
PAO

1
00:00:02,601 --> 00:00:03,836
>> Well hello everybody.

2
00:00:03,836 --> 00:00:06,205
Welcome inside Mission Control.

3
00:00:06,205 --> 00:00:09,175
We're welcoming the East
Paulding Middle School students

4
00:00:09,175 --> 00:00:10,509
in Dallas, Georgia.

5
00:00:10,509 --> 00:00:14,380
We know you guys are outside
Atlanta and I'm very pleased

6
00:00:14,380 --> 00:00:15,848
to have Heather Paul with me.

7
00:00:15,848 --> 00:00:18,150
She is a Mechanical Engineer.

8
00:00:18,150 --> 00:00:19,952
She graduated from
high school in Atlanta

9
00:00:19,952 --> 00:00:23,756
so she's very familiar
with that area.

10
00:00:23,756 --> 00:00:24,957
She currently is a Crew

11
00:00:24,957 --> 00:00:29,361
and Thermal Systems
Division Engineer here

12

00:00:29,361 --> 00:00:32,064
at the Johnson Space Center and
you're inside Mission Control

13
00:00:32,064 --> 00:00:35,201
where the Flight Control Team
oversees all the operations

14
00:00:35,201 --> 00:00:37,036
of the International
Space Station.

15
00:00:37,036 --> 00:00:39,004
We are very pleased
to have you guys

16
00:00:39,004 --> 00:00:41,507
with us today, me and Heather.

17
00:00:41,507 --> 00:00:44,677
And she's going to handle
all the hard questions

18
00:00:44,677 --> 00:00:46,178
that you guys may have for us.

19
00:00:46,178 --> 00:00:49,682
And Michael and I
guess April Leachman,

20
00:00:49,682 --> 00:00:51,517
[phonetic] you're the
teacher for these students

21
00:00:51,517 --> 00:00:54,019
so we're ready for
y'alls questions.

22
00:00:54,019 --> 00:00:59,091
>> Hello, my name

is Clark Vaughn.

23
00:00:59,091 --> 00:01:02,228
[phonetic] My question is if
we ever lived on the moon,

24
00:01:02,228 --> 00:01:04,930
how would we transfer oxygen?

25
00:01:04,930 --> 00:01:07,533
>> Heather: Clark that is a
very, very important question

26
00:01:07,533 --> 00:01:10,236
to think about because the
moon doesn't have an atmosphere

27
00:01:10,236 --> 00:01:13,305
so we would have to
provide our own oxygen

28
00:01:13,305 --> 00:01:14,673
for the astronauts to live.

29
00:01:14,673 --> 00:01:17,943
And we may bring some of the
oxygen with us but most likely

30
00:01:17,943 --> 00:01:20,546
if we're looking at living on
the moon for a longer period

31
00:01:20,546 --> 00:01:23,082
of time than we did for the
Apollo days, we're going to have

32
00:01:23,082 --> 00:01:25,851
to figure out a way to
generate that oxygen.

33
00:01:25,851 --> 00:01:27,953
So that is something that
our engineers are working

34
00:01:27,953 --> 00:01:31,056
on right now in fact and not
only generating the oxygen

35
00:01:31,056 --> 00:01:33,659
but recycling the
oxygen that we use.

36
00:01:33,659 --> 00:01:36,428
You know we breathe in oxygen,
we breathe out carbon dioxide

37
00:01:36,428 --> 00:01:40,499
so how could you recycle the
oxygen out of your exhale

38
00:01:40,499 --> 00:01:42,935
and make sure that you pull
the oxygen molecules in

39
00:01:42,935 --> 00:01:44,570
and maybe even generate oxygen

40
00:01:44,570 --> 00:01:46,939
from the carbon dioxide
molecules?

41
00:01:48,774 --> 00:01:47,640
Great question.

42
00:01:48,774 --> 00:01:54,547
>> Hello, my name is
Seth Grennon [phonetic]

43
00:01:54,547 --> 00:02:00,152

and will we ever be able to walk
on the moon or walk on Mars?

44
00:02:00,152 --> 00:02:03,022
>> Heather: Seth, you know
that's a question I often ask

45
00:02:03,022 --> 00:02:06,258
and we are working on our
spacesuits and our vehicles

46
00:02:06,258 --> 00:02:09,228
and our robots and rovers
to get us there and to work

47
00:02:09,228 --> 00:02:10,796
on the surface of Mars.

48
00:02:10,796 --> 00:02:13,832
As far as when that will happen,
you know it's a challenge

49
00:02:13,832 --> 00:02:16,702
to get there, it's a lot
further away than the moon.

50
00:02:16,702 --> 00:02:19,171
The moon only took us about
two to three days to get there

51
00:02:19,171 --> 00:02:20,639
to get to do our work.

52
00:02:20,639 --> 00:02:23,309
Mars is a lot further away
so it could take us anywhere

53
00:02:23,309 --> 00:02:25,911
from three to six months
to get there so you got

54
00:02:25,911 --> 00:02:27,213
to let our engineers work hard

55
00:02:27,213 --> 00:02:29,615
on that new vehicles we're
developing and our new suits

56
00:02:29,615 --> 00:02:32,151
and rovers and robots and
then hopefully maybe you,

57
00:02:32,151 --> 00:02:35,588
maybe your classmates will get
to either work with us here

58
00:02:35,588 --> 00:02:39,124
to be in Mission Control
center or even fly

59
00:02:39,124 --> 00:02:43,829
and be a part of that crew.

60
00:02:43,829 --> 00:02:44,930
>> Thank you.

61
00:02:44,930 --> 00:02:48,067
>> Hello, my name is
Rose Rawson [phonetic]

62
00:02:48,067 --> 00:02:53,405
and my question is are you ever
worried that from the rockets,

63
00:02:53,405 --> 00:02:57,576
the fuel, that it will
pollute outer space?

64
00:02:57,576 --> 00:03:00,212

>> Heather: I see, that's a
very environmental question,

65
00:03:00,212 --> 00:03:01,513
absolutely.

66
00:03:01,513 --> 00:03:04,216
And we do a lot to really
make sure that we understand

67
00:03:04,216 --> 00:03:07,620
where everything that we put
out of our vehicles goes,

68
00:03:07,620 --> 00:03:11,123
whether it's our rocket
fuel or even our trash

69
00:03:11,123 --> 00:03:12,992
or other things like that.

70
00:03:12,992 --> 00:03:15,628
So we're very, very
aware of what kinds

71
00:03:15,628 --> 00:03:18,264
of things we're putting
out into the atmosphere or,

72
00:03:18,264 --> 00:03:24,236
in the case of space,
the lack of atmosphere.

73
00:03:24,236 --> 00:03:25,704
>> Thank you.

74
00:03:25,704 --> 00:03:27,706
>> My name is Brian
Akuda [phonetic]

75
00:03:27,706 --> 00:03:33,579
and my question is can you like
tell the weather from space

76
00:03:33,579 --> 00:03:37,049
of what the weather will
be like here on earth?

77
00:03:37,049 --> 00:03:38,183
>> Heather: Absolutely.

78
00:03:38,183 --> 00:03:39,918
And in fact if you watch
the news and you learn

79
00:03:39,918 --> 00:03:43,889
about you know storm systems,
whether it's rain or snow,

80
00:03:43,889 --> 00:03:46,959
all of that information is
coming from our satellites

81
00:03:46,959 --> 00:03:50,562
that we have positioned around
our planets, in part thanks

82
00:03:50,562 --> 00:03:53,932
to our space shuttle
and space missions.

83
00:03:53,932 --> 00:03:56,035
And so you know a lot
of what we're doing

84
00:03:56,035 --> 00:03:58,771
in our space program is not
only to go explore places

85

00:03:58,771 --> 00:04:03,108
like the moon or mars or even an
asteroid but a huge influence is

86
00:04:03,108 --> 00:04:05,110
to make sure that
we are effecting

87
00:04:05,110 --> 00:04:07,780
and benefiting life
here on earth and that's

88
00:04:07,780 --> 00:04:11,317
through monitoring the weather
and keeping everyone informed.

89
00:04:11,317 --> 00:04:12,685
>> Thank you.

90
00:04:12,685 --> 00:04:14,019
>> Great question.

91
00:04:14,019 --> 00:04:16,155
>> Hello, my name is Devan
Swain [phonetic] and I wanted

92
00:04:16,155 --> 00:04:20,693
to know how do you assure

93
00:04:20,693 --> 00:04:25,397
that the astronauts have enough
oxygen to survive in space?

94
00:04:25,397 --> 00:04:26,332
>> Great question.

95
00:04:26,332 --> 00:04:27,533
>> Heather: Excellent.

96

00:04:27,533 --> 00:04:28,901
You know I'm loving these
life support questions

97
00:04:28,901 --> 00:04:31,337
because that's a lot of what
I focus my engineering career

98
00:04:31,337 --> 00:04:35,240
on is making sure the astronauts
have not only enough oxygen

99
00:04:35,240 --> 00:04:38,777
but good clean breathing oxygen
to keep our astronauts alive

100
00:04:38,777 --> 00:04:40,312
so they can do all of their work

101
00:04:40,312 --> 00:04:42,614
and science onboard
the space station.

102
00:04:42,614 --> 00:04:45,351
So we bring up oxygen
with us when we fly

103
00:04:45,351 --> 00:04:47,152
but then we also
can generate oxygen

104
00:04:47,152 --> 00:04:49,021
and we recycle that
oxygen as well.

105
00:04:49,021 --> 00:04:52,091
Our spacesuits have
oxygen tanks so it's kind

106
00:04:52,091 --> 00:04:54,860

of like your own portable
breathing apparatus inside

107
00:04:54,860 --> 00:04:56,228
of the life support system.

108
00:04:56,228 --> 00:04:59,398
And then we have adequate
oxygen onboard the space station

109
00:04:59,398 --> 00:05:01,533
as well.

110
00:05:01,533 --> 00:05:03,268
>> Thank you.

111
00:05:03,268 --> 00:05:07,306
>> My name is Patrick
Huntington [phonetic].

112
00:05:07,306 --> 00:05:11,810
And is NASA competitive with
any other space programs?

113
00:05:11,810 --> 00:05:13,912
If so, who are they?

114
00:05:13,912 --> 00:05:15,314
>> Heather: Good question.

115
00:05:15,314 --> 00:05:17,816
Well back in the day, Patrick,
we were actually in a space race

116
00:05:17,816 --> 00:05:21,220
with what are now our
partners, the Russians.

117
00:05:21,220 --> 00:05:23,622

So a long time ago we were
under more of a competition.

118
00:05:23,622 --> 00:05:27,459
But nowadays it's really
all about teamwork.

119
00:05:27,459 --> 00:05:30,195
We have 16 international
partners working

120
00:05:30,195 --> 00:05:33,532
on the International Space
Station and it's more important

121
00:05:33,532 --> 00:05:35,634
to think about how we
can work together instead

122
00:05:35,634 --> 00:05:36,969
of competing against each other.

123
00:05:36,969 --> 00:05:39,338
And we not only have our
international partners

124
00:05:39,338 --> 00:05:41,140
for space station but
we've now branched

125
00:05:41,140 --> 00:05:43,142
out to our industry partners,

126
00:05:43,142 --> 00:05:44,576
you know we just
launched the Cygnus

127
00:05:44,576 --> 00:05:46,779
so that is a great
example of one

128
00:05:46,779 --> 00:05:50,149
of our new commercial spacecraft
that is going to connect

129
00:05:50,149 --> 00:05:53,519
with our space station
in just a few days.

130
00:05:53,519 --> 00:05:55,220
>> Thank you.

131
00:05:57,222 --> 00:06:00,092
>> My name is Neal
Jackson and I want

132
00:06:00,092 --> 00:06:02,161
to know what rocket
fuel is made of?

133
00:06:02,161 --> 00:06:04,530
>> What rocket fuel is made of?

134
00:06:04,530 --> 00:06:06,331
>> Heather: Neal, what
rocket fuel is made of?

135
00:06:06,331 --> 00:06:08,534
Well that depends on
the rocket, I suppose.

136
00:06:08,534 --> 00:06:12,304
You know our space shuttle
had solid propellant as well

137
00:06:12,304 --> 00:06:14,940
as liquid and I don't
know the exact formulation

138

00:06:14,940 --> 00:06:17,943
because that is not
my area of expertise.

139
00:06:17,943 --> 00:06:20,712
But really when you think about
where you're going in space,

140
00:06:20,712 --> 00:06:22,047
that's going to determine
what kind

141
00:06:22,047 --> 00:06:23,449
of propellant you would use.

142
00:06:23,449 --> 00:06:26,318
So if you're going into lower
orbit, you probably don't need

143
00:06:26,318 --> 00:06:28,854
as much as you would need
if you were going to a place

144
00:06:28,854 --> 00:06:31,457
like the moon or even
further like Mars.

145
00:06:31,457 --> 00:06:35,928
That's a very good question.

146
00:06:35,928 --> 00:06:37,930
>> Thank you.

147
00:06:37,930 --> 00:06:39,131
>> Well my name is
Connor Pitts [phonetic]

148
00:06:39,131 --> 00:06:41,433
and my question is
what is your plan

149
00:06:41,433 --> 00:06:43,936
to put people back on space?

150
00:06:43,936 --> 00:06:45,437
>> Heather: Well
Connor we have people

151
00:06:45,437 --> 00:06:48,540
in space right now onboard the
International Space Station,

152
00:06:48,540 --> 00:06:50,476
living up there for about
six months at a time.

153
00:06:50,476 --> 00:06:55,013
And we just recently
selected our first astronaut

154
00:06:55,013 --> 00:06:57,749
and cosmonaut who are going to
live onboard the space station

155
00:06:57,749 --> 00:07:00,085
for one year continuously.

156
00:07:00,085 --> 00:07:03,055
So we have people up there
pretty much 24 hours a day,

157
00:07:03,055 --> 00:07:04,823
seven days a week right now.

158
00:07:04,823 --> 00:07:07,793
Now as far as looking to our
next destination, we're trying

159
00:07:07,793 --> 00:07:09,862

to figure out if we want
to go back to the moon,

160
00:07:09,862 --> 00:07:12,030
which would be pretty
cool, in my opinion.

161
00:07:12,030 --> 00:07:13,999
Or maybe even go
and find an asteroid

162
00:07:13,999 --> 00:07:16,902
and bring it back closer to
the earth so we can study it.

163
00:07:16,902 --> 00:07:20,873
Or eventually go on to Mars.

164
00:07:20,873 --> 00:07:22,007
>> Thank you.

165
00:07:22,007 --> 00:07:26,111
>> My name is Olivia
Ritika [phonetic]

166
00:07:26,111 --> 00:07:29,214
and my question is
what materials are

167
00:07:29,214 --> 00:07:31,750
in the present day spacesuit?

168
00:07:31,750 --> 00:07:33,085
>> Heather: Excellent question.

169
00:07:33,085 --> 00:07:35,320
And there are several different
layers in our space suit.

170

00:07:35,320 --> 00:07:39,291
And all of those layers are
important because they make sure

171
00:07:39,291 --> 00:07:41,960
that the astronaut stays alive
inside of the suit as well

172
00:07:41,960 --> 00:07:44,496
as thermally protected.

173
00:07:44,496 --> 00:07:48,233
So we first have a layer that
kind of acts not as flexible

174
00:07:48,233 --> 00:07:51,503
as a balloon but a balloon,
when you inflate it with air,

175
00:07:51,503 --> 00:07:54,573
it holds that air, especially
if you tie it up really tight.

176
00:07:54,573 --> 00:07:57,142
Well because we essentially
inflate our spacesuit

177
00:07:57,142 --> 00:07:59,811
with oxygen, you need a layer,
a pressure layer, that's going

178
00:07:59,811 --> 00:08:02,180
to hold that oxygen in.

179
00:08:02,180 --> 00:08:04,983
But once you inflate a balloon
it tends to get kind of rigid

180
00:08:04,983 --> 00:08:06,351
and it wants to stay

in the shape

181
00:08:06,351 --> 00:08:08,186
that it's been designed to be.

182
00:08:08,186 --> 00:08:09,922
The spacesuit is no different.

183
00:08:09,922 --> 00:08:12,925
So then the second layer is
what we call a restrain layer.

184
00:08:12,925 --> 00:08:14,826
And it's made out of
Dacron which is found

185
00:08:14,826 --> 00:08:16,895
in a lot of camping equipment.

186
00:08:16,895 --> 00:08:21,533
It's a very nice lightweight,
somewhat flexible material.

187
00:08:21,533 --> 00:08:24,770
And we can sew that material
to make the spacesuit into more

188
00:08:24,770 --> 00:08:27,406
of a human shape and
that's what's going to hold

189
00:08:27,406 --> 00:08:29,541
that bladder, that
pressure layer in

190
00:08:29,541 --> 00:08:31,677
and make sure it
doesn't over pressurize.

191

00:08:31,677 --> 00:08:36,281
And then we have a multilayer
garment that first starts off

192
00:08:36,281 --> 00:08:39,618
with neoprene and if any of you
are interested in scuba diving,

193
00:08:39,618 --> 00:08:42,621
you would wear a wet suit that's
primarily made out of neoprene

194
00:08:42,621 --> 00:08:44,356
to make sure that you
stay nice and warm,

195
00:08:44,356 --> 00:08:47,926
especially if you go deeper
into the water environments.

196
00:08:47,926 --> 00:08:50,729
We have neoprene in the
spacesuit for the same reason,

197
00:08:50,729 --> 00:08:53,231
to keep our astronauts
comfortable inside.

198
00:08:53,231 --> 00:08:54,766
Then we have multiple layers

199
00:08:54,766 --> 00:08:57,402
of a really shiny
material called Mylar.

200
00:08:57,402 --> 00:08:59,538
And if you've ever gotten
a happy birthday balloon

201
00:08:59,538 --> 00:09:01,907

from a grocery store,
one of those shiny ones,

202
00:09:01,907 --> 00:09:03,909
that's basically made
of a thicker Mylar

203
00:09:03,909 --> 00:09:06,044
than what we have
in the spacesuit.

204
00:09:06,044 --> 00:09:08,880
Or here in Texas, every day
in summer we have to put

205
00:09:08,880 --> 00:09:10,315
up those sun shields
here in the car,

206
00:09:10,315 --> 00:09:11,783
otherwise the car
gets really hot.

207
00:09:11,783 --> 00:09:14,386
Well mine is made out of Mylar
so I always think about that.

208
00:09:14,386 --> 00:09:16,688
Hey cool. I'm in a
spacesuit right now.

209
00:09:16,688 --> 00:09:19,124
And then the outer garment
that's light is actually a

210
00:09:19,124 --> 00:09:22,094
combination of materials of
nomex which is in our a lot

211
00:09:22,094 --> 00:09:24,963

of our firefighter
suits, Kevlar,

212
00:09:24,963 --> 00:09:26,732
which is in bullet proof vests

213
00:09:26,732 --> 00:09:28,533
and then a little bit
of Teflon as well.

214
00:09:28,533 --> 00:09:31,803
So a lot of really common
materials that we use here

215
00:09:31,803 --> 00:09:37,909
on earth we've developed into a
garment that makes a spacesuit.

216
00:09:37,909 --> 00:09:39,378
>> Thank you.

217
00:09:39,378 --> 00:09:40,479
>> Great question.

218
00:09:40,479 --> 00:09:46,284
>> Hi, my name is Hannah
Vandermet [phonetic]

219
00:09:46,284 --> 00:09:50,522
and my question is what
is the furthest planet

220
00:09:50,522 --> 00:09:53,258
that NASA has been to?

221
00:09:53,258 --> 00:09:54,626
>> Heather: Excellent question.

222
00:09:54,626 --> 00:09:57,896

Well the farthest that we've
been with humans is to the moon

223
00:09:57,896 --> 00:09:59,965
and that's not really a planet.

224
00:09:59,965 --> 00:10:03,001
But of course we've got our
rovers on Mars right now

225
00:10:03,001 --> 00:10:05,003
and we've got a lot of
different vehicles that are

226
00:10:05,003 --> 00:10:07,639
out there exploring
space even beyond

227
00:10:07,639 --> 00:10:10,375
and I think one just
recently went even beyond our

228
00:10:10,375 --> 00:10:11,543
solar system.

229
00:10:11,543 --> 00:10:12,644
>> Yep, Voyager 1.

230
00:10:12,644 --> 00:10:13,879
>> Heather: That's
right, Voyager 1 is

231
00:10:13,879 --> 00:10:15,614
out there collecting
great information

232
00:10:15,614 --> 00:10:17,482
for our scientists
and engineers.

233
00:10:17,482 --> 00:10:20,018
>> Thank you.

234
00:10:20,018 --> 00:10:24,856
>> Hi, my name is
Drew Patterson.

235
00:10:24,856 --> 00:10:26,124
[phonetic] I was going to ask,

236
00:10:26,124 --> 00:10:28,427
how many degrees
have you earned?

237
00:10:28,427 --> 00:10:30,929
>> Heather: Alright Drew,
well that is a great question.

238
00:10:30,929 --> 00:10:32,097
I started off

239
00:10:32,097 --> 00:10:33,465
>> This is going to
be a long answer.

240
00:10:33,465 --> 00:10:34,800
[laughter]

241
00:10:34,800 --> 00:10:38,103
>> Heather: I started off at
Auburn University in Alabama

242
00:10:38,103 --> 00:10:40,972
and I studied Mechanical
Engineering and Spanish

243
00:10:40,972 --> 00:10:43,075
so I have two undergraduate
degrees.

244
00:10:43,075 --> 00:10:46,011
And during that time I actually
was also a student working

245
00:10:46,011 --> 00:10:48,980
at NASA so it was a great way to
kind of get some work experience

246
00:10:48,980 --> 00:10:51,416
in to try to figure
out what type

247
00:10:51,416 --> 00:10:52,784
of engineering work
I'd want to do

248
00:10:52,784 --> 00:10:54,486
when I eventually
got hired here.

249
00:10:54,486 --> 00:10:57,823
I then went to the
University of Texas at Austin

250
00:10:57,823 --> 00:11:00,058
to continue my Mechanical
Engineering studies

251
00:11:00,058 --> 00:11:02,194
and I got a Master's
Degree there.

252
00:11:02,194 --> 00:11:03,762
Then I joined the NASA workforce

253
00:11:03,762 --> 00:11:05,497
and a few years afterwards
I realized

254
00:11:05,497 --> 00:11:08,433
that I just was not done
with my education and I went

255
00:11:08,433 --> 00:11:10,569
to the University of
Houston, Clear Lake

256
00:11:10,569 --> 00:11:13,672
and got a Master's Degree in
Fitness and Human Performance

257
00:11:13,672 --> 00:11:15,373
to really get a better
understanding

258
00:11:15,373 --> 00:11:19,177
of how the human body works
when we're under exercise.

259
00:11:19,177 --> 00:11:22,647
And I've spent a long time
working with our spacesuit team

260
00:11:22,647 --> 00:11:25,684
and we talk about working with
spacesuit, it's really about six

261
00:11:25,684 --> 00:11:28,553
to eight hours of exercise
so thinking about how

262
00:11:28,553 --> 00:11:30,522
to prepare enough oxygen
for them to breathe,

263
00:11:30,522 --> 00:11:33,592
you have to understand how
exercise effects your heart

264
00:11:33,592 --> 00:11:35,393
rate, your lung capacity.

265
00:11:35,393 --> 00:11:39,097
>> I think that's a
really good example

266
00:11:39,097 --> 00:11:41,833
of how your education
can continue even

267
00:11:41,833 --> 00:11:43,101
after you finish school.

268
00:11:43,101 --> 00:11:44,970
I know you're probably
thinking right now, I don't want

269
00:11:44,970 --> 00:11:46,872
to go to school anymore.

270
00:11:46,872 --> 00:11:49,474
But you may want to
once you've gotten out

271
00:11:49,474 --> 00:11:53,245
and you started working and
you say there's so much more

272
00:11:53,245 --> 00:11:56,515
that I want to learn and Heather
is a perfect example of someone

273
00:11:56,515 --> 00:12:01,319
who continues to want to learn
even after being a professional

274
00:12:01,319 --> 00:12:04,089
and working you know

after school.

275
00:12:04,089 --> 00:12:07,025
And so that's a really
good question and you guys,

276
00:12:07,025 --> 00:12:10,929
don't feel like you stop
at high school or college.

277
00:12:10,929 --> 00:12:14,299
You can keep learning
even after you're working.

278
00:12:14,299 --> 00:12:21,907
>> Hello, my name is
Leona Nackey [phonetic]

279
00:12:21,907 --> 00:12:26,044
and my question is how many
gallons of fuel does it take

280
00:12:26,044 --> 00:12:30,949
to launch the rockets
to the moon?

281
00:12:30,949 --> 00:12:32,651
>> Heather: Man this
is a toughie.

282
00:12:32,651 --> 00:12:35,253
I don't know.

283
00:12:35,253 --> 00:12:37,389
I'd have to go and look that up.

284
00:12:37,389 --> 00:12:38,924
>> Yeah, I know that
the space shuttle,

285
00:12:38,924 --> 00:12:40,659
which we just retired obviously.

286
00:12:40,659 --> 00:12:46,531
It's about a half a million
gallons of propellant oxygen

287
00:12:46,531 --> 00:12:52,437
and hydrogen that's required to
get a space shuttle into orbit.

288
00:12:52,437 --> 00:12:56,141
And the moon rockets
back in the late 60's,

289
00:12:56,141 --> 00:12:59,211
early 70's was even
more than that.

290
00:12:59,211 --> 00:13:02,280
Remembering that the
atmosphere is very thick

291
00:13:02,280 --> 00:13:05,984
and the hardest part of a rocket
launch is actually the first two

292
00:13:05,984 --> 00:13:08,753
minutes or so and once
you get past that you get

293
00:13:08,753 --> 00:13:10,722
into the thin part
of the atmosphere,

294
00:13:10,722 --> 00:13:13,592
the vehicles engines start
accelerating the vehicle

295

00:13:13,592 --> 00:13:15,060
because the atmosphere
is so thin.

296
00:13:15,060 --> 00:13:17,896
And suddenly you get to a
point where you're almost

297
00:13:17,896 --> 00:13:20,265
out of the atmosphere
completely.

298
00:13:20,265 --> 00:13:22,567
And so you don't need as
much propellant to move

299
00:13:22,567 --> 00:13:26,104
around once you're in space but
you still require it to move.

300
00:13:26,104 --> 00:13:28,106
But that's a great question.

301
00:13:28,106 --> 00:13:29,941
It takes a great
deal of propellant

302
00:13:29,941 --> 00:13:31,610
to break earth's gravity.

303
00:13:31,610 --> 00:13:35,180
And so living in space
and moving from space

304
00:13:35,180 --> 00:13:39,084
to further deeper space you know
may eventually be the way to go

305
00:13:39,084 --> 00:13:43,255
and produce propellant depots

in space where you refuel,

306
00:13:43,255 --> 00:13:45,257
like a gas station,
and then go further,

307
00:13:45,257 --> 00:13:47,525
because you might not
need as much out there.

308
00:13:47,525 --> 00:13:48,760
That's a great question.

309
00:13:48,760 --> 00:13:50,462
>> Heather: Really great
and that really relies a lot

310
00:13:50,462 --> 00:13:53,865
on orbital mechanics
too, understanding how

311
00:13:53,865 --> 00:13:57,669
if you can do a loop or two
around a planet like earth

312
00:13:57,669 --> 00:13:59,504
or maybe even around the moon,

313
00:13:59,504 --> 00:14:01,573
you can use that
gravitational pull

314
00:14:01,573 --> 00:14:03,675
to essentially slingshot
your vehicle

315
00:14:03,675 --> 00:14:06,077
so maybe you don't need
as much propellant.

316
00:14:06,077 --> 00:14:08,613
The more propellant
you have on launch,

317
00:14:08,613 --> 00:14:11,683
the heavier your vehicle is,
the harder it is to really get

318
00:14:11,683 --> 00:14:13,652
up into space so our engineers

319
00:14:13,652 --> 00:14:15,720
and our scientists are
really smart about looking

320
00:14:15,720 --> 00:14:18,490
at all the different options
for if we want to go from earth

321
00:14:18,490 --> 00:14:20,125
to a destination, what's going

322
00:14:20,125 --> 00:14:25,931
to be the most fuel
efficient way to get there.

323
00:14:25,931 --> 00:14:27,332
>> Thanks.

324
00:14:27,332 --> 00:14:33,138
>> Hi, my name is Kennedy
and I was wondering,

325
00:14:33,138 --> 00:14:35,974
how long did you stay in
college to have this job?

326
00:14:35,974 --> 00:14:38,543
>> Heather: Good

question, Kennedy.

327
00:14:38,543 --> 00:14:43,782
Well I was at Auburn University
for a total of about 41/2 years.

328
00:14:43,782 --> 00:14:46,651
That's my time that I
was actually at school.

329
00:14:46,651 --> 00:14:50,021
But I was also taking some
time to do a semester at school

330
00:14:50,021 --> 00:14:53,258
and a semester at NASA
so it took me probably

331
00:14:53,258 --> 00:14:57,729
about seven years total to
get through my school as well

332
00:14:57,729 --> 00:14:59,097
as my work experience.

333
00:14:59,097 --> 00:15:01,599
And I decided to extend out my
work experience a little bit

334
00:15:01,599 --> 00:15:04,102
because I just loved
so much working here.

335
00:15:04,102 --> 00:15:07,605
And it really helped me to
understand what all of that,

336
00:15:07,605 --> 00:15:09,708
those theories and those
homework projects that I had

337
00:15:09,708 --> 00:15:12,744
to learn at school, how to
apply them to really cool stuff

338
00:15:12,744 --> 00:15:13,912
that could fly in space.

339
00:15:13,912 --> 00:15:15,947
So I thought it was an
important thing for me

340
00:15:15,947 --> 00:15:19,484
to really do my research
here at NASA too to figure

341
00:15:19,484 --> 00:15:20,719
out where I would best fit in

342
00:15:20,719 --> 00:15:23,121
and what I wanted
to do in my career.

343
00:15:23,121 --> 00:15:25,523
Then my graduate degree
took me about two years.

344
00:15:25,523 --> 00:15:28,293
And even then I was still
alternating between a semester

345
00:15:28,293 --> 00:15:31,496
at school and a semester
here at Houston, Texas.

346
00:15:31,496 --> 00:15:37,635
[Silence]

347
00:15:37,635 --> 00:15:39,437

>> Hi, my name is Danny.

348
00:15:39,437 --> 00:15:44,175
What is your favorite
part of your job?

349
00:15:44,175 --> 00:15:45,210
>> Heather: Oh Danny, wow.

350
00:15:45,210 --> 00:15:47,412
I wish I could answer
several things.

351
00:15:47,412 --> 00:15:49,681
You know I think one of the
favorite things that I think

352
00:15:49,681 --> 00:15:51,850
about when I get to
work here is working

353
00:15:51,850 --> 00:15:54,252
with this great team of people.

354
00:15:54,252 --> 00:15:55,787
It's really all about
teamwork here.

355
00:15:55,787 --> 00:15:57,255
When you look at the
Mission Control Center,

356
00:15:57,255 --> 00:15:58,623
I mean there's several
people here

357
00:15:58,623 --> 00:16:01,092
that are all working
together as a team

358
00:16:01,092 --> 00:16:04,195
to make sure astronauts
are living successfully

359
00:16:04,195 --> 00:16:05,697
and working onboard
the Space Station

360
00:16:05,697 --> 00:16:08,767
and even behind the scenes
we have rooms full of people

361
00:16:08,767 --> 00:16:11,236
that are supporting each
person here in mission control.

362
00:16:11,236 --> 00:16:13,438
And then engineers
and scientists all

363
00:16:13,438 --> 00:16:16,608
across Johnson Space Center,
all across the United States

364
00:16:16,608 --> 00:16:20,011
at our different NASA centers
and just the amount of teamwork

365
00:16:20,011 --> 00:16:21,413
and effort and communication,

366
00:16:21,413 --> 00:16:23,748
it's just amazing
to be a part of.

367
00:16:23,748 --> 00:16:25,083
And then the other
thing I like to think

368

00:16:25,083 --> 00:16:27,619
about with my engineering
career is a really see myself

369
00:16:27,619 --> 00:16:30,722
as a problem solver so if
you like solving puzzles,

370
00:16:30,722 --> 00:16:34,993
whether it's Sudoku, a crossword
or putting a jigsaw together,

371
00:16:34,993 --> 00:16:36,394
that's really the
heart and essence

372
00:16:36,394 --> 00:16:39,964
of engineering is being willing
to look at problem and see it

373
00:16:39,964 --> 00:16:42,233
as a creative challenge
and how can you overcome

374
00:16:42,233 --> 00:16:43,968
that and fix that problem?

375
00:16:43,968 --> 00:16:46,504
So I like to say
we're problem solvers.

376
00:16:46,504 --> 00:16:52,343
[Silence]

377
00:16:52,343 --> 00:16:54,879
>> Hi, my name is Abbey
and I was wondering

378
00:16:54,879 --> 00:16:57,449
about how old you were

when you decided you wanted

379
00:16:57,449 --> 00:16:58,750
to become an engineer?

380
00:16:58,750 --> 00:17:00,285
>> That's a great question.

381
00:17:00,285 --> 00:17:01,886
>> Heather: That's a
great question, Abbey:

382
00:17:01,886 --> 00:17:05,190
I was interested in space
from a very, very young age.

383
00:17:05,190 --> 00:17:06,524
But when I decided I wanted

384
00:17:06,524 --> 00:17:09,160
to become an engineer was
probably about your age.

385
00:17:09,160 --> 00:17:12,997
I started realizing that to
be an astronaut you could go

386
00:17:12,997 --> 00:17:15,567
down a couple of different
career paths and one

387
00:17:15,567 --> 00:17:17,135
of them was engineering.

388
00:17:17,135 --> 00:17:19,604
And the benefit with
going into engineering was

389
00:17:19,604 --> 00:17:22,207

that if I didn't end up getting
selected to be an astronaut,

390
00:17:22,207 --> 00:17:25,310
I could do what's really
a very close second

391
00:17:25,310 --> 00:17:28,780
which is be an engineer that
works and trains the astronauts

392
00:17:28,780 --> 00:17:30,115
and develops the hardware

393
00:17:30,115 --> 00:17:32,250
that the astronauts
get to use in space.

394
00:17:32,250 --> 00:17:34,018
And in fact, a lot
of the training

395
00:17:34,018 --> 00:17:36,321
that our astronauts go through,
our engineers have to do

396
00:17:36,321 --> 00:17:38,323
as well, especially
when you're thinking

397
00:17:38,323 --> 00:17:40,191
about a spacesuit
design or some hardware

398
00:17:40,191 --> 00:17:43,128
that the astronauts are going
to use, our engineers have

399
00:17:43,128 --> 00:17:46,030
to be familiar with working

with that same equipment so that

400
00:17:46,030 --> 00:17:48,399
if there is something
that happens in space,

401
00:17:48,399 --> 00:17:51,536
we can replicate it or
simulate it here on earth.

402
00:17:51,536 --> 00:17:54,906
So really being an engineer
for NASA is something I thought

403
00:17:54,906 --> 00:17:56,574
about a long time ago.

404
00:17:56,574 --> 00:17:58,977
I didn't know which kind
of engineer I wanted to be

405
00:17:58,977 --> 00:18:01,379
but once I started looking
at colleges I realized

406
00:18:01,379 --> 00:18:03,948
that mechanical engineering
was the way to go

407
00:18:03,948 --> 00:18:05,917
because of all the
different opportunities,

408
00:18:05,917 --> 00:18:07,886
the really foundational aspects

409
00:18:07,886 --> 00:18:10,722
of mechanical engineering
would allow me to do just

410
00:18:10,722 --> 00:18:16,027
about any other type
of engineering.

411
00:18:16,027 --> 00:18:17,996
>> Thank you.

412
00:18:17,996 --> 00:18:22,600
>> Hi, my name is Barney
and I was wondering,

413
00:18:22,600 --> 00:18:28,506
what qualifications do you
need to be an engineer in NASA?

414
00:18:28,506 --> 00:18:29,908
>> Heather: Excellent question.

415
00:18:29,908 --> 00:18:32,977
Well you first of all have to go
to college and study some kind

416
00:18:32,977 --> 00:18:36,347
of a technical degree,
typically engineering

417
00:18:36,347 --> 00:18:39,117
and get your Bachelor of
Science Degree in engineering

418
00:18:39,117 --> 00:18:40,952
and that can be mechanical,
chemical,

419
00:18:40,952 --> 00:18:43,454
electrical, computer,
industrial.

420
00:18:43,454 --> 00:18:45,823

I work with so many
different types of engineers.

421
00:18:45,823 --> 00:18:49,260
And really realizing that
you may not really need to do

422
00:18:49,260 --> 00:18:50,695
that kind of engineering
ultimately

423
00:18:50,695 --> 00:18:53,898
because really we have to
be able to kind of merge

424
00:18:53,898 --> 00:18:57,335
into other aspects
of engineering.

425
00:18:57,335 --> 00:19:00,238
So a minimum I would say is
a Bachelor of Science Degree.

426
00:19:00,238 --> 00:19:02,407
Now some of our engineers,
like me, choose to go on

427
00:19:02,407 --> 00:19:04,976
and get a Master's
but it's not required.

428
00:19:04,976 --> 00:19:08,046
We also like to make sure that
you have some work experience

429
00:19:08,046 --> 00:19:10,882
so if you're interested in
engineering, start looking

430
00:19:10,882 --> 00:19:13,117

at opportunities for
internships, whether it's here

431
00:19:13,117 --> 00:19:15,620
at NASA, which of course
I highly recommend,

432
00:19:15,620 --> 00:19:18,389
or with one of our
contract partners or one

433
00:19:18,389 --> 00:19:19,591
of our commercial partners.

434
00:19:19,591 --> 00:19:21,826
There's a lot of
opportunities out there

435
00:19:21,826 --> 00:19:26,231
to get that work experience.

436
00:19:27,732 --> 00:19:28,900
>> Thank you.

437
00:19:28,900 --> 00:19:31,769
>> Hello, my name is
Angelica Santerro.

438
00:19:31,769 --> 00:19:36,808
[phonetic] My question is how
does a person sleep in space?

439
00:19:36,808 --> 00:19:38,109
[laughter]

440
00:19:38,109 --> 00:19:39,310
>> Heather: A very important
aspect of living in space,

441

00:19:39,310 --> 00:19:41,579
you've got to make sure
that you get enough rest.

442
00:19:41,579 --> 00:19:44,315
We have crew quarters where the
astronauts basically can kind

443
00:19:44,315 --> 00:19:47,552
of close themselves up in their
own little personal space.

444
00:19:47,552 --> 00:19:49,420
And really what they
sleep in is something

445
00:19:49,420 --> 00:19:51,089
that looks a lot
like a sleeping bag.

446
00:19:51,089 --> 00:19:53,658
They climb into it,
they're legs go in.

447
00:19:53,658 --> 00:19:56,027
And one of the more
interesting things

448
00:19:56,027 --> 00:19:58,730
that the astronauts have
shared with me about sleeping

449
00:19:58,730 --> 00:20:02,333
in space is that they miss that
sensation of resting their head

450
00:20:02,333 --> 00:20:06,271
on a pillow so we had to design
a head strap that would go

451

00:20:06,271 --> 00:20:09,107
across the astronaut's head
to tilt their head back

452
00:20:09,107 --> 00:20:11,576
and then rest on the back
of their sleeping bag,

453
00:20:11,576 --> 00:20:14,879
essentially to give them
that feeling of sleeping.

454
00:20:14,879 --> 00:20:17,148
And a lot of times our
astronauts can choose

455
00:20:17,148 --> 00:20:19,050
or not choose to
restrain their arms.

456
00:20:19,050 --> 00:20:20,885
So sometimes if you
see astronauts sleeping

457
00:20:20,885 --> 00:20:23,321
in space their arms have risen
up and they look a little bit

458
00:20:23,321 --> 00:20:26,257
like a mummy just in
time for Halloween.

459
00:20:26,257 --> 00:20:29,027
But I've heard it's very
comfortable to sleep in space.

460
00:20:29,027 --> 00:20:31,162
And really we work our
astronauts pretty hard

461

00:20:31,162 --> 00:20:33,564
and they do a lot of great work
for us so by the time they get

462
00:20:33,564 --> 00:20:36,634
to lay down, or float and sleep,

463
00:20:36,634 --> 00:20:38,670
they're ready to
catch a few Z's.

464
00:20:38,670 --> 00:20:47,445
>> Hi, my name is Sophia Marbrin
[phonetic] and I'm wondering,

465
00:20:47,445 --> 00:20:51,182
why did you decide
to be part of NASA?

466
00:20:51,182 --> 00:20:53,151
>> Heather: Excellent,
excellent question.

467
00:20:53,151 --> 00:20:55,753
Well back when I was about
your age and I started looking

468
00:20:55,753 --> 00:20:57,455
at the different
career options that were

469
00:20:57,455 --> 00:20:59,457
out there, I was so interested.

470
00:20:59,457 --> 00:21:02,026
I was already tied into
what NASA was doing

471
00:21:02,026 --> 00:21:05,096
through various things

with school.

472
00:21:05,096 --> 00:21:07,732
And I really just decided
that to be an astronaut

473
00:21:07,732 --> 00:21:09,834
or even an engineer
working in the space program

474
00:21:09,834 --> 00:21:11,669
at NASA was the place to be.

475
00:21:11,669 --> 00:21:13,938
Nowadays there's even
more opportunities.

476
00:21:13,938 --> 00:21:16,974
Of course NASA is really
at the forefront of working

477
00:21:16,974 --> 00:21:19,310
with our International
Space Station and looking

478
00:21:19,310 --> 00:21:22,480
at future technologies but there
are a lot of contractor partners

479
00:21:22,480 --> 00:21:25,316
that we work with that
offer a similar experience.

480
00:21:25,316 --> 00:21:27,051
We have all of our
international partners.

481
00:21:27,051 --> 00:21:30,088
So really the opportunities
are even greater for you guys

482
00:21:30,088 --> 00:21:33,491
that are interested in
working for the space program.

483
00:21:33,491 --> 00:21:34,892
>> Thanks.

484
00:21:34,892 --> 00:21:39,897
>> Hi, my name is Emily Rotors
[phonetic] and I was wondering

485
00:21:39,897 --> 00:21:42,700
if you were working
on any new spacesuits?

486
00:21:42,700 --> 00:21:44,569
>> Heather: Hey Emily,
well I love that t-shirt

487
00:21:44,569 --> 00:21:46,437
so [inaudible] to you.

488
00:21:46,437 --> 00:21:49,273
Absolutely, we are working
on new suits right now

489
00:21:49,273 --> 00:21:52,343
and we're trying to make our
new suits kind of multipurpose

490
00:21:52,343 --> 00:21:54,445
because we don't know
yet where we're going

491
00:21:54,445 --> 00:21:57,248
but we're really focusing
a lot on a suit to work

492

00:21:57,248 --> 00:21:58,750
with our new Orion vehicle.

493
00:21:58,750 --> 00:22:02,220
And it's going to look kind
of like the suit that we wore

494
00:22:02,220 --> 00:22:04,689
when our astronauts launched
and landed in the space shuttle,

495
00:22:04,689 --> 00:22:07,492
the bright orange,
advanced crew escape suit.

496
00:22:07,492 --> 00:22:10,628
We're working on
modifications to that to work

497
00:22:10,628 --> 00:22:13,831
with the requirements
for our Orion program.

498
00:22:13,831 --> 00:22:18,169
And then we've got our engineers
off working on a surface suit

499
00:22:18,169 --> 00:22:21,239
as well, something that's
going to be a definite upgrade

500
00:22:21,239 --> 00:22:23,941
from what we used on the
moon, much more mobile.

501
00:22:23,941 --> 00:22:26,411
Hopefully lighter weight
and hopefully more efficient

502
00:22:26,411 --> 00:22:29,580

with the life support system
so maybe we can stay out longer

503
00:22:29,580 --> 00:22:31,716
or wear less weight
on our backs.

504
00:22:31,716 --> 00:22:34,986
So stay turned and maybe
hopefully you can join our team

505
00:22:34,986 --> 00:22:36,087
as well.

506
00:22:36,087 --> 00:22:38,256
>> Thank you.

507
00:22:38,256 --> 00:22:41,759
>> Hi, I'm Elizabeth
LePay [phonetic]

508
00:22:41,759 --> 00:22:46,097
and I was wondering what happens
if an astronaut gets sick?

509
00:22:46,097 --> 00:22:47,331
Can they go home early?

510
00:22:47,331 --> 00:22:48,699
>> Heather: A very important
thing to think about.

511
00:22:48,699 --> 00:22:52,170
Now our astronauts are trained
in a little bit of medicine

512
00:22:52,170 --> 00:22:53,438
so they can kind
of help each other

513
00:22:53,438 --> 00:22:55,406
and we have some certain
medications up there

514
00:22:55,406 --> 00:22:56,974
if they get a little
under the weather.

515
00:22:56,974 --> 00:23:00,144
If it became really serious
we'd have to evaluate how

516
00:23:00,144 --> 00:23:01,712
to get them back home.

517
00:23:01,712 --> 00:23:04,048
But really our astronauts
are very, very well trained

518
00:23:04,048 --> 00:23:06,184
to take care of themselves
in space.

519
00:23:06,184 --> 00:23:09,487
We also have a flight doctor
that is here in mission control

520
00:23:09,487 --> 00:23:11,489
that monitors the crew's
health and make sure

521
00:23:11,489 --> 00:23:15,159
that they're feeling well enough
to stay up there and do the job.

522
00:23:15,159 --> 00:23:17,195
>> If it's really an emergency,

523
00:23:17,195 --> 00:23:20,765

they do have their
spacecraft that's always

524
00:23:20,765 --> 00:23:22,934
at the Space Station
so they can come home

525
00:23:22,934 --> 00:23:26,170
in an emergency fairly quickly.

526
00:23:26,170 --> 00:23:28,573
>> Heather: Great question.

527
00:23:28,573 --> 00:23:33,444
>> Hi, my name is Madison Ethen
[phonetic] and I was wondering,

528
00:23:33,444 --> 00:23:36,447
what have you learned from
Voyager 1 now that it's

529
00:23:36,447 --> 00:23:38,049
out of our solar system?

530
00:23:38,049 --> 00:23:40,985
>> Heather: That's an
excellent question.

531
00:23:40,985 --> 00:23:43,421
You know I think we're
excited to see what we learn

532
00:23:43,421 --> 00:23:46,858
from Voyager 1 and I think
it just left not too long ago

533
00:23:46,858 --> 00:23:48,459
so we have a little
bit of time to figure

534
00:23:48,459 --> 00:23:51,963
out what we're going
to see next.

535
00:23:51,963 --> 00:23:54,732
So hopefully stay tuned
to the NASA.gov website

536
00:23:54,732 --> 00:23:56,334
and we'll keep you
guys informed.

537
00:23:56,334 --> 00:23:58,402
And the other great
program that we're working

538
00:23:58,402 --> 00:24:01,606
on right now is the James Webb
Space telescope that is going

539
00:24:01,606 --> 00:24:03,007
to be a huge improvement.

540
00:24:03,007 --> 00:24:06,110
We've got the fantastic Hubble
Space telescope up right now.

541
00:24:06,110 --> 00:24:09,780
The James Webb is going to let
us see even further out there

542
00:24:09,780 --> 00:24:11,983
to see what's going
on so there's a lot

543
00:24:11,983 --> 00:24:13,718
of really exciting things going

544
00:24:13,718 --> 00:24:15,686

on in the space program
right now.

545
00:24:15,686 --> 00:24:18,256
I'm so excited you guys
prepared these amazing questions

546
00:24:18,256 --> 00:24:21,292
and I really do hope that
you stay tuned in and I hope

547
00:24:21,292 --> 00:24:23,794
that you can come
and join our team.

548
00:24:23,794 --> 00:24:26,330
>> Yeah we really do
appreciate your guys coming

549
00:24:26,330 --> 00:24:28,900
into mission control and
joining Heather and myself.

550
00:24:28,900 --> 00:24:31,502
We've had a great
time and as she said,

551
00:24:31,502 --> 00:24:32,904
those are great questions.

552
00:24:32,904 --> 00:24:36,774
And as she also alluded to, you
kind of can see there are a ton

553
00:24:36,774 --> 00:24:39,844
of different jobs out there in
the aerospace business and NASA

554
00:24:39,844 --> 00:24:43,180
and all the contractors

so we certainly would love

555
00:24:43,180 --> 00:24:45,616
to have you guys come and
join us when you guys get

556
00:24:45,616 --> 00:24:48,753
out of college and we're
looking forward to it.

557
00:24:48,753 --> 00:24:49,887
And thanks again for coming

558
00:24:49,887 --> 00:24:51,856
and joining us here
in Mission Control.