --> 01:23:46,719
challenge is what are you going to learn

2566
01:23:49,430 --> 01:23:48,080
there but it's also a proving ground for

2567
01:23:51,669 --> 01:23:49,440
them to develop those skills

2568
01:23:53,110 --> 01:23:51,679
to go on and do these other things so um

2569
01:23:55,030 --> 01:23:53,120
so thinking small you know

2570
01:23:56,470 --> 01:23:55,040
i i've heard the experiments as small as

2571
01:23:57,750 --> 01:23:56,480
like putting bubble wrap in something

2572
01:23:58,950 --> 01:23:57,760
right and seeing what happens when it

2573
01:24:00,709 --> 01:23:58,960
comes up in altitude

2574
01:24:02,149 --> 01:24:00,719
um obviously we're looking it's tech

2575
01:24:03,430 --> 01:24:02,159
rise so we're

2576
01:24:05,669 --> 01:24:03,440
hoping you put some tech with that

2577
01:24:06,629 --> 01:24:05,679
bubble wrap but um but yeah but start

2578
01:24:08,870 --> 01:24:06,639
thinking small

2579
01:24:09,669 --> 01:24:08,880
and um dreaming big it's kind of the big

2580
01:24:12,310 --> 01:24:09,679
idea with this

2581
01:24:14,070 --> 01:24:12,320
so on that note i think we're gonna wrap

2582
01:24:16,790 --> 01:24:14,080
up the q and a

2583
01:24:18,390 --> 01:24:16,800
and uh we're gonna go towards uh some of

2584
01:24:20,790 --> 01:24:18,400
our education sessions

2585
01:24:22,470 --> 01:24:20,800
and um as chris mentioned we have two

2586
01:24:23,750 --> 01:24:22,480
educator workshops coming up we have an

2587
01:24:25,830 --> 01:24:23,760
educator workshop

2588
01:24:27,110 --> 01:24:25,840

on july 28th we have another one on

2589
01:24:28,870 --> 01:24:27,120
august 11th

2590
01:24:30,550 --> 01:24:28,880
and the idea here is this is all like

2591
01:24:32,950 --> 01:24:30,560
really top level stuff the idea is we're

2592
01:24:35,510 --> 01:24:32,960
going to take you step by step by step

2593
01:24:37,110 --> 01:24:35,520
with how to use a microcontroller to do

2594
01:24:37,590 --> 01:24:37,120
something really simple like turn on a

2595
01:24:39,669 --> 01:24:37,600
light

2596
01:24:41,270 --> 01:24:39,679
to get that first um you know idea

2597
01:24:43,030 --> 01:24:41,280
started so you can start thinking about

2598
01:24:45,350 --> 01:24:43,040
projects to do with your students

2599
01:24:46,950 --> 01:24:45,360
um and so we are going to transition now

2600
01:24:49,030 --> 01:24:46,960
i'm going to say goodbye to all of our

2601
01:24:49,990 --> 01:24:49,040
wonderful speakers except chris you get

2602
01:24:51,910 --> 01:24:50,000
to stay

2603
01:24:53,510 --> 01:24:51,920
um but all the rest of you i just want

2604
01:24:54,709 --> 01:24:53,520
to say thank you thank you thank you for

2605
01:24:57,030 --> 01:24:54,719
being a part of this

2606
01:24:58,470 --> 01:24:57,040
with us um from the bottom of my heart

2607
01:25:00,950 --> 01:24:58,480
and we're gonna move on

2608
01:25:02,790 --> 01:25:00,960
um to our session where we talk about

2609
01:25:04,310 --> 01:25:02,800
our resources and tutorials

2610
01:25:06,470 --> 01:25:04,320
so if you go to the future engineers

2611
01:25:08,470 --> 01:25:06,480
website and you scroll down

2612
01:25:09,750 --> 01:25:08,480
uh you will see there's curated links

2613
01:25:10,870 --> 01:25:09,760

and lessons in different areas but

2614
01:25:12,790 --> 01:25:10,880
that's just the beginning

2615
01:25:14,709 --> 01:25:12,800
we're rolling out a whole bunch of

2616
01:25:16,310 --> 01:25:14,719
tutorials about how to get hands-on with

2617
01:25:18,790 --> 01:25:16,320
coding for the first time

2618
01:25:19,910 --> 01:25:18,800
um and and how to design for flight and

2619
01:25:21,030 --> 01:25:19,920
we have something really special in

2620
01:25:23,189 --> 01:25:21,040
store for you today that we're going to

2621
01:25:25,669 --> 01:25:23,199
give you a sneak peek of a simulator

2622
01:25:26,870 --> 01:25:25,679
that can be used you know once students

2623
01:25:28,870 --> 01:25:26,880
get awarded

2624
01:25:29,990 --> 01:25:28,880
you can use this simulator even now to

2625
01:25:31,990 --> 01:25:30,000
start tinkering around

2626
01:25:33,430 --> 01:25:32,000
so we're going to start first by chris

2627
01:25:35,669 --> 01:25:33,440
just giving us an overview

2628
01:25:37,350 --> 01:25:35,679
of these three vehicles to understand

2629
01:25:38,629 --> 01:25:37,360
really the opportunity that there is

2630
01:25:39,350 --> 01:25:38,639
here for the different types of

2631
01:25:41,110 --> 01:25:39,360
experience

2632
01:25:43,030 --> 01:25:41,120
experiment students might think about

2633
01:25:45,990 --> 01:25:43,040
and then we're going to switch it over

2634
01:25:47,830 --> 01:25:46,000
to some folks uh tanya and arnie to give

2635
01:25:49,750 --> 01:25:47,840
you a little demonstration and a little

2636
01:25:51,990 --> 01:25:49,760
overview of what is a microcontroller

2637
01:25:56,950 --> 01:25:52,000
so go ahead chris and uh why don't you

2638
01:26:03,350 --> 01:26:01,750

you're muted sorry thank you

2639
01:26:05,270 --> 01:26:03,360
i'm sure that's happened to most of us

2640
01:26:06,870 --> 01:26:05,280
at least a hundred times over the past

2641
01:26:09,189 --> 01:26:06,880
15 months but

2642
01:26:11,590 --> 01:26:09,199
apologies all right so uh as you heard

2643
01:26:13,430 --> 01:26:11,600
earlier um i'm the program executive for

2644
01:26:17,110 --> 01:26:13,440
the uh the flight opportunities program

2645
01:26:18,790 --> 01:26:17,120
and um you know our uh during our kind

2646
01:26:21,350 --> 01:26:18,800
of regular business hours

2647
01:26:21,990 --> 01:26:21,360
uh we try to get promising technologies

2648
01:26:24,390 --> 01:26:22,000
for space

2649
01:26:27,270 --> 01:26:24,400
exploration discovery and the expansion

2650
01:26:30,790 --> 01:26:27,280
of space commerce

2651
01:26:33,189 --> 01:26:30,800
tested through suborbital flights with

2652
01:26:34,229 --> 01:26:33,199
industry providers and what we're really

2653
01:26:36,229 --> 01:26:34,239
excited about

2654
01:26:38,550 --> 01:26:36,239
with this challenge is we're giving

2655
01:26:40,149 --> 01:26:38,560
students access to those same types of

2656
01:26:41,990 --> 01:26:40,159
environments and those same

2657
01:26:44,470 --> 01:26:42,000
nasa-sponsored commercial flights that

2658
01:26:45,510 --> 01:26:44,480
we use uh for our technology development

2659
01:26:48,390 --> 01:26:45,520
and demonstration

2660
01:26:49,030 --> 01:26:48,400
so um as was uh stated earlier there's

2661
01:26:50,390 --> 01:26:49,040
three

2662
01:26:52,229 --> 01:26:50,400
flight providers who are providing

2663
01:26:54,629 --> 01:26:52,239

flights for this challenge so

2664
01:26:56,390 --> 01:26:54,639
raven aerostar will be providing their

2665
01:26:57,430 --> 01:26:56,400
high altitude balloon it's a zero

2666
01:26:59,270 --> 01:26:57,440
pressure balloon

2667
01:27:01,669 --> 01:26:59,280
it'll give about four hours of flight

2668
01:27:03,750 --> 01:27:01,679
time at 70 thousand feet

2669
01:27:06,070 --> 01:27:03,760
and during that time the experiment will

2670
01:27:08,470 --> 01:27:06,080
have exposure to the upper atmosphere

2671
01:27:10,870 --> 01:27:08,480
views of earth perhaps if you can look

2672
01:27:13,030 --> 01:27:10,880
around the balloon views of space

2673
01:27:13,910 --> 01:27:13,040
and for imaging and kind of remote

2674
01:27:16,629 --> 01:27:13,920
sensing

2675
01:27:18,149 --> 01:27:16,639
purposes and then up aerospace and blue

2676
01:27:20,229 --> 01:27:18,159
origin we'll be providing

2677
01:27:22,149 --> 01:27:20,239
suborbital rockets those are the up

2678
01:27:24,709 --> 01:27:22,159
aerospace space loft xl

2679
01:27:25,990 --> 01:27:24,719
and the blue origin new shepard and

2680
01:27:28,709 --> 01:27:26,000
those flights will take

2681
01:27:29,270 --> 01:27:28,719
experiments just past the edge of space

2682
01:27:30,950 --> 01:27:29,280
and

2683
01:27:33,270 --> 01:27:30,960
they'll experience about three minutes

2684
01:27:36,310 --> 01:27:33,280
of microgravity or uh you know

2685
01:27:39,750 --> 01:27:36,320
zero g um as as is often said

2686
01:27:42,550 --> 01:27:39,760
weightlessness um and

2687
01:27:44,229 --> 01:27:42,560
that will help you examine some of the

2688
01:27:46,470 --> 01:27:44,239

effects of microgravity

2689
01:27:47,750 --> 01:27:46,480
uh relative to things for space

2690
01:27:49,270 --> 01:27:47,760
exploration like we were just talking

2691
01:27:51,189 --> 01:27:49,280
about a few minutes ago in terms of

2692
01:27:52,950 --> 01:27:51,199
when you remove that dominant force what

2693
01:27:55,030 --> 01:27:52,960
happens fundamental physics

2694
01:27:56,310 --> 01:27:55,040
um experiments get done on the

2695
01:27:58,229 --> 01:27:56,320
international space station

2696
01:28:00,149 --> 01:27:58,239
and other platforms in this way and this

2697
01:28:02,550 --> 01:28:00,159
helps us test out technologies

2698
01:28:03,430 --> 01:28:02,560
that we can use for moon mars and and

2699
01:28:05,110 --> 01:28:03,440
beyond

2700
01:28:06,470 --> 01:28:05,120
um in in that environment where we've

2701
01:28:08,070 --> 01:28:06,480
got lower gravity and also

2702
01:28:10,310 --> 01:28:08,080
in getting to that environment with

2703
01:28:13,910 --> 01:28:10,320
those long duration space flights

2704
01:28:14,310 --> 01:28:13,920
um you'll also get exposure potentially

2705
01:28:18,149 --> 01:28:14,320
through

2706
01:28:22,470 --> 01:28:18,159
space

2707
01:28:25,430 --> 01:28:22,480
um and um today's session is really

2708
01:28:27,030 --> 01:28:25,440
uh meant to give us all a kind of a

2709
01:28:29,270 --> 01:28:27,040
brief overview

2710
01:28:30,310 --> 01:28:29,280
of the elements and the experiments and

2711
01:28:33,270 --> 01:28:30,320
an introduction

2712
01:28:34,470 --> 01:28:33,280
uh to to these and uh next we'll be uh

2713
01:28:36,070 --> 01:28:34,480

going through this uh

2714
01:28:37,270 --> 01:28:36,080
flight simulator from each of the flight

2715
01:28:38,149 --> 01:28:37,280
providers that will give you a little

2716
01:28:40,790 --> 01:28:38,159
bit of a

2717
01:28:43,189 --> 01:28:40,800
feel for for kind of what you might your

2718
01:28:44,709 --> 01:28:43,199
payload what your educational experiment

2719
01:28:46,709 --> 01:28:44,719
might might see

2720
01:28:47,990 --> 01:28:46,719
and we don't really expect students or

2721
01:28:50,709 --> 01:28:48,000
teachers to have

2722
01:28:52,629 --> 01:28:50,719
experience with suborbital flights we're

2723
01:28:54,149 --> 01:28:52,639
welcoming submissions from teams that

2724
01:28:56,470 --> 01:28:54,159
have a great idea but

2725
01:28:58,790 --> 01:28:56,480
don't have the experience yet uh with

2726
01:29:00,950 --> 01:28:58,800
coding or electronics or

2727
01:29:03,669 --> 01:29:00,960
really know what they're doing which is

2728
01:29:06,550 --> 01:29:03,679
totally understandable in this situation

2729
01:29:08,470 --> 01:29:06,560
uh so uh if selected as a winner future

2730
01:29:10,629 --> 01:29:08,480
engineers will help provide technical

2731
01:29:13,030 --> 01:29:10,639
support as you embark on this journey

2732
01:29:15,510 --> 01:29:13,040
and um there's going to be a series of

2733
01:29:15,990 --> 01:29:15,520
of workshops over the summer to help you

2734
01:29:18,790 --> 01:29:16,000
get

2735
01:29:20,950 --> 01:29:18,800
um uh better acquainted with some of the

2736
01:29:21,669 --> 01:29:20,960
capabilities you might leverage uh to to

2737
01:29:23,189 --> 01:29:21,679
do this

2738
01:29:25,590 --> 01:29:23,199

and you're gonna get a little bit of a

2739
01:29:31,750 --> 01:29:25,600
taste of that

2740
01:29:41,270 --> 01:29:39,430
and now you're muted

2741
01:29:42,709 --> 01:29:41,280
it happens to the best of us it happens

2742
01:29:45,350 --> 01:29:42,719
to the best of us

2743
01:29:47,270 --> 01:29:45,360
all right so um so i put an image of the

2744
01:29:48,470 --> 01:29:47,280
vehicles up on the screen so now we are

2745
01:29:49,990 --> 01:29:48,480
going to um

2746
01:29:51,430 --> 01:29:50,000
uh once again i should remind you that

2747
01:29:53,110 --> 01:29:51,440
we've got we've got this data coming

2748
01:29:54,709 --> 01:29:53,120
from the vehicles right and so

2749
01:29:56,310 --> 01:29:54,719
we can use that data to trigger

2750
01:29:57,430 --> 01:29:56,320
something something really simple and

2751
01:29:58,390 --> 01:29:57,440
we're going to walk through a simple

2752
01:30:00,870 --> 01:29:58,400
experiment with that

2753
01:30:02,550 --> 01:30:00,880
and tanya our director of k-12

2754
01:30:03,350 --> 01:30:02,560
engagement at future engineers is going

2755
01:30:05,030 --> 01:30:03,360
to go over

2756
01:30:06,390 --> 01:30:05,040
a basic overview of what is a

2757
01:30:07,990 --> 01:30:06,400
microcontroller

2758
01:30:09,350 --> 01:30:08,000
um i know this sounds complicated but

2759
01:30:10,629 --> 01:30:09,360
yet again sign up for those workshops

2760
01:30:11,910 --> 01:30:10,639
and you're going to be an expert

2761
01:30:14,390 --> 01:30:11,920
we are here with you every step of the

2762
01:30:17,669 --> 01:30:14,400
way and then next we are going to

2763
01:30:21,350 --> 01:30:17,679

also uh hear from arne martin

2764
01:30:24,070 --> 01:30:21,360
uh after that and arnie is a

2765
01:30:25,030 --> 01:30:24,080
designer an artist and a professor of

2766
01:30:27,669 --> 01:30:25,040
product design

2767
01:30:28,870 --> 01:30:27,679
um at art center college of design and

2768
01:30:30,229 --> 01:30:28,880
we are going to hear from them both so

2769
01:30:34,310 --> 01:30:30,239
i'm going to stop sharing my screen and

2770
01:30:36,790 --> 01:30:34,320
i'm going to go to tanya

2771
01:30:38,390 --> 01:30:36,800
hi guys tanya from future engineers

2772
01:30:41,110 --> 01:30:38,400
microcontrollers are part of

2773
01:30:42,870 --> 01:30:41,120
everyday life and are everywhere from

2774
01:30:45,030 --> 01:30:42,880
your computer keyboard

2775
01:30:46,550 --> 01:30:45,040
to microwave ovens the electrical

2776
01:30:49,910 --> 01:30:46,560
devices all around us

2777
01:30:50,950 --> 01:30:49,920
rely on microcontrollers to work even a

2778
01:30:54,629 --> 01:30:50,960
car can have

2779
01:30:56,709 --> 01:30:54,639
over 65 microcontrollers in it

2780
01:30:58,950 --> 01:30:56,719
so you might have seen that youtube

2781
01:31:01,350 --> 01:30:58,960
video of the squirrel obstacle course

2782
01:31:03,430 --> 01:31:01,360
or the glitter package those are made

2783
01:31:08,550 --> 01:31:03,440
possible by microcontrollers i have a

2784
01:31:11,830 --> 01:31:11,189
so you see this black box right here

2785
01:31:13,830 --> 01:31:11,840
that

2786
01:31:21,189 --> 01:31:13,840
is the microcontroller and let's go to a

2787
01:31:24,790 --> 01:31:23,750
so what is a microcontroller

2788
01:31:26,870 --> 01:31:24,800

microcontrollers

2789
01:31:28,830 --> 01:31:26,880
are programmable integrated circuits

2790
01:31:30,149 --> 01:31:28,840
that come in many different shapes and

2791
01:31:33,110 --> 01:31:30,159
sizes

2792
01:31:35,110 --> 01:31:33,120
there are essentially mini computers

2793
01:31:38,790 --> 01:31:35,120
that can do basic math

2794
01:31:41,430 --> 01:31:38,800
and logical computer operations

2795
01:31:43,510 --> 01:31:41,440
many microcontrollers can perform

2796
01:31:45,189 --> 01:31:43,520
millions of functions per second i wish

2797
01:31:46,629 --> 01:31:45,199
i could perform millions of functions

2798
01:31:49,750 --> 01:31:46,639
per second that would be

2799
01:31:50,950 --> 01:31:49,760
amazing typically they're used in

2800
01:31:54,229 --> 01:31:50,960
applications

2801
01:31:56,830 --> 01:31:54,239
that require a repetitive function

2802
01:31:58,390 --> 01:31:56,840
such as but not limited to traffic

2803
01:32:01,189 --> 01:31:58,400
lights

2804
01:32:02,310 --> 01:32:01,199
your the remote for your tv high-tech

2805
01:32:05,910 --> 01:32:02,320
devices

2806
01:32:09,229 --> 01:32:05,920
washer and dryers microwaves satellites

2807
01:32:11,590 --> 01:32:09,239
rockets and more in our modern world

2808
01:32:13,270 --> 01:32:11,600
microcontrollers really are all around

2809
01:32:15,189 --> 01:32:13,280
us

2810
01:32:16,550 --> 01:32:15,199
so you're probably wondering what does

2811
01:32:19,270 --> 01:32:16,560
this have to do

2812
01:32:20,790 --> 01:32:19,280
with nasa's techrize student challenge

2813
01:32:22,390 --> 01:32:20,800

well i'm going to tell you

2814
01:32:24,870 --> 01:32:22,400
the techrize challenge is all about

2815
01:32:26,950 --> 01:32:24,880
using science and technology

2816
01:32:28,310 --> 01:32:26,960
to discover more about the world around

2817
01:32:30,790 --> 01:32:28,320
us and because

2818
01:32:32,709 --> 01:32:30,800
microcontrollers can be programmed to do

2819
01:32:34,870 --> 01:32:32,719
many different functions

2820
01:32:37,189 --> 01:32:34,880
you and your students can use them in

2821
01:32:39,430 --> 01:32:37,199
your techriz payload design

2822
01:32:40,870 --> 01:32:39,440
maybe you want to snap a picture above

2823
01:32:43,990 --> 01:32:40,880
the troposphere

2824
01:32:45,830 --> 01:32:44,000
or use a sensor to record air pressure

2825
01:32:48,149 --> 01:32:45,840
at a specific elevation

2826
01:32:49,830 --> 01:32:48,159
microcontrollers can do that and the

2827
01:32:52,310 --> 01:32:49,840
possibilities are nearly

2828
01:32:54,550 --> 01:32:52,320
endless so i'm actually going to hand it

2829
01:32:57,510 --> 01:32:54,560
off to arnie and he's gonna actually

2830
01:32:59,030 --> 01:32:57,520
show us how to use flight data from our

2831
01:33:00,149 --> 01:32:59,040
flight simulator to get a

2832
01:33:02,709 --> 01:33:00,159
microcontroller

2833
01:33:04,390 --> 01:33:02,719
to basically trigger it to do something

2834
01:33:05,430 --> 01:33:04,400
now this flight simulator is actually

2835
01:33:07,910 --> 01:33:05,440
available

2836
01:33:09,030 --> 01:33:07,920
in our techrize challenge page and i'll

2837
01:33:12,950 --> 01:33:09,040
put that in the chat

2838
01:33:15,590 --> 01:33:12,960

so without further ado take it away arne

2839
01:33:16,070 --> 01:33:15,600
thanks tonya uh hi everyone happy to be

2840
01:33:18,629 --> 01:33:16,080
here

2841
01:33:20,550 --> 01:33:18,639
um as deanne mentioned i'm a designer an

2842
01:33:21,750 --> 01:33:20,560
artist an educator

2843
01:33:23,510 --> 01:33:21,760
and i've always had a kind of deep

2844
01:33:24,629 --> 01:33:23,520
curiosity for science and engineering

2845
01:33:26,629 --> 01:33:24,639
and technology

2846
01:33:28,310 --> 01:33:26,639
uh so as a teacher at art center i

2847
01:33:29,830 --> 01:33:28,320
developed a class for

2848
01:33:31,669 --> 01:33:29,840
students who had never written code

2849
01:33:33,350 --> 01:33:31,679
before uh to learn how to make

2850
01:33:35,350 --> 01:33:33,360
interactive devices using a programming

2851
01:33:38,310 --> 01:33:35,360
language called circuit python

2852
01:33:40,070 --> 01:33:38,320
and microcontrollers like this one and i

2853
01:33:41,750 --> 01:33:40,080
guess that's just to emphasize the fact

2854
01:33:43,590 --> 01:33:41,760
that you know this is pretty accessible

2855
01:33:44,790 --> 01:33:43,600
technology it's really not as difficult

2856
01:33:46,390 --> 01:33:44,800
as it may seem

2857
01:33:47,669 --> 01:33:46,400
um and so today i'm going to show you a

2858
01:33:49,510 --> 01:33:47,679
quick demonstration where we're going to

2859
01:33:50,950 --> 01:33:49,520
see how this little circuit playground

2860
01:33:52,870 --> 01:33:50,960
express microcontroller

2861
01:33:54,310 --> 01:33:52,880
can be programmed with circuit python

2862
01:33:55,510 --> 01:33:54,320
and can help teachers support

2863
01:33:58,310 --> 01:33:55,520

students who want to create science

2864
01:33:59,830 --> 01:33:58,320
experiments to fly to the edge space

2865
01:34:01,189 --> 01:33:59,840
circuit python is a pretty good way to

2866
01:34:03,110 --> 01:34:01,199
do this because it was designed

2867
01:34:04,870 --> 01:34:03,120
specifically for novice programmers to

2868
01:34:06,149 --> 01:34:04,880
learn to write code for microcontrollers

2869
01:34:07,750 --> 01:34:06,159
just like the ones that tonya just

2870
01:34:09,350 --> 01:34:07,760
introduced

2871
01:34:11,189 --> 01:34:09,360
so here's the scenario i'm going to

2872
01:34:16,229 --> 01:34:11,199
share my slides here really quick

2873
01:34:20,470 --> 01:34:17,990
let's imagine that a group of students

2874
01:34:25,350 --> 01:34:20,480
want to explore how confetti behaves in

2875
01:34:28,709 --> 01:34:27,189
well we just heard about two tech rise

2876
01:34:30,629 --> 01:34:28,719
challenge flights that will experience a

2877
01:34:31,990 --> 01:34:30,639
short window of microgravity aboard

2878
01:34:33,910 --> 01:34:32,000
sub-orbital rockets and

2879
01:34:35,110 --> 01:34:33,920
both of those flights with up aerospace

2880
01:34:36,709 --> 01:34:35,120
and blue origin

2881
01:34:38,870 --> 01:34:36,719
as well as the high altitude balloon

2882
01:34:39,910 --> 01:34:38,880
from raven aerostar have what are called

2883
01:34:42,149 --> 01:34:39,920
specially designed

2884
01:34:44,070 --> 01:34:42,159
chassis that can contain experiments

2885
01:34:45,910 --> 01:34:44,080
designed by students

2886
01:34:47,510 --> 01:34:45,920
each of these chassis gives you a

2887
01:34:50,229 --> 01:34:47,520
mechanical way to mount

2888
01:34:51,189 --> 01:34:50,239

electronics and mechanical actuation and

2889
01:34:53,990 --> 01:34:51,199
all sorts of things

2890
01:34:55,669 --> 01:34:54,000
inside of this container but they also

2891
01:34:57,669 --> 01:34:55,679
have a way to communicate with the

2892
01:34:59,750 --> 01:34:57,679
spacecraft so you can actually receive

2893
01:35:01,510 --> 01:34:59,760
data from the spacecraft

2894
01:35:02,870 --> 01:35:01,520
and then program the microcontroller to

2895
01:35:04,870 --> 01:35:02,880
do something with it

2896
01:35:06,870 --> 01:35:04,880
uh that flight data just looks like a

2897
01:35:08,229 --> 01:35:06,880
long series of numbers and this is very

2898
01:35:10,229 --> 01:35:08,239
similar to the way in which like a

2899
01:35:11,669 --> 01:35:10,239
printer or a mouse or a keyboard

2900
01:35:13,350 --> 01:35:11,679
communicates with a computer and it's

2901
01:35:13,990 --> 01:35:13,360
using something called serial data which

2902
01:35:16,149 --> 01:35:14,000
is just like a

2903
01:35:18,149 --> 01:35:16,159
long string of numbers that

2904
01:35:20,629 --> 01:35:18,159
microcontrollers can can interpret and

2905
01:35:23,189 --> 01:35:20,639
use to communicate

2906
01:35:24,790 --> 01:35:23,199
so to test confetti in microgravity on a

2907
01:35:26,229 --> 01:35:24,800
sub-orbital rocket flight using one of

2908
01:35:27,830 --> 01:35:26,239
these 2u chassis

2909
01:35:29,669 --> 01:35:27,840
we can build what is essentially a

2910
01:35:30,790 --> 01:35:29,679
simple robot with a microcontroller as

2911
01:35:32,709 --> 01:35:30,800
its brain

2912
01:35:33,990 --> 01:35:32,719
uh the hardware is really simple a

2913
01:35:35,669 --> 01:35:34,000

microcontroller like the circuit

2914
01:35:37,990 --> 01:35:35,679
playground that you see up there

2915
01:35:39,590 --> 01:35:38,000
um a motor controller like that

2916
01:35:41,590 --> 01:35:39,600
companion board that kind of mounts to

2917
01:35:43,109 --> 01:35:41,600
that to the microcontroller

2918
01:35:44,790 --> 01:35:43,119
and a servo motor to release the

2919
01:35:47,350 --> 01:35:44,800
confetti in flight and

2920
01:35:49,109 --> 01:35:47,360
because we're not really in microgravity

2921
01:35:50,550 --> 01:35:49,119
uh i put a fan in there too so that we

2922
01:35:51,910 --> 01:35:50,560
can see it move around and hopefully do

2923
01:35:55,590 --> 01:35:51,920
something exciting for the camera

2924
01:35:57,830 --> 01:35:55,600
okay experiments like this

2925
01:35:59,750 --> 01:35:57,840
need a way to know exactly when the

2926
01:36:01,669 --> 01:35:59,760
flight is in microgravity to begin

2927
01:36:04,149 --> 01:36:01,679
experimenting or collecting data

2928
01:36:04,790 --> 01:36:04,159
so or in our case to drop confetti so in

2929
01:36:06,070 --> 01:36:04,800
this case

2930
01:36:08,390 --> 01:36:06,080
what we're doing is we're looking at

2931
01:36:10,149 --> 01:36:08,400
this and saying how do we know or how

2932
01:36:11,990 --> 01:36:10,159
can we program our experiment to know

2933
01:36:13,030 --> 01:36:12,000
exactly when we enter the conditions

2934
01:36:15,430 --> 01:36:13,040
that we need to be in

2935
01:36:17,109 --> 01:36:15,440
in order to test our hypothesis or

2936
01:36:17,750 --> 01:36:17,119
collect our information or collect our

2937
01:36:18,950 --> 01:36:17,760
data

2938
01:36:20,870 --> 01:36:18,960

and the way that we're going to do this

2939
01:36:21,910 --> 01:36:20,880
today is we're using flight data or

2940
01:36:23,669 --> 01:36:21,920
telemetry

2941
01:36:25,270 --> 01:36:23,679
and that flight data looks a lot like

2942
01:36:26,229 --> 01:36:25,280
this long string of numbers up here at

2943
01:36:28,229 --> 01:36:26,239
the top

2944
01:36:29,510 --> 01:36:28,239
um and what's happening here is that we

2945
01:36:32,229 --> 01:36:29,520
have a a

2946
01:36:33,510 --> 01:36:32,239
basic um what's called an event at the

2947
01:36:35,270 --> 01:36:33,520
beginning of this long string of

2948
01:36:36,310 --> 01:36:35,280
information and then everything after

2949
01:36:38,950 --> 01:36:36,320
the event

2950
01:36:40,629 --> 01:36:38,960
is essentially uh specific information

2951
01:36:41,830 --> 01:36:40,639
about the flight or about the rocket so

2952
01:36:44,390 --> 01:36:41,840
things like time

2953
01:36:44,870 --> 01:36:44,400
uh physical orientation xyz orientation

2954
01:36:47,109 --> 01:36:44,880
speed

2955
01:36:48,790 --> 01:36:47,119
altitude uh and all kinds of other you

2956
01:36:50,229 --> 01:36:48,800
know flight data

2957
01:36:51,830 --> 01:36:50,239
and really the program that i wrote for

2958
01:36:53,350 --> 01:36:51,840
today all it's doing is responding to

2959
01:36:53,990 --> 01:36:53,360
that one thing the event at the

2960
01:36:55,669 --> 01:36:54,000
beginning

2961
01:36:57,830 --> 01:36:55,679
and each one of those events is listed

2962
01:37:01,189 --> 01:36:57,840
here in a table and you can see that

2963
01:37:03,590 --> 01:37:01,199

a b c d e f g h i through m

2964
01:37:05,109 --> 01:37:03,600
all have meaning they all mean something

2965
01:37:06,390 --> 01:37:05,119
from the flight computer and our

2966
01:37:11,109 --> 01:37:06,400
our controller is just going to collect

2967
01:37:14,790 --> 01:37:12,709
but we don't have access to a rocket

2968
01:37:16,070 --> 01:37:14,800
today right so what we use instead is we

2969
01:37:17,990 --> 01:37:16,080
use this flight simulator and this is

2970
01:37:20,070 --> 01:37:18,000
the flight simulator that uh that was

2971
01:37:22,149 --> 01:37:20,080
developed by future engineers for this

2972
01:37:23,750 --> 01:37:22,159
uh challenge and when you look at this

2973
01:37:24,229 --> 01:37:23,760
you can see it's pretty simple interface

2974
01:37:28,709 --> 01:37:24,239
we have

2975
01:37:29,189 --> 01:37:28,719
one way on the lower left right there to

2976
01:37:33,430 --> 01:37:29,199
connect

2977
01:37:36,870 --> 01:37:33,440
from our simulator

2978
01:37:39,750 --> 01:37:36,880
that's going to be over usb we have a

2979
01:37:41,669 --> 01:37:39,760
play a play pause button a backup button

2980
01:37:43,430 --> 01:37:41,679
and we can also control how fast

2981
01:37:44,950 --> 01:37:43,440
relative to real time we run this so

2982
01:37:46,070 --> 01:37:44,960
we're going to run our experiment at 10x

2983
01:37:48,470 --> 01:37:46,080
which is faster than

2984
01:37:49,910 --> 01:37:48,480
the actual rocket flight and then on

2985
01:37:51,030 --> 01:37:49,920
this we'll see the flight path of the

2986
01:37:53,109 --> 01:37:51,040
rocket we'll see

2987
01:37:54,550 --> 01:37:53,119
uh specific events that were in that

2988
01:37:56,470 --> 01:37:54,560

table that we just looked at things like

2989
01:37:59,750 --> 01:37:56,480
liftoff and main engine cutoff

2990
01:38:01,590 --> 01:37:59,760
capsule separation coast start apogee

2991
01:38:04,070 --> 01:38:01,600
which is when i want to drop confetti

2992
01:38:04,790 --> 01:38:04,080
and then the coast end and then also you

2993
01:38:06,229 --> 01:38:04,800
know when

2994
01:38:07,830 --> 01:38:06,239
parachutes are deployed and when we're

2995
01:38:10,629 --> 01:38:07,840
floating safely back to earth before

2996
01:38:15,510 --> 01:38:13,750
so just as a as an overview we can put

2997
01:38:16,870 --> 01:38:15,520
all of this hardware together in the

2998
01:38:20,390 --> 01:38:16,880
chassis

2999
01:38:22,070 --> 01:38:20,400
simulator which is

3000
01:38:24,070 --> 01:38:22,080
basically standing in for the rocket in

3001
01:38:26,310 --> 01:38:24,080
this case and that simulator is gonna

3002
01:38:27,669 --> 01:38:26,320
is gonna pipe out data uh and it's gonna

3003
01:38:29,270 --> 01:38:27,679
just send it in long strings of

3004
01:38:30,870 --> 01:38:29,280
information and we're going to collect

3005
01:38:32,070 --> 01:38:30,880
it with our microcontroller

3006
01:38:33,189 --> 01:38:32,080
and that's going to be what we call

3007
01:38:34,629 --> 01:38:33,199
input and the input to the

3008
01:38:35,590 --> 01:38:34,639
microcontroller in this case is just the

3009
01:38:37,430 --> 01:38:35,600
flight data

3010
01:38:39,030 --> 01:38:37,440
and then the output is going to be what

3011
01:38:40,870 --> 01:38:39,040
i've programmed the microcontroller to

3012
01:38:42,870 --> 01:38:40,880
do when certain events happen so that i

3013
01:38:45,510 --> 01:38:42,880

can do things like trigger a servo

3014
01:38:47,510 --> 01:38:45,520
turn on a fan motor and then also so

3015
01:38:49,430 --> 01:38:47,520
that we can see the data in real time

3016
01:38:51,030 --> 01:38:49,440
i also have another usb output here so

3017
01:38:53,270 --> 01:38:51,040
that i can actually see the data coming

3018
01:38:55,830 --> 01:38:53,280
back over the usb serial

3019
01:38:57,430 --> 01:38:55,840
um and so without too much more

3020
01:39:01,830 --> 01:38:57,440
explanation here i think

3021
01:39:04,870 --> 01:39:01,840
i can switch my screen over to share

3022
01:39:06,629 --> 01:39:04,880
my whole screen there it is

3023
01:39:07,750 --> 01:39:06,639
and i can show you the live simulator

3024
01:39:09,189 --> 01:39:07,760
which is running right here in the upper

3025
01:39:11,189 --> 01:39:09,199
right hand corner so that's the same as

3026
01:39:12,709 --> 01:39:11,199
the slide that we just saw

3027
01:39:14,470 --> 01:39:12,719
hopefully on the left right here you can

3028
01:39:16,870 --> 01:39:14,480
see my experiment uh

3029
01:39:18,390 --> 01:39:16,880
in its box and you can see the green

3030
01:39:19,669 --> 01:39:18,400
leds flashing that's my go

3031
01:39:21,510 --> 01:39:19,679
signal that's telling me that this is

3032
01:39:22,470 --> 01:39:21,520
ready to go and then down here on the

3033
01:39:24,229 --> 01:39:22,480
bottom right

3034
01:39:25,350 --> 01:39:24,239
i have a serial monitor which is really

3035
01:39:28,070 --> 01:39:25,360
just a way for the for the

3036
01:39:29,430 --> 01:39:28,080
microcontroller to tell me what it sees

3037
01:39:31,030 --> 01:39:29,440
and when i press play here it's going to

3038
01:39:33,270 --> 01:39:31,040

take us through a simulated rocket

3039
01:39:36,149 --> 01:39:33,280
flight

3040
01:39:36,709 --> 01:39:36,159
so here we are we have liftoff uh we

3041
01:39:38,470 --> 01:39:36,719
have

3042
01:39:39,990 --> 01:39:38,480
red lights flashing inside of the box

3043
01:39:42,629 --> 01:39:40,000
randomly here telling us that the

3044
01:39:43,990 --> 01:39:42,639
engines are burning and we are headed

3045
01:39:45,910 --> 01:39:44,000
for space

3046
01:39:47,510 --> 01:39:45,920
in just a moment we'll have main engine

3047
01:39:49,350 --> 01:39:47,520
cutoff and then

3048
01:39:51,590 --> 01:39:49,360
separation which is when the capsule

3049
01:39:53,350 --> 01:39:51,600
becomes separate from the rocket booster

3050
01:39:55,109 --> 01:39:53,360
and now we're in microgravity and in

3051
01:39:56,070 --> 01:39:55,119
just a moment we're gonna hit apogee of

3052
01:39:57,590 --> 01:39:56,080
the flight

3053
01:39:59,270 --> 01:39:57,600
right about there and there comes the

3054
01:40:02,390 --> 01:39:59,280
confetti

3055
01:40:04,229 --> 01:40:02,400
blowing around inside the box and uh

3056
01:40:05,750 --> 01:40:04,239
we're now on the downswing here we're

3057
01:40:07,350 --> 01:40:05,760
headed back to earth

3058
01:40:09,030 --> 01:40:07,360
and in just a minute we're gonna close

3059
01:40:12,310 --> 01:40:09,040
up the hatch there and uh

3060
01:40:14,229 --> 01:40:12,320
head back down to the ground and

3061
01:40:16,550 --> 01:40:14,239
in just a moment we'll see parachutes

3062
01:40:17,910 --> 01:40:16,560
deploy we'll see some blue lights that

3063
01:40:18,870 --> 01:40:17,920

tell us that we're floating back to

3064
01:40:21,510 --> 01:40:18,880
earth

3065
01:40:22,149 --> 01:40:21,520
and the experiment will end so the whole

3066
01:40:24,629 --> 01:40:22,159
point here

3067
01:40:26,550 --> 01:40:24,639
is that this simulator will help you

3068
01:40:27,189 --> 01:40:26,560
along with support from future engineers

3069
01:40:30,470 --> 01:40:27,199
to

3070
01:40:31,910 --> 01:40:30,480
and test them and know that they're

3071
01:40:34,310 --> 01:40:31,920
going to work on the ground

3072
01:40:35,590 --> 01:40:34,320
before you ever get them into the rocket

3073
01:40:36,950 --> 01:40:35,600
and it's going to let you develop

3074
01:40:38,310 --> 01:40:36,960
something that really works

3075
01:40:40,390 --> 01:40:38,320
and it's going to help you learn a lot

3076
01:40:41,830 --> 01:40:40,400
in the process uh and with that i'm

3077
01:40:45,590 --> 01:40:41,840
going to hand it back over to

3078
01:40:49,030 --> 01:40:45,600
uh deanne hi dan

3079
01:40:50,629 --> 01:40:49,040
hi amazing amazing stuff is it crazy

3080
01:40:52,070 --> 01:40:50,639
because we just launched the simulator i

3081
01:40:52,629 --> 01:40:52,080
think tanya said she's putting it in the

3082
01:40:54,470 --> 01:40:52,639
chat

3083
01:40:55,910 --> 01:40:54,480
um you know when you do a live demo

3084
01:40:58,470 --> 01:40:55,920
you're always like okay i hope it works

3085
01:40:59,430 --> 01:40:58,480
but that was amazing arnie and

3086
01:41:00,950 --> 01:40:59,440
they're really great everyone was

3087
01:41:01,750 --> 01:41:00,960
talking earlier about how to take a

3088
01:41:03,830 --> 01:41:01,760

simple idea

3089
01:41:04,870 --> 01:41:03,840
and turn it into space right so so you

3090
01:41:06,950 --> 01:41:04,880
know the hypothesis

3091
01:41:08,229 --> 01:41:06,960
is what happens when i release a bunch

3092
01:41:09,830 --> 01:41:08,239
of loose particles

3093
01:41:11,350 --> 01:41:09,840
and you know you think confetti that

3094
01:41:12,629 --> 01:41:11,360
seems completely ridiculous we wanted

3095
01:41:13,189 --> 01:41:12,639
confetti because it's a launch party

3096
01:41:15,510 --> 01:41:13,199
today

3097
01:41:16,870 --> 01:41:15,520
but um confetti's not that far off like

3098
01:41:18,470 --> 01:41:16,880
if you think about what they're talking

3099
01:41:20,470 --> 01:41:18,480
about on the moon having to deal with

3100
01:41:22,310 --> 01:41:20,480
dust going everywhere and and you know

3101
01:41:23,830 --> 01:41:22,320
so so thinking of it of like what

3102
01:41:25,669 --> 01:41:23,840
hypothesis you might have for

3103
01:41:27,030 --> 01:41:25,679
for how certain things might behave on

3104
01:41:28,950 --> 01:41:27,040
microgravity differently

3105
01:41:30,390 --> 01:41:28,960
so so being able to drop something like

3106
01:41:32,070 --> 01:41:30,400
that and measure it is great

3107
01:41:34,149 --> 01:41:32,080
but i just want to emphasize if this

3108
01:41:34,790 --> 01:41:34,159
seems completely bananas if this is just

3109
01:41:37,510 --> 01:41:34,800
like this is

3110
01:41:38,550 --> 01:41:37,520
so complicated i just want to emphasize

3111
01:41:40,790 --> 01:41:38,560
to you

3112
01:41:43,270 --> 01:41:40,800
you don't even have to have touched a

3113
01:41:44,550 --> 01:41:43,280

line of code to put in a proposal idea

3114
01:41:45,830 --> 01:41:44,560
and we encourage you to go to our

3115
01:41:47,350 --> 01:41:45,840
educator workshops you can go to the

3116
01:41:47,830 --> 01:41:47,360
future engineers page and sign up for

3117
01:41:49,510 --> 01:41:47,840
those

3118
01:41:51,189 --> 01:41:49,520
um but you really just need to put in

3119
01:41:53,669 --> 01:41:51,199
that proposal put in that idea

3120
01:41:55,189 --> 01:41:53,679
and we have dedicated team for those for

3121
01:41:56,709 --> 01:41:55,199
those on teams that win

3122
01:41:59,030 --> 01:41:56,719
we have dedicated staff that are there

3123
01:42:00,629 --> 01:41:59,040
to have office hours and to do sessions

3124
01:42:02,870 --> 01:42:00,639
and to do education workshops

3125
01:42:04,790 --> 01:42:02,880
to help you guys take your students and

3126
01:42:07,109 --> 01:42:04,800
turn that idea into reality

3127
01:42:08,629 --> 01:42:07,119
so um this is a really good starter feel

3128
01:42:10,229 --> 01:42:08,639
free to go into that simulator even if

3129
01:42:11,510 --> 01:42:10,239
you don't hook up a microcontroller to

3130
01:42:13,510 --> 01:42:11,520
it you can just press play and just

3131
01:42:14,950 --> 01:42:13,520
watch the cool flight events happening

3132
01:42:16,709 --> 01:42:14,960
um and as well if you go to the future

3133
01:42:18,070 --> 01:42:16,719
engineer site you're going to see

3134
01:42:19,430 --> 01:42:18,080
there's other tech sheets

3135
01:42:21,430 --> 01:42:19,440
but for example if you click raven

3136
01:42:21,830 --> 01:42:21,440
you'll get to the raven uh simulator as

3137
01:42:23,109 --> 01:42:21,840
well

3138
01:42:24,709 --> 01:42:23,119

and i should say that's just the start

3139
01:42:25,669 --> 01:42:24,719
we're going to have more tutorials and

3140
01:42:27,430 --> 01:42:25,679
we're going to integrate those

3141
01:42:29,430 --> 01:42:27,440
simulators to even be more robust to

3142
01:42:31,270 --> 01:42:29,440
integrate with more maker coding skills

3143
01:42:33,109 --> 01:42:31,280
um going forwards this is the tease of

3144
01:42:33,830 --> 01:42:33,119
what's to come so thank you so much

3145
01:42:38,229 --> 01:42:33,840
arnie

3146
01:42:40,149 --> 01:42:38,239
um and now we are going to transition

3147
01:42:41,990 --> 01:42:40,159
uh it sounds like we're gonna bring on

3148
01:42:44,229 --> 01:42:42,000
george we just talked about microgravity

3149
01:42:45,990 --> 01:42:44,239
george we are going to bring you on if

3150
01:42:47,750 --> 01:42:46,000
you are here and ready to go i have your

3151
01:42:49,830 --> 01:42:47,760
slice because george has experienced

3152
01:42:51,910 --> 01:42:49,840
flying microgravity experiments

3153
01:42:53,189 --> 01:42:51,920
and george it's all about challenges

3154
01:42:54,790 --> 01:42:53,199
today i have a challenge for you

3155
01:42:55,910 --> 01:42:54,800
you need to do your presentation in five

3156
01:42:56,629 --> 01:42:55,920
minutes or less are you up for the

3157
01:42:58,790 --> 01:42:56,639
challenge

3158
01:43:00,550 --> 01:42:58,800
uh yeah but you might not want me to use

3159
01:43:02,390 --> 01:43:00,560
my slides which is unfortunate because

3160
01:43:05,030 --> 01:43:02,400
that's the best part

3161
01:43:06,629 --> 01:43:05,040
ah but i have your slide straight so

3162
01:43:08,550 --> 01:43:06,639
just keep showing them and i'll talk

3163
01:43:10,870 --> 01:43:08,560

over them

3164
01:43:12,629 --> 01:43:10,880
do you see this oh wait i have to i i've

3165
01:43:14,390 --> 01:43:12,639
got so good at clicking buttons that i

3166
01:43:15,990 --> 01:43:14,400
need to push their screen first so hold

3167
01:43:18,070 --> 01:43:16,000
on one second

3168
01:43:19,430 --> 01:43:18,080
and we are going to get to your slides

3169
01:43:22,470 --> 01:43:19,440
george and i'm excited to hear your

3170
01:43:25,590 --> 01:43:24,790
so here we go is that what you want did

3171
01:43:27,830 --> 01:43:25,600
you see it

3172
01:43:28,629 --> 01:43:27,840
there you go all right take it away yeah

3173
01:43:30,149 --> 01:43:28,639
so i'm

3174
01:43:31,830 --> 01:43:30,159
a professor at the university of

3175
01:43:34,470 --> 01:43:31,840
louisville uh previously at the

3176
01:43:37,669 --> 01:43:34,480
university of utah in salt lake city

3177
01:43:39,350 --> 01:43:37,679
um and the word nerd was bounced around

3178
01:43:42,390 --> 01:43:39,360
quite a bit several minutes ago

3179
01:43:45,350 --> 01:43:42,400
and i started out as a rocket nerd i

3180
01:43:47,990 --> 01:43:45,360
still am but in the way i also became a

3181
01:43:49,910 --> 01:43:48,000
surgical research nerd and in fact what

3182
01:43:51,510 --> 01:43:49,920
we're doing right now is developing

3183
01:43:53,590 --> 01:43:51,520
advanced healthcare

3184
01:43:55,669 --> 01:43:53,600
including surgical capabilities for

3185
01:43:58,390 --> 01:43:55,679
exploration spaceflight

3186
01:44:01,510 --> 01:43:58,400
and that involves little parts and that

3187
01:44:04,950 --> 01:44:01,520
involves big parts and parts in between

3188
01:44:08,149 --> 01:44:04,960

and one of the advantages that i

3189
01:44:09,350 --> 01:44:08,159
have over most people right now that are

3190
01:44:11,030 --> 01:44:09,360
tuned in

3191
01:44:12,390 --> 01:44:11,040
it is i spent a lot of time in

3192
01:44:15,350 --> 01:44:12,400
microgravity

3193
01:44:17,590 --> 01:44:15,360
that's created on the xero g airplane

3194
01:44:19,030 --> 01:44:17,600
and what that's allowed me to do is part

3195
01:44:21,510 --> 01:44:19,040
of my brain is a 1g

3196
01:44:23,510 --> 01:44:21,520
brain and part of my brain is a zero-g

3197
01:44:25,430 --> 01:44:23,520
brain and it knows when to flip back and

3198
01:44:27,830 --> 01:44:25,440
forth automatically

3199
01:44:29,430 --> 01:44:27,840
but that what that means is i i kind of

3200
01:44:32,950 --> 01:44:29,440
understand what happens in

3201
01:44:37,990 --> 01:44:32,960
in microgravity and that helps you

3202
01:44:43,350 --> 01:44:41,109
so just you know try try to keep that in

3203
01:44:45,750 --> 01:44:43,360
mind as you can

3204
01:44:46,390 --> 01:44:45,760
a couple of things i will mention

3205
01:44:50,709 --> 01:44:46,400
because i've

3206
01:44:52,950 --> 01:44:50,719
done a lot of advising student groups

3207
01:44:54,950 --> 01:44:52,960
in fact i just last summer i advise

3208
01:44:55,990 --> 01:44:54,960
several groups in a program in canada

3209
01:44:57,590 --> 01:44:56,000
that are doing

3210
01:44:59,030 --> 01:44:57,600
something very much like what you're

3211
01:45:01,990 --> 01:44:59,040
doing is

3212
01:45:03,189 --> 01:45:02,000
it's really easy to come up with a very

3213
01:45:04,870 --> 01:45:03,199

complicated

3214
01:45:06,390 --> 01:45:04,880
experiment for this little payload

3215
01:45:08,790 --> 01:45:06,400
package

3216
01:45:10,070 --> 01:45:08,800
try to keep it as simple as you can

3217
01:45:13,669 --> 01:45:10,080
because by nature

3218
01:45:16,870 --> 01:45:13,679
it will become more complicated

3219
01:45:20,470 --> 01:45:16,880
the second thing is that

3220
01:45:22,950 --> 01:45:20,480
if you're flying on a sounding rocket

3221
01:45:25,910 --> 01:45:22,960
like upspace or on a suborbital

3222
01:45:28,149 --> 01:45:25,920
spacecraft like blue origin

3223
01:45:30,310 --> 01:45:28,159
if you've never experienced extreme g's

3224
01:45:33,750 --> 01:45:30,320
yourself it's hard to

3225
01:45:35,350 --> 01:45:33,760
fully appreciate how securely something

3226
01:45:39,350 --> 01:45:35,360
needs to be fastened

3227
01:45:40,229 --> 01:45:39,360
so that it doesn't come dislodged during

3228
01:45:43,910 --> 01:45:40,239
the

3229
01:45:45,590 --> 01:45:43,920
flight because you don't want things to

3230
01:45:46,950 --> 01:45:45,600
come apart then because if they're apart

3231
01:45:47,830 --> 01:45:46,960
then they're not going to work when you

3232
01:45:51,189 --> 01:45:47,840
need them

3233
01:45:52,229 --> 01:45:51,199
in the microgravity phase and i i speak

3234
01:45:54,790 --> 01:45:52,239
from experience

3235
01:45:56,470 --> 01:45:54,800
stuff happens and you'll learn from it

3236
01:45:57,189 --> 01:45:56,480
so that hopefully it doesn't happen

3237
01:45:59,350 --> 01:45:57,199
again

3238
01:46:00,390 --> 01:45:59,360

but as you're developing your experiment

3239
01:46:02,629 --> 01:46:00,400
as you're getting

3240
01:46:04,790 --> 01:46:02,639
the guidance from all these different

3241
01:46:07,270 --> 01:46:04,800
workshops that they're talking about

3242
01:46:09,590 --> 01:46:07,280
hopefully you'll get some good insights

3243
01:46:13,030 --> 01:46:09,600
as to how to make your payload

3244
01:46:14,790 --> 01:46:13,040
simple and physically robust

3245
01:46:16,310 --> 01:46:14,800
and then the other thing i would suggest

3246
01:46:18,870 --> 01:46:16,320
is test test

3247
01:46:20,229 --> 01:46:18,880
test again to make sure that it's

3248
01:46:22,629 --> 01:46:20,239
operating

3249
01:46:24,229 --> 01:46:22,639
absolutely the way you need it to

3250
01:46:25,350 --> 01:46:24,239
because if it doesn't operate the way

3251
01:46:28,149 --> 01:46:25,360
you need it to in one

3252
01:46:29,270 --> 01:46:28,159
g it's probably not going to operate the

3253
01:46:32,470 --> 01:46:29,280
way you want it to

3254
01:46:35,430 --> 01:46:32,480
in microgravity so those

3255
01:46:35,750 --> 01:46:35,440
uh are the simple words of advice that i

3256
01:46:38,950 --> 01:46:35,760
can

3257
01:46:42,229 --> 01:46:41,750
thank you thank you thank you all right

3258
01:46:45,270 --> 01:46:42,239
so

3259
01:46:46,870 --> 01:46:45,280
george um that was a great tea up and

3260
01:46:48,790 --> 01:46:46,880
great words of advice to go to our

3261
01:46:52,070 --> 01:46:48,800
educator panel next

3262
01:46:54,390 --> 01:46:52,080
and let me find myself here um thank you

3263
01:46:56,470 --> 01:46:54,400

so much george um uh

3264
01:46:57,830 --> 01:46:56,480
i think i think advice about a lot of

3265
01:46:59,430 --> 01:46:57,840
the experiments you see are about

3266
01:47:01,590 --> 01:46:59,440
keeping it simple so we're gonna next

3267
01:47:03,910 --> 01:47:01,600
bring on our educator panel

3268
01:47:05,189 --> 01:47:03,920
we have three different folks uh joining

3269
01:47:07,750 --> 01:47:05,199
our educator panel

3270
01:47:08,310 --> 01:47:07,760
we have we have liz we have stephen and

3271
01:47:10,629 --> 01:47:08,320
we have

3272
01:47:14,709 --> 01:47:10,639
david and i think liz are coming on too

3273
01:47:18,149 --> 01:47:16,550
so um you know what i'll go ahead and

3274
01:47:18,709 --> 01:47:18,159
start with introductions while we get

3275
01:47:21,990 --> 01:47:18,719
liz

3276
01:47:24,550 --> 01:47:22,000
on um and full disclosure here

3277
01:47:26,070 --> 01:47:24,560
i teed up everyone's slides uh but our

3278
01:47:27,510 --> 01:47:26,080
introduction slides so we're just going

3279
01:47:28,229 --> 01:47:27,520
to rock our introductions and if you

3280
01:47:29,430 --> 01:47:28,239
want to share

3281
01:47:31,350 --> 01:47:29,440
like a one slide while you do your

3282
01:47:33,590 --> 01:47:31,360
introduction you're welcome to do that

3283
01:47:35,270 --> 01:47:33,600
um but everyone here today we're just

3284
01:47:37,030 --> 01:47:35,280
going to talk to these educators all

3285
01:47:38,709 --> 01:47:37,040
of our educators here steve and david

3286
01:47:40,390 --> 01:47:38,719
and liz have experience

3287
01:47:42,709 --> 01:47:40,400
designing flight experiments with

3288
01:47:43,750 --> 01:47:42,719

students getting hands-on with coding

3289
01:47:46,870 --> 01:47:43,760
and electronics

3290
01:47:49,189 --> 01:47:46,880
with students and particularly with nasa

3291
01:47:49,990 --> 01:47:49,199
nasa flights um so we have stephen

3292
01:47:52,629 --> 01:47:50,000
colacott he's

3293
01:47:53,750 --> 01:47:52,639
professor and flight opportunities pei

3294
01:47:55,830 --> 01:47:53,760
um

3295
01:47:57,430 --> 01:47:55,840
uh over at purdue university a

3296
01:47:59,109 --> 01:47:57,440
boilermaker with us we have david

3297
01:48:00,149 --> 01:47:59,119
lockett albert einstein distinguished

3298
01:48:01,990 --> 01:48:00,159
educator fellow

3299
01:48:03,350 --> 01:48:02,000
the most impressive title in the entire

3300
01:48:05,910 --> 01:48:03,360
world essentially

3301
01:48:07,430 --> 01:48:05,920
um and david is a middle school stem

3302
01:48:08,950 --> 01:48:07,440
teacher and he's doing a one year

3303
01:48:10,629 --> 01:48:08,960
fellowship at nasa

3304
01:48:11,990 --> 01:48:10,639
and has is going to speak to some of his

3305
01:48:14,629 --> 01:48:12,000
experience before um

3306
01:48:16,470 --> 01:48:14,639
doing that fellowship as well and last

3307
01:48:18,149 --> 01:48:16,480
but not least we have liz kinnick who is

3308
01:48:21,270 --> 01:48:18,159
the president of teachers in space

3309
01:48:23,590 --> 01:48:21,280
who their their job is to basically get

3310
01:48:25,030 --> 01:48:23,600
get uh teachers working with developing

3311
01:48:25,830 --> 01:48:25,040
experiments for space we're excited to

3312
01:48:27,350 --> 01:48:25,840
have you guys

3313
01:48:29,270 --> 01:48:27,360

um i'm gonna give each of you about a

3314
01:48:30,870 --> 01:48:29,280
minute to introduce yourself and maybe

3315
01:48:33,430 --> 01:48:30,880
some examples of what you've done and

3316
01:48:35,669 --> 01:48:33,440
we're going to ask some questions

3317
01:48:37,830 --> 01:48:35,679
so why don't we start with you liz okay

3318
01:48:38,629 --> 01:48:37,840
great so yeah teachers in space have

3319
01:48:41,109 --> 01:48:38,639
been flying

3320
01:48:43,030 --> 01:48:41,119
uh space experiments built by teachers

3321
01:48:44,870 --> 01:48:43,040
and their students for 10 years now we

3322
01:48:48,070 --> 01:48:44,880
have our own balloon program

3323
01:48:51,350 --> 01:48:48,080
we have flown with blue origin and we

3324
01:48:53,109 --> 01:48:51,360
have flown uh with spacex i don't know

3325
01:48:56,950 --> 01:48:53,119
if i'm able to share these slides

3326
01:48:59,270 --> 01:48:56,960
but um we have a lot of experience

3327
01:48:59,990 --> 01:48:59,280
doing radiation collection experiments

3328
01:49:02,790 --> 01:49:00,000
data collection

3329
01:49:04,950 --> 01:49:02,800
experiments and as a result of the blue

3330
01:49:07,990 --> 01:49:04,960
origin flight that we flew

3331
01:49:08,870 --> 01:49:08,000
in 2019 with the flight experiments

3332
01:49:11,030 --> 01:49:08,880
program

3333
01:49:12,149 --> 01:49:11,040
we earned our first orbital flight so

3334
01:49:15,350 --> 01:49:12,159
we're putting our first

3335
01:49:16,950 --> 01:49:15,360
3u cubesat into space hopefully in the

3336
01:49:19,990 --> 01:49:16,960
coming month it's going on the first

3337
01:49:22,629 --> 01:49:20,000
flight of firefly aerospace and that

3338
01:49:23,669 --> 01:49:22,639

is going to be a satellite that will

3339
01:49:26,310 --> 01:49:23,679
send its

3340
01:49:27,790 --> 01:49:26,320
data back to earth while it's in orbit

3341
01:49:29,750 --> 01:49:27,800
so if you go on our website

3342
01:49:30,550 --> 01:49:29,760
teachesandspace.com you can learn how to

3343
01:49:32,149 --> 01:49:30,560
listen

3344
01:49:34,229 --> 01:49:32,159
how to find that satellite and how to

3345
01:49:35,990 --> 01:49:34,239
listen to it and we would love to help

3346
01:49:37,750 --> 01:49:36,000
anybody who needs help

3347
01:49:39,189 --> 01:49:37,760
uh designing and building experiments

3348
01:49:40,550 --> 01:49:39,199
for space because that's what we love to

3349
01:49:41,510 --> 01:49:40,560
do

3350
01:49:42,790 --> 01:49:41,520
great and i know you mentioned

3351
01:49:44,310 --> 01:49:42,800
satellites so just a reminder we're

3352
01:49:46,390 --> 01:49:44,320
staying suborbital with this

3353
01:49:47,589 --> 01:49:46,400
yes one day you're gonna go farther just

3354
01:49:49,430 --> 01:49:47,599
like liz mentioned

3355
01:49:50,629 --> 01:49:49,440
um steven you have experience working

3356
01:49:52,229 --> 01:49:50,639
with university students all the way

3357
01:49:55,189 --> 01:49:52,239
down the second graders i'm told

3358
01:49:55,990 --> 01:49:55,199
so i'd love to get your introduction yes

3359
01:49:59,030 --> 01:49:56,000
yes certainly

3360
01:50:00,790 --> 01:49:59,040
let me uh let me i uh

3361
01:50:02,390 --> 01:50:00,800
i'm happy to be here thank you for

3362
01:50:06,790 --> 01:50:02,400
having me and

3363
01:50:08,870 --> 01:50:06,800

um yeah for 25 years i have been

3364
01:50:10,310 --> 01:50:08,880
um here's some pictures from that 25

3365
01:50:11,510 --> 01:50:10,320
years at purdue i've been working with a

3366
01:50:14,550 --> 01:50:11,520
variety of students

3367
01:50:17,990 --> 01:50:14,560
in a variety of zero gravity uh

3368
01:50:19,669 --> 01:50:18,000
ex experiences the upper left there is a

3369
01:50:21,750 --> 01:50:19,679
should be a big interest here today that

3370
01:50:24,070 --> 01:50:21,760
was our zero gravity glow experiment

3371
01:50:25,830 --> 01:50:24,080
with a local second grade class my

3372
01:50:26,629 --> 01:50:25,840
purdue students two of them they're with

3373
01:50:29,350 --> 01:50:26,639
me

3374
01:50:30,550 --> 01:50:29,360
um we we had the first k-12 payload on

3375
01:50:33,669 --> 01:50:30,560
blue origin

3376
01:50:35,109 --> 01:50:33,679
and uh all with local fundraising and uh

3377
01:50:36,870 --> 01:50:35,119
and that was great fun that was really

3378
01:50:39,189 --> 01:50:36,880
great fun and you see aircraft work

3379
01:50:40,709 --> 01:50:39,199
the lower left one of the early blue

3380
01:50:43,350 --> 01:50:40,719
origin new shepard flights

3381
01:50:43,750 --> 01:50:43,360
and neutral buoyancy lab in the upper

3382
01:50:46,070 --> 01:50:43,760
right

3383
01:50:48,310 --> 01:50:46,080
and believe it or not those four guys in

3384
01:50:49,750 --> 01:50:48,320
red polo shirts are actually high school

3385
01:50:50,629 --> 01:50:49,760
students and that's the rocket they

3386
01:50:52,709 --> 01:50:50,639
built

3387
01:50:53,830 --> 01:50:52,719
we were to launch a payload on that so

3388
01:50:56,229 --> 01:50:53,840

i've been doing a lot

3389
01:50:58,709 --> 01:50:56,239
and i'm just really excited that future

3390
01:51:01,750 --> 01:50:58,719
engineers have put this program together

3391
01:51:03,189 --> 01:51:01,760
and um teachers i i encourage you and

3392
01:51:05,990 --> 01:51:03,199
echo what george

3393
01:51:07,669 --> 01:51:06,000
uh said about uh try to keep it simple i

3394
01:51:09,109 --> 01:51:07,679
i would just add the the big impact

3395
01:51:11,510 --> 01:51:09,119
you're going to have

3396
01:51:13,669 --> 01:51:11,520
is not really the data from the payload

3397
01:51:15,270 --> 01:51:13,679
but your impact on the students lives

3398
01:51:19,430 --> 01:51:15,280
and their futures and so

3399
01:51:21,830 --> 01:51:19,440
um yeah charge ahead do great work

3400
01:51:23,270 --> 01:51:21,840
all right and next we're going to go to

3401
01:51:24,870 --> 01:51:23,280
david why don't you give us a little

3402
01:51:25,910 --> 01:51:24,880
introduction and we'll have time for

3403
01:51:27,830 --> 01:51:25,920
just like

3404
01:51:30,070 --> 01:51:27,840
uh you know a couple questions and then

3405
01:51:31,910 --> 01:51:30,080
we're gonna we're gonna wrap it up soon

3406
01:51:33,189 --> 01:51:31,920
go ahead david hey thank you for having

3407
01:51:34,629 --> 01:51:33,199
me uh david lockett

3408
01:51:36,470 --> 01:51:34,639
hey i'm an albert einstein fellow this

3409
01:51:38,790 --> 01:51:36,480
year serving at the office of

3410
01:51:40,390 --> 01:51:38,800
nasa stem engagements uh i'm a computer

3411
01:51:42,709 --> 01:51:40,400
science and stem teacher

3412
01:51:43,990 --> 01:51:42,719
and in our classroom where we worked on

3413
01:51:45,830 --> 01:51:44,000

a variety of projects

3414
01:51:48,070 --> 01:51:45,840
and working on particular projects when

3415
01:51:51,189 --> 01:51:48,080
i share my screen

3416
01:51:55,030 --> 01:51:51,199
these projects were projects that allow

3417
01:51:56,790 --> 01:51:55,040
students to learn more about meteorology

3418
01:51:59,430 --> 01:51:56,800
and how nasa takes different variables

3419
01:52:01,189 --> 01:51:59,440
into account to perform missions

3420
01:52:03,270 --> 01:52:01,199
in these different projects students

3421
01:52:04,470 --> 01:52:03,280
worked on they could plan efficiently

3422
01:52:06,709 --> 01:52:04,480
and they could carry out balloon

3423
01:52:07,830 --> 01:52:06,719
launches some of the photos that you're

3424
01:52:10,310 --> 01:52:07,840
looking at now

3425
01:52:11,189 --> 01:52:10,320
students worked in various groups and

3426
01:52:13,189 --> 01:52:11,199
were assigned

3427
01:52:15,510 --> 01:52:13,199
different positions that are similar to

3428
01:52:18,310 --> 01:52:15,520
those used by nasa like flight director

3429
01:52:18,870 --> 01:52:18,320
safety officer payload integration

3430
01:52:21,910 --> 01:52:18,880
launch

3431
01:52:23,990 --> 01:52:21,920
operations in meteorology

3432
01:52:25,189 --> 01:52:24,000
in these different projects students

3433
01:52:25,910 --> 01:52:25,199
correlated the behavior of their

3434
01:52:29,030 --> 01:52:25,920
experiments

3435
01:52:30,070 --> 01:52:29,040
to draw possible conclusions so

3436
01:52:31,109 --> 01:52:30,080
just give you an idea some of the

3437
01:52:33,990 --> 01:52:31,119
projects that we worked on throughout

3438
01:52:40,709 --> 01:52:37,430

awesome stuff so i have um i think my

3439
01:52:41,910 --> 01:52:40,719
my big question is how do you start

3440
01:52:43,669 --> 01:52:41,920
you know when you're trying to do

3441
01:52:44,310 --> 01:52:43,679
something that seems this ambitious

3442
01:52:46,470 --> 01:52:44,320
right

3443
01:52:47,910 --> 01:52:46,480
um how do you start with your students

3444
01:52:49,430 --> 01:52:47,920
and david i'm going to start with you on

3445
01:52:51,510 --> 01:52:49,440
that

3446
01:52:52,470 --> 01:52:51,520
well you know how do we start you know i

3447
01:52:54,229 --> 01:52:52,480
start by you know

3448
01:52:55,750 --> 01:52:54,239
peaking my students interest you know

3449
01:52:57,350 --> 01:52:55,760
asking different questions you know

3450
01:52:59,990 --> 01:52:57,360
you like space what do you like about

3451
01:53:00,709 --> 01:53:00,000
space what projects can we look at in

3452
01:53:02,709 --> 01:53:00,719
order to

3453
01:53:03,990 --> 01:53:02,719
you know explore you know how can we

3454
01:53:05,990 --> 01:53:04,000
learn a little bit more

3455
01:53:07,990 --> 01:53:06,000
about the natural world around us so

3456
01:53:11,510 --> 01:53:08,000
from there we research and then we go

3457
01:53:16,070 --> 01:53:13,350
great now liz stephen do you guys have

3458
01:53:17,910 --> 01:53:16,080
any tidbits about how do you start

3459
01:53:19,350 --> 01:53:17,920
well for us we always start with what

3460
01:53:20,149 --> 01:53:19,360
are the questions what do you want to

3461
01:53:22,950 --> 01:53:20,159
know

3462
01:53:24,390 --> 01:53:22,960
and so once they have brainstormed some

3463
01:53:26,470 --> 01:53:24,400

questions things they would like to find

3464
01:53:28,550 --> 01:53:26,480
out we do a little research what is

3465
01:53:29,910 --> 01:53:28,560
already being studied what experiments

3466
01:53:32,149 --> 01:53:29,920
have people done

3467
01:53:33,830 --> 01:53:32,159
and then we look for a testable question

3468
01:53:35,510 --> 01:53:33,840
and then we choose what is the right

3469
01:53:36,149 --> 01:53:35,520
type of flight because it depends on

3470
01:53:38,070 --> 01:53:36,159
whether

3471
01:53:39,990 --> 01:53:38,080
you want something that gets up quickly

3472
01:53:41,510 --> 01:53:40,000
and comes down quickly and has exposure

3473
01:53:43,270 --> 01:53:41,520
to the atmosphere which is good for a

3474
01:53:44,790 --> 01:53:43,280
balloon or a glider

3475
01:53:47,910 --> 01:53:44,800
or whether you need something that's

3476
01:53:49,589 --> 01:53:47,920
going to stay in space for a while

3477
01:53:51,910 --> 01:53:49,599
in which case you might prefer to do

3478
01:53:53,510 --> 01:53:51,920
something that's orbital or you might

3479
01:53:55,350 --> 01:53:53,520
sometimes just want to get it up on a

3480
01:53:58,310 --> 01:53:55,360
rocket and see whether it can exit

3481
01:53:59,830 --> 01:53:58,320
whether it can survive being launched

3482
01:54:02,950 --> 01:53:59,840
and brought back so it depends on

3483
01:54:03,990 --> 01:54:02,960
what you're trying to test how about you

3484
01:54:05,990 --> 01:54:04,000
stephen

3485
01:54:08,149 --> 01:54:06,000
yeah i would agree um with with what

3486
01:54:11,189 --> 01:54:08,159
both david and liz said um

3487
01:54:13,350 --> 01:54:11,199
my take on that is you know you know the

3488
01:54:14,870 --> 01:54:13,360

students creativity uh and i'm talking

3489
01:54:16,390 --> 01:54:14,880
the k-12 now not

3490
01:54:18,390 --> 01:54:16,400
not the ones i get at purdue who have

3491
01:54:19,750 --> 01:54:18,400
already demonstrated they're fascinated

3492
01:54:21,109 --> 01:54:19,760
by space and don't want to do anything

3493
01:54:24,709 --> 01:54:21,119
else in their life

3494
01:54:26,390 --> 01:54:24,719
um but you know the get them thinking

3495
01:54:27,830 --> 01:54:26,400
and then get them talking about what do

3496
01:54:29,270 --> 01:54:27,840
they want to see i think is what liz

3497
01:54:30,790 --> 01:54:29,280
said or what do they want to know

3498
01:54:32,709 --> 01:54:30,800
what would you like to see happen with

3499
01:54:34,310 --> 01:54:32,719
the younger students um

3500
01:54:35,990 --> 01:54:34,320
the things going on around you in

3501
01:54:38,310 --> 01:54:36,000
everyday life how do they

3502
01:54:40,470 --> 01:54:38,320
change when you go into space flight and

3503
01:54:44,229 --> 01:54:40,480
whether that's

3504
01:54:47,350 --> 01:54:44,239
astronaut lives or

3505
01:54:48,310 --> 01:54:47,360
senses or or what have you um certainly

3506
01:54:51,109 --> 01:54:48,320
start with a

3507
01:54:51,510 --> 01:54:51,119
really broad wide open aperture there

3508
01:54:55,589 --> 01:54:51,520
and just

3509
01:55:00,790 --> 01:54:58,950
really great stuff um so

3510
01:55:02,470 --> 01:55:00,800
i want to make sure we get to chris so

3511
01:55:03,990 --> 01:55:02,480
so i am going to do this we're going to

3512
01:55:05,189 --> 01:55:04,000
go to chris and we're gonna wrap it up

3513
01:55:08,149 --> 01:55:05,199

for this broadcast

3514
01:55:09,430 --> 01:55:08,159
um uh but if anyone has any questions

3515
01:55:12,310 --> 01:55:09,440
feel free to ask them

3516
01:55:13,270 --> 01:55:12,320
in the chat to our panelists stephen liz

3517
01:55:15,109 --> 01:55:13,280
and david

3518
01:55:16,790 --> 01:55:15,119
and i hope you guys can answer any of

3519
01:55:18,790 --> 01:55:16,800
their questions that they have

3520
01:55:20,629 --> 01:55:18,800
and thank you so much i think you're

3521
01:55:22,229 --> 01:55:20,639
just illustrating the different types of

3522
01:55:24,070 --> 01:55:22,239
experiments and things um

3523
01:55:25,589 --> 01:55:24,080
that that students can consider for

3524
01:55:27,669 --> 01:55:25,599
space and um

3525
01:55:28,870 --> 01:55:27,679
i guess and give me like a twitter like

3526
01:55:31,350 --> 01:55:28,880
a really twitter

3527
01:55:32,310 --> 01:55:31,360
uh short answer of what does it feel

3528
01:55:35,189 --> 01:55:32,320
like when

3529
01:55:38,149 --> 01:55:35,199
that experiment finally launches how

3530
01:55:40,470 --> 01:55:38,159
about each of you take that real quick

3531
01:55:41,669 --> 01:55:40,480
uh launch is easy it's when you're

3532
01:55:43,270 --> 01:55:41,679
waiting to get it back and you're

3533
01:55:43,910 --> 01:55:43,280
nervous about getting the data that's

3534
01:55:45,669 --> 01:55:43,920
that's hard

3535
01:55:47,109 --> 01:55:45,679
that's the thing and i think the most

3536
01:55:48,229 --> 01:55:47,119
exciting thing for us about our blue

3537
01:55:50,470 --> 01:55:48,239
origin flight

3538
01:55:51,350 --> 01:55:50,480

was we went to lunch we came back from

3539
01:55:53,350 --> 01:55:51,360
lunch and they said

3540
01:55:55,669 --> 01:55:53,360
here's your cube we got the cube and the

3541
01:55:57,270 --> 01:55:55,679
data back the same day

3542
01:55:58,870 --> 01:55:57,280
which is what happens when we do a

3543
01:56:01,189 --> 01:55:58,880
balloon flight but to get an

3544
01:56:01,910 --> 01:56:01,199
actual space flight back and the data

3545
01:56:03,910 --> 01:56:01,920
right there

3546
01:56:05,910 --> 01:56:03,920
i pulled the chip i downloaded it i

3547
01:56:07,750 --> 01:56:05,920
emailed it to my teacher whose class

3548
01:56:08,550 --> 01:56:07,760
designed it and he sent me back a chart

3549
01:56:11,270 --> 01:56:08,560
right we had an

3550
01:56:12,790 --> 01:56:11,280
amazing presentation the same day and

3551
01:56:13,669 --> 01:56:12,800
david hugh twitter length i know you're

3552
01:56:15,350 --> 01:56:13,679
active on twitter

3553
01:56:17,350 --> 01:56:15,360
hey definitely have that growth mindset

3554
01:56:20,470 --> 01:56:17,360
don't be afraid don't be afraid to fail

3555
01:56:21,910 --> 01:56:20,480
try and succeed awesome awesome awesome

3556
01:56:23,189 --> 01:56:21,920
thank you thank you thank you

3557
01:56:25,030 --> 01:56:23,199
i'm going to say goodbye to you guys

3558
01:56:27,510 --> 01:56:25,040
we're going to bring on chris for our

3559
01:56:29,589 --> 01:56:27,520
closing remarks from nasa uh

3560
01:56:31,589 --> 01:56:29,599
and uh we're gonna we're gonna wrap it

3561
01:56:33,189 --> 01:56:31,599
up here with our final remarks so come

3562
01:56:38,470 --> 01:56:33,199
on chris brown thank you so much to our

3563
01:56:43,669 --> 01:56:41,270

all right and last but not least we have

3564
01:56:45,830 --> 01:56:43,679
chris who is a deputy associate

3565
01:56:49,430 --> 01:56:45,840
administrator at nasa's office of stem

3566
01:56:50,470 --> 01:56:49,440
engagement um big fan you know i'm a fan

3567
01:56:52,310 --> 01:56:50,480
of yours chris and

3568
01:56:53,750 --> 01:56:52,320
i just love for you to wrap it up for us

3569
01:56:55,350 --> 01:56:53,760
with some closing remarks thank you so

3570
01:56:58,229 --> 01:56:55,360
much for joining us

3571
01:57:00,229 --> 01:56:58,239
great dan thanks so much and hi everyone

3572
01:57:02,709 --> 01:57:00,239
i'm thrilled to be with you all to help

3573
01:57:04,149 --> 01:57:02,719
close out this evening's event

3574
01:57:06,390 --> 01:57:04,159
first of all i want to extend my

3575
01:57:08,550 --> 01:57:06,400
heartfelt thanks to all of our speakers

3576
01:57:09,589 --> 01:57:08,560
for sharing their wisdom and experiences

3577
01:57:11,270 --> 01:57:09,599
with us

3578
01:57:13,510 --> 01:57:11,280
it has been such an informative and

3579
01:57:15,030 --> 01:57:13,520
enjoyable event and it's very exciting

3580
01:57:16,390 --> 01:57:15,040
for us to consider the many

3581
01:57:19,350 --> 01:57:16,400
possibilities we have

3582
01:57:21,350 --> 01:57:19,360
in front of us i'm thrilled to serve as

3583
01:57:23,189 --> 01:57:21,360
deputy associate administrator for stem

3584
01:57:25,350 --> 01:57:23,199
engagement at nasa

3585
01:57:26,470 --> 01:57:25,360
our work encompasses a broad and diverse

3586
01:57:29,030 --> 01:57:26,480
set of programs

3587
01:57:30,070 --> 01:57:29,040
activities and opportunities dedicated

3588
01:57:33,030 --> 01:57:30,080

to inspiring

3589
01:57:35,270 --> 01:57:33,040
engaging and educating students as well

3590
01:57:36,550 --> 01:57:35,280
as supporting educators and educational

3591
01:57:38,629 --> 01:57:36,560
institutions

3592
01:57:40,870 --> 01:57:38,639
and our community is comprised of a

3593
01:57:42,950 --> 01:57:40,880
stellar and dedicated group of people

3594
01:57:44,229 --> 01:57:42,960
who are passionate about developing our

3595
01:57:46,550 --> 01:57:44,239
next generation

3596
01:57:47,589 --> 01:57:46,560
of scientists engineers technologists

3597
01:57:50,709 --> 01:57:47,599
mathematicians

3598
01:57:53,589 --> 01:57:50,719
and explorers as an engineer who's now

3599
01:57:55,990 --> 01:57:53,599
hit my third decade working at nasa

3600
01:57:58,229 --> 01:57:56,000
i've been fortunate to have many

3601
01:57:59,669 --> 01:57:58,239
memorable and life-changing experiences

3602
01:58:01,990 --> 01:57:59,679
throughout my career

3603
01:58:02,709 --> 01:58:02,000
i've worked on projects ranging from

3604
01:58:04,950 --> 01:58:02,719
designing

3605
01:58:07,350 --> 01:58:04,960
building and testing space and earth

3606
01:58:08,790 --> 01:58:07,360
science missions and spacecraft

3607
01:58:10,870 --> 01:58:08,800
to leading the development and

3608
01:58:13,109 --> 01:58:10,880
operations of the mission design

3609
01:58:14,870 --> 01:58:13,119
center to leading the creation of future

3610
01:58:15,830 --> 01:58:14,880
engineering design environments and

3611
01:58:17,510 --> 01:58:15,840
tools

3612
01:58:19,589 --> 01:58:17,520
to running a systems engineering

3613
01:58:22,310 --> 01:58:19,599

organization and more

3614
01:58:23,990 --> 01:58:22,320
but this job playing a role in shaping

3615
01:58:27,109 --> 01:58:24,000
the lives of students is

3616
01:58:29,669 --> 01:58:27,119
truly an honor and a privilege

3617
01:58:31,350 --> 01:58:29,679
in nasa stem engagement we aim to meet

3618
01:58:33,510 --> 01:58:31,360
students where they are

3619
01:58:35,510 --> 01:58:33,520
and certainly that has principle has

3620
01:58:37,589 --> 01:58:35,520
been central to our work with students

3621
01:58:38,950 --> 01:58:37,599
during this unprecedented time over the

3622
01:58:41,189 --> 01:58:38,960
past year

3623
01:58:42,390 --> 01:58:41,199
we offer compelling and exciting student

3624
01:58:44,709 --> 01:58:42,400
learning opportunities

3625
01:58:47,030 --> 01:58:44,719
tied with the truly out of this world

3626
01:58:49,750 --> 01:58:47,040
technical work we do at nasa

3627
01:58:51,910 --> 01:58:49,760
in space technology aeronautics human

3628
01:58:53,430 --> 01:58:51,920
exploration and science

3629
01:58:55,510 --> 01:58:53,440
these opportunities range from

3630
01:58:56,790 --> 01:58:55,520
internships to student challenges and

3631
01:58:59,030 --> 01:58:56,800
competitions

3632
01:58:59,830 --> 01:58:59,040
to research grants and fellowships and

3633
01:59:02,310 --> 01:58:59,840
more

3634
01:59:04,709 --> 01:59:02,320
and we deliberately work with educators

3635
01:59:06,470 --> 01:59:04,719
institutions and partners to magnify our

3636
01:59:08,470 --> 01:59:06,480
reach and impact

3637
01:59:10,629 --> 01:59:08,480
ultimately our aim is to build a diverse

3638
01:59:12,149 --> 01:59:10,639

future stem workforce and we are laser

3639
01:59:15,109 --> 01:59:12,159
focused on attracting

3640
01:59:17,430 --> 01:59:15,119
students to stem through a nasa lens as

3641
01:59:19,589 --> 01:59:17,440
well as enabling students to contribute

3642
01:59:21,189 --> 01:59:19,599
to our work here on earth and in space

3643
01:59:22,870 --> 01:59:21,199
through unique early learning

3644
01:59:24,629 --> 01:59:22,880
opportunities

3645
01:59:26,950 --> 01:59:24,639
to do our work in stem engagement at

3646
01:59:29,109 --> 01:59:26,960
nasa we know that in so many ways our

3647
01:59:31,990 --> 01:59:29,119
success depends on you

3648
01:59:34,390 --> 01:59:32,000
dedicated teachers and educators you can

3649
01:59:36,229 --> 01:59:34,400
bring nasa into your classrooms

3650
01:59:38,870 --> 01:59:36,239
you can engage your students in one of

3651
01:59:40,790 --> 01:59:38,880
our seven artemis student challenges

3652
01:59:42,470 --> 01:59:40,800
teach them about our home planet earth

3653
01:59:43,350 --> 01:59:42,480
and the universe with one of our

3654
01:59:47,189 --> 01:59:43,360
education

3655
01:59:49,270 --> 01:59:47,199
toolkits join a nasa educator workshop

3656
01:59:51,030 --> 01:59:49,280
and discover resources through exploring

3657
01:59:53,510 --> 01:59:51,040
the nasa educator professional

3658
01:59:55,589 --> 01:59:53,520
development collaborative

3659
01:59:57,750 --> 01:59:55,599
to be part of our educator community you

3660
01:59:59,589 --> 01:59:57,760
can sign up for nasa express

3661
02:00:01,430 --> 01:59:59,599
our weekly newsletter that features

3662
02:00:04,390 --> 02:00:01,440
upcoming opportunities

3663
02:00:05,510 --> 02:00:04,400

we have over 50 000 subscribers but we

3664
02:00:09,589 --> 02:00:05,520
need more

3665
02:00:12,149 --> 02:00:09,599
to learn more visit stem.nasa.gov

3666
02:00:13,910 --> 02:00:12,159
at nasa we stand with you as you

3667
02:00:16,470 --> 02:00:13,920
continue to guide students

3668
02:00:19,910 --> 02:00:16,480
you bring sparks of inspiration to our

3669
02:00:21,910 --> 02:00:19,920
next generation of explorers every day

3670
02:00:24,149 --> 02:00:21,920
i grew up in a small rural town in

3671
02:00:26,629 --> 02:00:24,159
pennsylvania and was the first person in

3672
02:00:28,870 --> 02:00:26,639
my family to go to college

3673
02:00:31,109 --> 02:00:28,880
i learned firsthand the power of

3674
02:00:33,750 --> 02:00:31,119
education and its potential

3675
02:00:35,430 --> 02:00:33,760
in propelling people on paths toward

3676
02:00:37,669 --> 02:00:35,440
fulfilled lives

3677
02:00:41,109 --> 02:00:37,679
and using education as a solid

3678
02:00:42,950 --> 02:00:41,119
foundation and finding their life's work

3679
02:00:44,870 --> 02:00:42,960
given my background and where i came

3680
02:00:48,070 --> 02:00:44,880
from it's mind-boggling that i could

3681
02:00:49,669 --> 02:00:48,080
eventually end up here where i am today

3682
02:00:51,750 --> 02:00:49,679
there was little opportunity where i

3683
02:00:53,589 --> 02:00:51,760
grew up educational programs to learn

3684
02:00:55,589 --> 02:00:53,599
outside the classroom were few

3685
02:00:57,990 --> 02:00:55,599
but thanks to teachers who inspired and

3686
02:00:58,790 --> 02:00:58,000
guided me particularly math and science

3687
02:01:00,470 --> 02:00:58,800
teachers

3688
02:01:02,870 --> 02:01:00,480

i ended up studying engineering and

3689
02:01:04,229 --> 02:01:02,880
started on a path to a successful career

3690
02:01:06,149 --> 02:01:04,239
in stem

3691
02:01:07,830 --> 02:01:06,159
students today in our ever expanding

3692
02:01:09,589 --> 02:01:07,840
digital world have more at their

3693
02:01:11,750 --> 02:01:09,599
fingertips than ever before and

3694
02:01:14,550 --> 02:01:11,760
certainly more than i did

3695
02:01:15,030 --> 02:01:14,560
but they can't go it alone stem pathways

3696
02:01:17,830 --> 02:01:15,040
are not

3697
02:01:18,870 --> 02:01:17,840
solo endeavors we know that working in

3698
02:01:22,070 --> 02:01:18,880
stem is a team

3699
02:01:24,550 --> 02:01:22,080
effort we all need to play our roles

3700
02:01:25,830 --> 02:01:24,560
on the team in this larger national stem

3701
02:01:28,070 --> 02:01:25,840
ecosystem

3702
02:01:30,070 --> 02:01:28,080
we have the opportunity to inspire and

3703
02:01:31,910 --> 02:01:30,080
engage students through compelling and

3704
02:01:33,109 --> 02:01:31,920
exciting learning opportunities like

3705
02:01:35,350 --> 02:01:33,119
techrise

3706
02:01:37,910 --> 02:01:35,360
and we must continue to work diligently

3707
02:01:38,950 --> 02:01:37,920
to address digital and socio-economic

3708
02:01:40,870 --> 02:01:38,960
divides

3709
02:01:42,229 --> 02:01:40,880
and commit to broadening student

3710
02:01:44,870 --> 02:01:42,239
participation

3711
02:01:45,510 --> 02:01:44,880
to ensure diversity equity and inclusion

3712
02:01:48,629 --> 02:01:45,520
in stem

3713
02:01:52,070 --> 02:01:48,639

fields while we've made much progress

3714
02:01:53,910 --> 02:01:52,080
we have so much more to do thank you all

3715
02:01:56,070 --> 02:01:53,920
for your contributions in shaping the

3716
02:01:57,109 --> 02:01:56,080
next generation and particularly for

3717
02:01:59,030 --> 02:01:57,119
your dedication

3718
02:02:00,229 --> 02:01:59,040
in helping us build the future stem

3719
02:02:02,629 --> 02:02:00,239
workforce

3720
02:02:04,470 --> 02:02:02,639
at nasa we hope you are as excited as we

3721
02:02:06,550 --> 02:02:04,480
are about techrise

3722
02:02:08,790 --> 02:02:06,560
it is an outstanding example of those

3723
02:02:10,709 --> 02:02:08,800
valuable hands-on learning experiences

3724
02:02:12,550 --> 02:02:10,719
that can help students discover their

3725
02:02:15,430 --> 02:02:12,560
talents and interests

3726
02:02:16,550 --> 02:02:15,440
and their abilities to do truly amazing

3727
02:02:18,149 --> 02:02:16,560
things

3728
02:02:20,390 --> 02:02:18,159
our hope is that you will share tech

3729
02:02:21,350 --> 02:02:20,400
rise broadly with your students and

3730
02:02:23,109 --> 02:02:21,360
colleagues

3731
02:02:25,750 --> 02:02:23,119
and i'd like to encourage you all to

3732
02:02:27,750 --> 02:02:25,760
join us again in july or august for one

3733
02:02:30,790 --> 02:02:27,760
of two nasa tech prize

3734
02:02:32,470 --> 02:02:30,800
educator summer workshops during which

3735
02:02:33,350 --> 02:02:32,480
we will dive into the basics of

3736
02:02:36,550 --> 02:02:33,360
electronics

3737
02:02:37,350 --> 02:02:36,560
coding and designing for flight for more

3738
02:02:42,390 --> 02:02:37,360

information

3739
02:02:44,310 --> 02:02:42,400
visit futureengineers.org nasa techrise

3740
02:02:45,830 --> 02:02:44,320
thanks again to all of you for joining

3741
02:02:46,629 --> 02:02:45,840
us and thanks to the department of

3742
02:02:48,870 --> 02:02:46,639
education

3743
02:02:50,709 --> 02:02:48,880
for inviting nasa to participate in

3744
02:02:52,470 --> 02:02:50,719
tonight's program

3745
02:02:54,709 --> 02:02:52,480
and now i'd like to encourage you to

3746
02:02:58,550 --> 02:02:54,719
stay as we transition to the official

3747
02:03:01,189 --> 02:02:58,560
kickoff of the 2021 ed games expo

3748
02:03:03,109 --> 02:03:01,199
it is my distinct privilege to introduce

3749
02:03:15,270 --> 02:03:03,119
the secretary of education

3750
02:03:16,709 --> 02:03:15,280
miguel cardona and thank you so much

3751
02:03:19,189 --> 02:03:16,719
chris so that is the

3752
02:03:19,830 --> 02:03:19,199
end of our nasa tech rise student

3753
02:03:22,709 --> 02:03:19,840
challenge

3754
02:03:24,550 --> 02:03:22,719
uh official kickoff event uh we hope you

3755
02:03:26,149 --> 02:03:24,560
have an amazing amazing summer

3756
02:03:27,990 --> 02:03:26,159
that's the end of our broadcast and we

3757
02:03:30,070 --> 02:03:28,000
are putting a youtube link

3758
02:03:31,270 --> 02:03:30,080
where you can continue on your ed games

3759
02:03:34,310 --> 02:03:31,280
expo journey

3760
02:03:37,510 --> 02:03:34,320
and you can watch the kickoff for the

3761
02:03:39,270 --> 02:03:37,520
full ed games expo so thank you everyone

3762
02:03:40,870 --> 02:03:39,280
for being a part of this thank you chris

3763
02:03:43,109 --> 02:03:40,880

for your closing remarks

3764
02:03:44,629 --> 02:03:43,119
and um please go to the website

3765
02:03:46,470 --> 02:03:44,639
pre-register we'll tell you when all

3766
02:03:48,149 --> 02:03:46,480
these new great resources come available

3767
02:03:50,790 --> 02:03:48,159
sign up for one of our workshops july

3768
02:03:52,149 --> 02:03:50,800
28th or august 11th and thank you again

3769
02:04:02,550 --> 02:03:52,159
and have a wonderful evening

3770
02:04:06,069 --> 02:04:04,430
learn more and sign up now at

3771
02:04:10,730 --> 02:04:06,079
futureengineers.org