
Derrol Nail
NASA Communications
COUNTDOWN TO MARS
Moogega Cooper
Mars 2020 Lead Planetary Prot. Eng.

1
00:00:08,190 --> 00:00:15,050
After a 300 million mile journey through space,
the Mars Perseverance Rover is ready to begin

2
00:00:15,050 --> 00:00:20,380
the most challenging part of the trip, landing
on the red planet.

3
00:00:20,380 --> 00:00:27,540
If successful, it will embark on the most
advanced mission ever sent here, to discover

4
00:00:27,540 --> 00:00:32,250
if life ever existed on Mars.

5
00:00:32,250 --> 00:00:38,030
The rocket ranch welcomes Dr. Moogega Cooper,
NASA JPL's planetary protection lead for Mars

6
00:00:38,030 --> 00:00:39,430
Perseverance.

7
00:00:39,430 --> 00:00:44,730
She'll tell us how she and her team are actually
protecting Mars and she'll describe the incredibly

8
00:00:44,730 --> 00:00:48,540
complex maneuvers needed to land on the red
planet.

9
00:00:48,540 --> 00:00:53,650
Plus, she'll tell us about the most exciting
parts of its astrobiology mission.

10
00:00:53,650 --> 00:00:57,430
I’m Derrol Nail and this is the Rocket Ranch.

11
00:00:57,430 --> 00:01:01,299
EGS program chief engineer verifying no constraints

to launch.

12
00:01:01,299 --> 00:01:04,419
Three, two, one, and lift off.

13
00:01:04,419 --> 00:01:06,389
Welcome to space.

14
00:01:09,260 --> 00:01:11,710
It's an exciting time.

15
00:01:11,710 --> 00:01:19,310
We are not too far away from the landing of
the Perseverance Rover on the surface of Mars.

16
00:01:19,310 --> 00:01:22,270
This was a project you were involved in pretty
closely.

17
00:01:22,270 --> 00:01:23,270
Definitely.

18
00:01:23,270 --> 00:01:24,270
Yeah.

19
00:01:24,270 --> 00:01:26,280
You know every part of that Rover.

20
00:01:26,280 --> 00:01:28,080
Every square centimeter.

21
00:01:28,080 --> 00:01:29,860
And why is that?

22
00:01:29,860 --> 00:01:34,930
So every single part, almost every single
part of the Rover that's landing right now

23

00:01:34,930 --> 00:01:39,850
and the whole system that's landing it has
been sampled by myself or my team.

24
00:01:39,850 --> 00:01:42,560
To make sure that it had no life on it, right?

25
00:01:42,560 --> 00:01:44,290
Excess amount of microbes, exactly.

26
00:01:44,290 --> 00:01:47,320
So we have to make sure that it was clean
enough so it doesn't contaminate the surface

27
00:01:47,320 --> 00:01:50,890
of Mars where we're trying to explore for
possible ancient life.

28
00:01:50,890 --> 00:01:55,430
So it's a high-tech robotic geologist, right?

29
00:01:55,430 --> 00:01:56,430
Yeah.

30
00:01:56,430 --> 00:01:59,730
Going to the surface and doing the work of
a geologist remotely.

31
00:01:59,730 --> 00:02:00,730
Exactly.

32
00:02:00,730 --> 00:02:01,730
Yeah.

33
00:02:01,730 --> 00:02:06,560
It's going to go there and do so many exciting
things, both for future human missions, creating

34
00:02:06,560 --> 00:02:11,780

oxygen for fuel or for breathing air, looking
at the weather system so that we can make

35
00:02:11,780 --> 00:02:17,040
sure we prepare accordingly, bring the right
sunscreen and all kinds of things.

36
00:02:17,040 --> 00:02:18,040
Great tech demos.

37
00:02:18,040 --> 00:02:19,040
It's really exciting.

38
00:02:19,040 --> 00:02:24,810
So before we get to the surface, there's this
exciting part where the Perseverance Rover

39
00:02:24,810 --> 00:02:26,550
has to land.

40
00:02:26,550 --> 00:02:27,880
It's a big deal.

41
00:02:27,880 --> 00:02:28,880
It is.

42
00:02:28,880 --> 00:02:32,010
So much so they call it the seven minutes
of terror.

43
00:02:32,010 --> 00:02:33,600
Now, why is that?

44
00:02:33,600 --> 00:02:39,890
Yeah, because it's a terrifying seven-minute
process where many things have to go right.

45
00:02:39,890 --> 00:02:43,660
You have a parachute that has to be deployed

at the right time.

46
00:02:43,660 --> 00:02:49,319
You have to have a separation of the back shell and the heat shield in a way so that

47
00:02:49,319 --> 00:02:54,120
the heat shield doesn't slam back into the launch vehicle or into the descent stage.

48
00:02:54,120 --> 00:02:56,959
You have to make sure all those components are gone.

49
00:02:56,959 --> 00:03:01,000
The descent stage needs to fire at just the right time so that the whole system doesn't

50
00:03:01,000 --> 00:03:03,220
slam onto the surface of Mars.

51
00:03:03,220 --> 00:03:05,770
It has to descend on an umbilical.

52
00:03:05,770 --> 00:03:07,510
Those umbilicals need to be cut at the right time.

53
00:03:07,510 --> 00:03:10,590
It needs to fly away so that it doesn't drag the Rover.

54
00:03:10,590 --> 00:03:13,280
I mean, all of these things have to happen right.

55
00:03:13,280 --> 00:03:19,120
It's such a fascinating engineering feat that you guys are pulling off there.

56
00:03:19,120 --> 00:03:20,160
It's just amazing.

57
00:03:20,160 --> 00:03:23,500
Even watching the animations, it's just like,
wow.

58
00:03:23,500 --> 00:03:24,959
Yeah, it's amazing.

59
00:03:24,959 --> 00:03:29,880
The EDL team, Entry Descent and Landing Team,
has done such a phenomenal job in planning

60
00:03:29,880 --> 00:03:32,209
and preparing for this.

61
00:03:32,209 --> 00:03:33,209
It's really exciting.

62
00:03:33,209 --> 00:03:36,150
Should be seven minutes of excitement.

63
00:03:36,150 --> 00:03:37,150
That's what you would rename it.

64
00:03:37,150 --> 00:03:39,910
That's for everybody else, except for the
EDL team.

65
00:03:39,910 --> 00:03:41,140
Great point.

66
00:03:41,140 --> 00:03:48,290
And speaking of excitement, most people are
familiar, if you follow the exploration programs

67
00:03:48,290 --> 00:03:53,870

out at JPL, with that shot of the control
room, the mission control room, where everybody

68
00:03:53,870 --> 00:03:54,870
is there.

69
00:03:54,870 --> 00:03:56,920
Now, this is a podcast, so we kind of paint
word pictures.

70
00:03:56,920 --> 00:04:02,140
But you've got everybody there, they're sitting
behind their monitors and their workstations.

71
00:04:02,140 --> 00:04:07,981
And there is that moment where they confirm
that it's gone through the atmosphere, it's

72
00:04:07,981 --> 00:04:13,170
done everything that you just described and
landed softly and gently on the surface of

73
00:04:13,170 --> 00:04:17,340
Mars and now it can do its work.

74
00:04:17,340 --> 00:04:20,750
Why do you see people jumping for joy and
hugging each other and crying?

75
00:04:20,750 --> 00:04:21,750
Yeah.

76
00:04:21,750 --> 00:04:26,330
I mean, with all of those things that have
to be right, that means there's so many things

77
00:04:26,330 --> 00:04:28,449
that could go wrong.

78

00:04:28,449 --> 00:04:33,910
And with that successful signal acquisition
that yes, we indeed landed, I mean, that just

79
00:04:33,910 --> 00:04:39,870
sparks such a sense of joy because now you
know you can move on to the next phase to

80
00:04:39,870 --> 00:04:41,740
start surface operations.

81
00:04:41,740 --> 00:04:47,740
So you'll get Adam Steltzner jumping for joy
in the room, which will be Al Chen this time

82
00:04:47,740 --> 00:04:48,740
around.

83
00:04:48,740 --> 00:04:53,980
He's going to be jumping for joy in his whatever
color shirt they print out for this crew and

84
00:04:53,980 --> 00:04:55,010
the whole team.

85
00:04:55,010 --> 00:05:02,340
So yeah, it's just exciting because now you
have cemented that phase into stone.

86
00:05:02,340 --> 00:05:05,560
Then, now, you can move on to the next big
thing.

87
00:05:05,560 --> 00:05:12,690
Now, the science begins, the scary part of
getting off the Earth, traveling 300 million

88
00:05:12,690 --> 00:05:14,650
miles and landing on the surface is over.

89
00:05:14,650 --> 00:05:17,840
Now, the science can begin.

90
00:05:17,840 --> 00:05:22,440
One of the things I think of when they do
the EDL, when it lands is that ... I don't

91
00:05:22,440 --> 00:05:27,540
know if it was during Curiosity or one of
the recent missions where I believe there

92
00:05:27,540 --> 00:05:29,160
was a choreographed dance move ...

93
00:05:29,160 --> 00:05:31,020
Oh, that was for Insight.

94
00:05:31,020 --> 00:05:32,620
The Insight lander.

95
00:05:32,620 --> 00:05:33,620
Right.

96
00:05:33,620 --> 00:05:38,430
Any knowledge of any plans for any celebratory
dances?

97
00:05:38,430 --> 00:05:43,980
I don't know of any plans, but I know the
person that would do something.

98
00:05:43,980 --> 00:05:45,580
I could ask this person.

99
00:05:45,580 --> 00:05:47,430
Are you going to out that person?

100
00:05:47,430 --> 00:05:52,690

I won't out this person, but I might ask him
to do something or give me a little bit of

101
00:05:52,690 --> 00:05:53,690
knowledge.

102
00:05:53,690 --> 00:05:54,690
I'll sneak you in a word later.

103
00:05:54,690 --> 00:05:55,690
I appreciate that.

104
00:05:55,690 --> 00:05:56,690
Yeah.

105
00:05:56,690 --> 00:05:57,690
You have to watch, basically.

106
00:05:57,690 --> 00:05:59,280
Watch the landing show.

107
00:05:59,280 --> 00:06:01,050
That'll be an exciting one to watch.

108
00:06:01,050 --> 00:06:03,970
What will you be doing for the landing of
the rover?

109
00:06:03,970 --> 00:06:08,330
I will be, at the minimum, watching online
from the comfort of my home.

110
00:06:08,330 --> 00:06:12,180
I hope to find some sort of party.

111
00:06:12,180 --> 00:06:17,860
Of course, a COVID safe party, but I will
find some party to watch, hopefully with colleagues,

112
00:06:17,860 --> 00:06:19,870
at a socially distant distance.

113
00:06:19,870 --> 00:06:21,900
Right, right.

114
00:06:21,900 --> 00:06:23,770
Because I mean, that's part of it, right?

115
00:06:23,770 --> 00:06:30,540
It is celebrating with those that you have
put so much blood, sweat and tears with when

116
00:06:30,540 --> 00:06:33,220
a project comes to fruition like that.

117
00:06:33,220 --> 00:06:37,759
Once it's landed on Mars, we're talking about
the science beginning.

118
00:06:37,759 --> 00:06:43,600
This Rover is going to be doing some incredible
work that's different than any of the rovers

119
00:06:43,600 --> 00:06:45,370
we've landed before.

120
00:06:45,370 --> 00:06:46,580
Talk a little bit about that.

121
00:06:46,580 --> 00:06:47,580
Yeah.

122
00:06:47,580 --> 00:06:52,040
So even down to the drill, if you look at
prior Rovers, like the Curiosity Rover, it

123
00:06:52,040 --> 00:06:59,210

has a drill that's meant to grind the soil
and the dirt and the rocks into a fine powder.

124
00:06:59,210 --> 00:07:03,830
If you look at the drill for the Curiosity
or for Perseverance, it's actually a coring

125
00:07:03,830 --> 00:07:04,830
drill.

126
00:07:04,830 --> 00:07:08,910
So it's meant to take more of an intact sample,
about the size of a piece of chalk for those

127
00:07:08,910 --> 00:07:12,240
of you old enough to know chalkboards.

128
00:07:12,240 --> 00:07:13,330
[laughter]

129
00:07:13,330 --> 00:07:14,419
Right?

130
00:07:14,419 --> 00:07:17,789
So even down to the drill, it's completely
different.

131
00:07:17,789 --> 00:07:18,830
We'll understand stratigraphy.

132
00:07:18,830 --> 00:07:24,370
So if you imagine like lines on the side of
a rock, those lines tell you different information

133
00:07:24,370 --> 00:07:29,520
and having those lines preserved gives you
orders of more magnitude of more information

134
00:07:29,520 --> 00:07:33,410

about that geology than if you ground it all
up and mix it together.

135
00:07:33,410 --> 00:07:34,410
Ah.

136
00:07:34,410 --> 00:07:36,840
So having it as a core, a solid core.

137
00:07:36,840 --> 00:07:38,229
How long is that?

138
00:07:38,229 --> 00:07:41,500
It's about 10 centimeters long.

139
00:07:41,500 --> 00:07:43,470
10 centimeters, okay.

140
00:07:43,470 --> 00:07:49,340
We know that this has been called an astrobiology
mission.

141
00:07:49,340 --> 00:07:52,440
We're going to be looking for signs of life
in these cores?

142
00:07:52,440 --> 00:07:53,440
Yeah.

143
00:07:53,440 --> 00:07:54,440
Signs of ancient life.

144
00:07:54,440 --> 00:07:55,440
Ancient life.

145
00:07:55,440 --> 00:07:56,440
Yeah.

146

00:07:56,440 --> 00:07:57,440
Dinosaur bones?

147
00:07:57,440 --> 00:07:58,440
Not dinosaur bones.

148
00:07:58,440 --> 00:08:02,319
I remember that line from our launch coverage,
which of which you were a co-host.

149
00:08:02,319 --> 00:08:04,960
You said, "No, we're not going to be finding
dinosaur bones."

150
00:08:04,960 --> 00:08:07,250
Trying to make it a thing though.

151
00:08:07,250 --> 00:08:08,250
It's a thing with me at least.

152
00:08:08,250 --> 00:08:09,870
We'll make it a thing.

153
00:08:09,870 --> 00:08:11,190
Well, what do you think?

154
00:08:11,190 --> 00:08:14,800
I mean, what would be a sign of ancient life?

155
00:08:14,800 --> 00:08:18,690
Yeah, so they're looking for what we call
biosignatures.

156
00:08:18,690 --> 00:08:22,020
There are carbon structures.

157
00:08:22,020 --> 00:08:28,460
There are things that if you see this signature,
you know that it came from or that chances

158
00:08:28,460 --> 00:08:31,110
are high that it came from a biological source.

159
00:08:31,110 --> 00:08:37,099
With the Allan Hills meteorite, there were signatures there that people would argue back

160
00:08:37,099 --> 00:08:43,760
and forth, whether or not it came from a biological source or naturally occurring, just regular

161
00:08:43,760 --> 00:08:45,250
geology-induced processes.

162
00:08:45,250 --> 00:08:49,960
So there are these biosignatures that really hint more strongly at the fact that it comes

163
00:08:49,960 --> 00:08:51,440
from something that was living.

164
00:08:51,440 --> 00:08:57,860
Now, the Allan Hills meteorite, this was something that struck Mars and pieces of Mars hit Earth.

165
00:08:57,860 --> 00:08:58,860
That's right.

166
00:08:58,860 --> 00:09:03,260
And we know that we have parts of Mars on Earth, but they traveled through our atmosphere

167
00:09:03,260 --> 00:09:07,610
and it was exposed to the environment of Earth.

168
00:09:07,610 --> 00:09:09,880
But that's interesting that there was such incredible debate.

169
00:09:09,880 --> 00:09:10,880
Yeah, there was.

170
00:09:10,880 --> 00:09:11,880
Yeah.

171
00:09:11,880 --> 00:09:15,630
And I think it was Lori Glaze during her interview,
doing a launch commentary that said, ... someone

172
00:09:15,630 --> 00:09:20,610
said that it was all kind of inadvertent,
random sample returned.

173
00:09:20,610 --> 00:09:23,220
Oh, I think it was Jennifer Trosper.

174
00:09:23,220 --> 00:09:26,490
Sample return kind of at random.

175
00:09:26,490 --> 00:09:31,070
Something hit Mars millions of years ago,
maybe billions of years ago and it launched

176
00:09:31,070 --> 00:09:32,540
out and it fell onto Earth.

177
00:09:32,540 --> 00:09:37,800
But now we can use instruments to selectively
choose where we want our samples to be.

178
00:09:37,800 --> 00:09:42,300
And it's really incredible that we have the
choice based on these in-situ instruments

179
00:09:42,300 --> 00:09:44,350
to pick the right place.

180
00:09:44,350 --> 00:09:45,940
And let's talk a little bit about that.

181
00:09:45,940 --> 00:09:52,060
The place you picked was Jezero Crater and
a lot has been made about this.

182
00:09:52,060 --> 00:09:56,070
It looks like it was a river delta that flowed
into a lake.

183
00:09:56,070 --> 00:09:57,070
Yeah.

184
00:09:57,070 --> 00:09:58,790
So there's a lake and it has these river deltas.

185
00:09:58,790 --> 00:10:04,470
Basically, evidence that water was flowing
in and flowing out of this lake area.

186
00:10:04,470 --> 00:10:09,790
So those deltas are really great at preserving
those sediments, those bio-signatures, whatever

187
00:10:09,790 --> 00:10:18,010
might be there, possible biosignatures, into
a nice surface that we can core and interrogate.

188
00:10:18,010 --> 00:10:19,891
What do you think?

189
00:10:19,891 --> 00:10:23,870
Do you think there might be ancient life on
Mars?

190
00:10:23,870 --> 00:10:28,980
I mean, with the numbers out there, I mean,
there are a lot of ... Could life exists somewhere

191
00:10:28,980 --> 00:10:29,980
else?

192
00:10:29,980 --> 00:10:30,980
Possibly.

193
00:10:30,980 --> 00:10:36,560
And the nice thing about being a scientist
at heart and a scientist by training is that

194
00:10:36,560 --> 00:10:38,430
it doesn't matter what I think.

195
00:10:38,430 --> 00:10:39,790
Let's see what the data says.

196
00:10:39,790 --> 00:10:42,930
Well, we, of course, have an informed opinion.

197
00:10:42,930 --> 00:10:47,800
We have an informed location that we're going
to that will set us up for success, that if

198
00:10:47,800 --> 00:10:52,610
life does or ancient life does exist anywhere
on Mars, that's a really great place to find

199
00:10:52,610 --> 00:10:53,610
it.

200
00:10:53,610 --> 00:10:56,260
And we're going to fly those samples back
to Earth.

201
00:10:56,260 --> 00:10:58,510
First time anything like this has ever been
done.

202
00:10:58,510 --> 00:10:59,510
That's right, yeah.

203
00:10:59,510 --> 00:11:03,290
There has been no sample return from Mars
in ever.

204
00:11:03,290 --> 00:11:04,290
And any planet.

205
00:11:04,290 --> 00:11:05,290
Or any planet.

206
00:11:05,290 --> 00:11:06,290
That's right.

207
00:11:06,290 --> 00:11:07,290
Yeah.

208
00:11:07,290 --> 00:11:08,950
And there's the moon, of course, Apollo.

209
00:11:08,950 --> 00:11:10,250
They brought samples back.

210
00:11:10,250 --> 00:11:12,390
Other than that ...

211
00:11:12,390 --> 00:11:13,820
That's it.

212
00:11:13,820 --> 00:11:19,380
There's also a really neat tech demonstration
with the Mars helicopter.

213
00:11:19,380 --> 00:11:25,380
And that's getting a lot of buzz because people
are like, "How do you fly on Mars in such

214
00:11:25,380 --> 00:11:27,700
a super-thin atmosphere?"

215
00:11:27,700 --> 00:11:31,020
We know that here on Earth, you need an atmosphere.

216
00:11:31,020 --> 00:11:34,810
You need something for which to drive and
propel you up.

217
00:11:34,810 --> 00:11:35,810
Right?

218
00:11:35,810 --> 00:11:36,810
Exactly.

219
00:11:36,810 --> 00:11:37,810
But that barely exists on Mars.

220
00:11:37,810 --> 00:11:43,430
It does and that's why it was such a huge
challenge and I give so much kudos to the

221
00:11:43,430 --> 00:11:45,850
team that actually made this happen.

222
00:11:45,850 --> 00:11:47,660
Yeah, you don't have very much atmosphere.

223
00:11:47,660 --> 00:11:52,880
It's 1% of that of Earth, so you don't have
a lot to give you lift.

224
00:11:52,880 --> 00:11:55,430
And so, they had to make the propellers extremely
light.

225

00:11:55,430 --> 00:11:56,790
There's lot of foam in there.

226
00:11:56,790 --> 00:12:02,780
If you were to cut away the carbon fiber wrapping
on the outside, it's mostly air in there,

227
00:12:02,780 --> 00:12:05,460
but yet it's still structurally sound.

228
00:12:05,460 --> 00:12:06,860
It has to work.

229
00:12:06,860 --> 00:12:10,450
It has to spin without breaking apart into
little pieces.

230
00:12:10,450 --> 00:12:12,060
So yeah, they made light propellers.

231
00:12:12,060 --> 00:12:15,500
They made the body, the fuselage very light.

232
00:12:15,500 --> 00:12:18,279
And then the propellors also spin at a very
high rate.

233
00:12:18,279 --> 00:12:21,600
When you were here, what was that experience
like watching the launch?

234
00:12:21,600 --> 00:12:27,630
Yeah, I've watched launches in the past, but
I haven't seen the launch end-to-end of something

235
00:12:27,630 --> 00:12:28,630
that I've worked on.

236
00:12:28,630 --> 00:12:33,160

This was the first launch where I knew that
I helped with that baby in there and that

237
00:12:33,160 --> 00:12:35,089
payload fairing.

238
00:12:35,089 --> 00:12:36,520
I've contributed to that.

239
00:12:36,520 --> 00:12:39,960
And to see it launch, it just meant so much
more to me.

240
00:12:39,960 --> 00:12:43,250
And I didn't think that a launch would mean
any more than it usually does.

241
00:12:43,250 --> 00:12:44,600
It's already spectacular.

242
00:12:44,600 --> 00:12:47,930
But yeah, it was just very, very emotional.

243
00:12:47,930 --> 00:12:49,450
You were a part of the launch broadcast.

244
00:12:49,450 --> 00:12:54,180
Could you describe what was going through
your mind, what you were feeling as you were

245
00:12:54,180 --> 00:12:55,550
watching the rocket liftoff?

246
00:12:55,550 --> 00:12:56,550
Yeah.

247
00:12:56,550 --> 00:13:01,130
There was a lot of compartmentalization happening
during the launch broadcast because you were

248
00:13:01,130 --> 00:13:08,150
there, you kind of had a job to do and I wanted
to stay focused on the cause, but also something

249
00:13:08,150 --> 00:13:12,209
exciting is happening that took seven years
to get to this point.

250
00:13:12,209 --> 00:13:16,990
So yeah, it was a mix between professionalism
and excitement and just, "Okay.

251
00:13:16,990 --> 00:13:17,990
Keep it together.

252
00:13:17,990 --> 00:13:19,640
A lot of internal monologues happening."

253
00:13:19,640 --> 00:13:21,180
But yeah, it was amazing.

254
00:13:21,180 --> 00:13:26,980
Dr. Moogega Cooper, we appreciate you being
here and visiting us here on the Rocket Ranch.

255
00:13:26,980 --> 00:13:31,810
And thanks for sharing your insight on the
Mars 2020 project and the Perseverance Rover.

256
00:13:31,810 --> 00:13:33,000
Yeah, go Perseverance!

257
00:13:33,000 --> 00:13:35,040
Good luck on the landing too.

258
00:13:35,040 --> 00:13:37,530
Thank you, yeah.

259
00:13:37,530 --> 00:13:46,250
A special, thanks to Dr. Moogega Cooper, NASA
JPL's planetary protection lead for Mars Perseverance.

260
00:13:46,250 --> 00:13:48,180
And to learn more about everything going on
at the Kennedy Space Center, go to nasa.gov/kennedy.

261
00:13:48,180 --> 00:13:55,610
And if you'd like to find out what's happening
at our other NASA centers around the country,

262
00:13:55,610 --> 00:13:56,839
go to nasa.gov/podcast.

263
00:13:56,839 --> 00:14:03,779
A special shout out to our producer, John
Sackman, and editor, Frankie Martin.