1
00:00:07,072 --> 00:00:10,744
[dramatic orchestral music]

2
00:00:30,629 --> 00:00:33,065
- Welcome to NASA's Jet
Propulsion Laboratory

3
00:00:33,065 --> 00:00:34,901
in Pasadena, California.

4
00:00:34,901 --> 00:00:36,535
I'm Veronica McGregor.

5
00:00:36,535 --> 00:00:38,438
We're here for another
very exciting event

6
00:00:38,438 --> 00:00:41,641
that's going to take place
just five days from now.

7
00:00:41,641 --> 00:00:44,444
We are attempting to land
another mission on Mars,

8
00:00:44,444 --> 00:00:46,179
and this mission
is like no other

9
00:00:46,179 --> 00:00:47,980
that we've sent
to the red planet.

10
00:00:47,980 --> 00:00:51,684
This mission we'll be studying
the deep interior of Mars,

11
00:00:51,684 --> 00:00:53,252
to tell us more,

not only about Mars,

12
00:00:53,252 --> 00:00:55,522
but also about how all
rocky planets formed,

13
00:00:55,522 --> 00:00:56,589
including the Earth.

14
00:00:57,790 --> 00:01:00,192
Our landing time is
Monday, November 26,

15
00:01:00,192 --> 00:01:03,630
at about noon Pacific Time,
3:00 p.m. Eastern Time,

16
00:01:03,630 --> 00:01:06,065
and I want to give you
some websites immediately,

17
00:01:06,065 --> 00:01:07,600
because I want you
to bookmark these

18
00:01:07,600 --> 00:01:10,403
so you come back on Monday
and you watch the landing

19
00:01:10,403 --> 00:01:12,138
live from mission control.

20
00:01:12,138 --> 00:01:15,475
If nothing else today,
please book nasa.gov/live,

21
00:01:17,143 --> 00:01:21,648
and/or, either one,
go.nasa.gov/InSightToolkit.

22
00:01:23,649 --> 00:01:26,219
The InSight toolkit
will have a link

23
00:01:26,219 --> 00:01:29,154
to multiple ways that
you can watch on live,

24
00:01:29,154 --> 00:01:32,659
both on NASA and on
social media channels,

25
00:01:32,659 --> 00:01:36,495
including a live feed from
mission control in 360 degrees,

26
00:01:36,495 --> 00:01:38,030
so you can feel like
you're sitting in there

27
00:01:38,030 --> 00:01:39,699
with the rest of
the mission team.

28
00:01:41,301 --> 00:01:44,036
Our event today is going to
be divided into two parts.

29
00:01:44,036 --> 00:01:45,571
We're gonna spend the first hour

30
00:01:45,571 --> 00:01:47,806
talking with mission managers

31
00:01:47,806 --> 00:01:51,210
about how InSight will
operate on the surface of Mars

32
00:01:51,210 --> 00:01:52,811

and also tell us
a little bit more

33
00:01:52,811 --> 00:01:56,215
about the white knuckle event
that will take place Monday

34
00:01:56,215 --> 00:01:58,084
with entry descent and landing.

35
00:01:59,519 --> 00:02:01,688
Following that, we're going
to have the science panel,

36
00:02:01,688 --> 00:02:04,023
that will start at
11:00 a.m. Pacific Time,

37
00:02:04,023 --> 00:02:05,758
and they will describe
how these instruments

38
00:02:05,758 --> 00:02:08,060
that we're going to place
on the surface of Mars

39
00:02:08,060 --> 00:02:10,896
will be able to take the
vital signs of the planet

40
00:02:10,896 --> 00:02:13,433
to tell us more
about rocky planets.

41
00:02:16,002 --> 00:02:19,972
I'm going to start now by
introducing our first guest,

42
00:02:19,972 --> 00:02:22,308
and it is Dr. Thomas Zurbuchen,

43
00:02:22,308 --> 00:02:25,010
and he is the NASA
Associate Administrator

44
00:02:25,010 --> 00:02:26,779
for the Science
Mission Directorate.

45
00:02:26,779 --> 00:02:28,014
Welcome.

46
00:02:28,014 --> 00:02:32,819
- Thank you so much.
[crowd applauding]

47
00:02:33,419 --> 00:02:34,353
Hi, everybody.

48
00:02:34,353 --> 00:02:36,255
Well, I'm so excited to be here,

49
00:02:36,255 --> 00:02:38,657
and of course, to
recognize that InSight

50
00:02:38,657 --> 00:02:41,694
is part of the NASA
science program.

51
00:02:41,694 --> 00:02:45,397
Over 100 missions
exploring our planet,

52
00:02:45,397 --> 00:02:47,167
our star, the sun,

53
00:02:48,368 --> 00:02:50,336
planets elsewhere

in the solar system,

54
00:02:50,336 --> 00:02:53,272
but also worlds well
beyond our solar system,

55
00:02:53,272 --> 00:02:55,874
asking questions
that are really hard,

56
00:02:55,874 --> 00:02:58,711
such as, where did we come from?

57
00:02:58,711 --> 00:03:00,346
Is there life elsewhere?

58
00:03:02,315 --> 00:03:04,717
With this program,
with the many missions,

59
00:03:04,717 --> 00:03:06,752
we explore the secrets
of the universe

60
00:03:06,752 --> 00:03:11,758
and we enlarge the space
we live and think in.

61
00:03:12,491 --> 00:03:13,725
With this program,

62
00:03:13,725 --> 00:03:16,963
we also protect and
improve life on Earth,

63
00:03:16,963 --> 00:03:19,632
and we think of the many
people that were affected

64

00:03:19,632 --> 00:03:22,334
by the catastrophes
here at this coast,

65
00:03:22,334 --> 00:03:23,803
but also elsewhere on Earth,

66
00:03:23,803 --> 00:03:27,339
in which we have a direct
impact in a positive fashion,

67
00:03:27,339 --> 00:03:29,709
and we're so glad about it.

68
00:03:29,709 --> 00:03:33,312
InSight will join these
missions that you see up there

69
00:03:33,312 --> 00:03:38,318
at Mars, history, and,
please for the second visual,

70
00:03:39,718 --> 00:03:42,121
a history of exploration
of this neighboring planet.

71
00:03:42,121 --> 00:03:45,525
Going to Mars is
really, really hard.

72
00:03:46,926 --> 00:03:49,461
As humanity, the explorers
all over the world,

73
00:03:49,461 --> 00:03:52,297
we're batting about 50% or less

74
00:03:52,297 --> 00:03:53,799
of successful missions there.

75
00:03:53,799 --> 00:03:55,467
The exciting part
is here, though.

76
00:03:55,467 --> 00:03:58,104
We're building on the
success of the best team

77
00:03:58,104 --> 00:03:59,272
that has ever landed

78
00:04:01,507 --> 00:04:04,543
on this planet, which
is the NASA team

79
00:04:04,543 --> 00:04:08,547
with its contractors
and its collaborators.

80
00:04:08,547 --> 00:04:12,584
InSight will join the
missions that are out there

81
00:04:12,584 --> 00:04:16,956
that have since 1965,
at the first flyby,

82
00:04:16,956 --> 00:04:19,492
and it will join missions
that are already there,

83
00:04:19,492 --> 00:04:24,297
roaming around the surface
and flying around it.

84
00:04:24,297 --> 00:04:27,467
And of course, you read
that just a few days ago

85

00:04:27,467 --> 00:04:30,636
we actually announced
where Mars 2020 will land

86
00:04:30,636 --> 00:04:32,204
on this exciting planet,

87
00:04:32,204 --> 00:04:35,541
and frankly, we're really
looking forward to that,

88
00:04:35,541 --> 00:04:37,743
and also think beyond that

89
00:04:37,743 --> 00:04:39,945
as we go to the moon now,

90
00:04:39,945 --> 00:04:42,615
and eventually to
Mars with humans.

91
00:04:42,615 --> 00:04:45,384
We will, of course, take
advantage of all the knowledge

92
00:04:45,384 --> 00:04:49,722
we're gaining right
here with these robots

93
00:04:49,722 --> 00:04:51,590
that are there and
really teach us

94
00:04:51,590 --> 00:04:52,891
everything about
this environment

95
00:04:52,891 --> 00:04:55,194
that we can then benefit from.

96
00:04:55,194 --> 00:04:57,797
Right now, everything is
about InSight, though,

97
00:04:57,797 --> 00:05:00,199
because this exciting
mission is on the way

98
00:05:00,199 --> 00:05:02,635
to becoming an active
mission on the surface,

99
00:05:02,635 --> 00:05:05,404
and the person who has most
to do with this, frankly,

100
00:05:05,404 --> 00:05:07,573
is the project
manager, Tom Hoffman,

101
00:05:07,573 --> 00:05:10,275
I'm now happy to
introduce to the stage.

102
00:05:10,275 --> 00:05:14,213
Thank you so much.
[crowd applauding]

103
00:05:16,748 --> 00:05:18,251
- Thank you very much, Thomas.

104
00:05:19,852 --> 00:05:21,119
I cannot express to
you how excited I am

105
00:05:21,119 --> 00:05:23,555
to be standing up here
today to talk with you,

106

00:05:23,555 --> 00:05:25,324
just five days from us landing.

107
00:05:25,324 --> 00:05:29,662
My heart is beating inside
of my chest like a drum.

108
00:05:31,097 --> 00:05:33,098
I've been working on this
project for seven years

109
00:05:33,098 --> 00:05:35,834
and to be literally just
five days from landing

110
00:05:35,834 --> 00:05:37,035
and starting to get the science

111
00:05:37,035 --> 00:05:39,004
that we've been
working so hard for

112
00:05:39,004 --> 00:05:40,239
to me is absolutely thrilling.

113
00:05:40,239 --> 00:05:43,175
I'm so excited I can't
even express to you

114
00:05:43,175 --> 00:05:44,410
how excited I am.

115
00:05:44,410 --> 00:05:47,646
So we launched May
5th of this year

116
00:05:47,646 --> 00:05:49,081
from Vandenberg Air Force Base.

117

00:05:49,081 --> 00:05:51,217
We're the very first
interplanetary launch ever

118
00:05:51,217 --> 00:05:53,286
from the West Coast, and
being a West Coast guy,

119
00:05:53,286 --> 00:05:56,188
California native, very
excited to break the monopoly

120
00:05:56,188 --> 00:06:00,159
that Florida has had on
launches to other planets.

121
00:06:01,259 --> 00:06:03,128
We've been journeying to Mars.

122
00:06:03,128 --> 00:06:05,631
We've gotten about 295

123
00:06:05,631 --> 00:06:08,801
of the 301 million miles
that we have to go.

124
00:06:08,801 --> 00:06:11,504
We've gone almost the seven
months that we need to go,

125
00:06:11,504 --> 00:06:13,005
just five days left.

126
00:06:13,005 --> 00:06:14,974
But we can't do that alone.

127
00:06:14,974 --> 00:06:17,309
We have been working
with, really,

128
00:06:17,309 --> 00:06:20,579
as Thomas said, the very best
partners across the globe

129
00:06:20,579 --> 00:06:21,847
for this mission.

130
00:06:21,847 --> 00:06:23,149
So if I can get the
first graphic here,

131
00:06:23,149 --> 00:06:25,518
you can see we have
domestic partners

132
00:06:25,518 --> 00:06:26,885
that largely built
the spacecraft.

133
00:06:26,885 --> 00:06:28,920
You'll hear from
Stu Spath coming up.

134
00:06:28,920 --> 00:06:31,990
Lockheed Martin is the
main spacecraft vendor.

135
00:06:31,990 --> 00:06:34,426
We have components from many
other domestic partners.

136
00:06:34,426 --> 00:06:36,495
But the instruments
were all built

137
00:06:36,495 --> 00:06:39,164
largely by European partners.

138
00:06:39,164 --> 00:06:41,300

We have representatives of those

139
00:06:41,300 --> 00:06:43,803
that will be talking
in the next talk.

140
00:06:43,803 --> 00:06:46,305
In addition to that, the science
team is made up of people

141
00:06:46,305 --> 00:06:47,639
across the globe.

142
00:06:47,639 --> 00:06:48,907
You've heard the expression,

143
00:06:48,907 --> 00:06:50,142
it takes a village
to raise a child.

144
00:06:50,142 --> 00:06:52,144
It really takes the whole globe

145
00:06:52,144 --> 00:06:55,748
to build a breakthrough
instrument like we have today

146
00:06:55,748 --> 00:06:57,683
with this InSight mission.

147
00:06:59,051 --> 00:07:01,687
With that, I'd like to
go to the next graphic.

148
00:07:04,123 --> 00:07:07,460
So we've been cruising to
Mars for about seven months.

149
00:07:08,561 --> 00:07:09,962

What we've been doing
on the way there

150
00:07:09,962 --> 00:07:11,863
is we've been doing trajectory
correction maneuvers.

151
00:07:11,863 --> 00:07:13,665
Those are designed
to get us targeted

152
00:07:13,665 --> 00:07:15,668
to exactly the right
spot in the atmosphere

153
00:07:15,668 --> 00:07:17,836
that we need to
be in order for us

154
00:07:17,836 --> 00:07:19,972
to land where we
wanna land on Mars.

155
00:07:19,972 --> 00:07:23,075
So we've done four
of those so far.

156
00:07:23,075 --> 00:07:26,211
We have one more
potentially to go.

157
00:07:26,211 --> 00:07:27,579
You'll see that we have TCM-6,

158
00:07:27,579 --> 00:07:29,348
so you say, he can't count.

159
00:07:30,482 --> 00:07:31,783
We had an opportunity
to skip one of 'em

160
00:07:31,783 --> 00:07:33,719
because our navigators
did such a good job,

161
00:07:33,719 --> 00:07:35,654
we didn't do TCM-4.

162
00:07:35,654 --> 00:07:37,489
We're working
right now on TCM-6.

163
00:07:37,489 --> 00:07:38,824
We're actually
looking really good.

164
00:07:38,824 --> 00:07:40,426
We might even be able
to skip that one,

165
00:07:40,426 --> 00:07:43,261
'cause, again, the navigators
have done such a great job

166
00:07:43,261 --> 00:07:45,831
really targeting us
for where we wanna be.

167
00:07:45,831 --> 00:07:47,233
So we're gonna keep
working on that

168
00:07:47,233 --> 00:07:49,101
for the next several days,

169
00:07:49,101 --> 00:07:51,203
working on the trajectory
correction maneuver,

170

00:07:51,203 --> 00:07:53,873
working on the final parameters
that we're gonna need to do

171
00:07:53,873 --> 00:07:57,476
once we get to do entry,
descent, and landing on Mars.

172
00:07:57,476 --> 00:07:59,879
So we'll be updating those
over the next few days.

173
00:07:59,879 --> 00:08:02,180
So while everybody's off
having turkey tomorrow,

174
00:08:02,180 --> 00:08:03,883
there'll be a bunch
of people here at JPL

175
00:08:03,883 --> 00:08:06,885
working all day long,
hopefully taking

176
00:08:06,885 --> 00:08:08,487
a little bit of a break
for a turkey dinner,

177
00:08:08,487 --> 00:08:10,122
but largely working to make sure

178
00:08:10,122 --> 00:08:11,791
we land successfully on Mars.

179
00:08:12,958 --> 00:08:15,427
So when we get there,
we have lots of ways

180
00:08:15,427 --> 00:08:16,862
we're gonna be communicating

181
00:08:16,862 --> 00:08:18,330
during the entry, descent,
and landing process.

182
00:08:18,330 --> 00:08:21,100
So far we've been talking
largely with a DSN

183
00:08:21,100 --> 00:08:22,601
with the spacecraft.

184
00:08:22,601 --> 00:08:23,768
We'll continue that all the way

185
00:08:23,768 --> 00:08:26,471
until we get right up to entry.

186
00:08:26,471 --> 00:08:28,507
At that point we'll drop
off our cruise stage,

187
00:08:28,507 --> 00:08:31,410
and we'll be using
our UHF antennas

188
00:08:31,410 --> 00:08:34,480
to talk to MRO, Mars
Reconnaissance Orbiter.

189
00:08:34,480 --> 00:08:36,482
That's our main method
of communication

190
00:08:36,482 --> 00:08:39,084
for knowing that EDL
went successfully.

191
00:08:39,084 --> 00:08:43,089

But MRO does not have
real-time capability

192
00:08:43,089 --> 00:08:45,057
to send data back to
us so that we know

193
00:08:45,057 --> 00:08:47,326
exactly what's happening
right when it's happening.

194
00:08:47,326 --> 00:08:48,527
So in order to have that,

195
00:08:48,527 --> 00:08:50,229
we brought along two CubeSats,

196
00:08:50,229 --> 00:08:52,999
called MarCO, which Annie's
gonna talk in just a little bit.

197
00:08:52,999 --> 00:08:55,367
Those will be actually giving
us real-time information

198
00:08:55,367 --> 00:08:58,370
as we go through the entry,
descent, and landing process,

199
00:08:58,370 --> 00:09:00,272
getting through the
parachute deployment,

200
00:09:00,272 --> 00:09:01,740
heat shield separation.

201
00:09:01,740 --> 00:09:03,776
MarCO's gonna be telling
hopefully real-time

202
00:09:03,776 --> 00:09:05,244
that that's happening.

203
00:09:05,244 --> 00:09:07,946
Once we land successfully,

204
00:09:07,946 --> 00:09:09,414
then we'll also have Odyssey,

205
00:09:09,414 --> 00:09:11,917
which is another
orbiting asset at Mars,

206
00:09:11,917 --> 00:09:13,385
which will come by later

207
00:09:13,385 --> 00:09:15,521
and tell us that our solar rays
have successfully deployed.

208
00:09:15,521 --> 00:09:18,457
So really, we're using
all of those assets there

209
00:09:18,457 --> 00:09:20,159
to make cell phone
calls, essentially,

210
00:09:20,159 --> 00:09:21,761
to get back to Earth.

211
00:09:23,696 --> 00:09:25,164
Let's go to the next video

212
00:09:25,164 --> 00:09:26,665
and you can kinda see
what happens on our entry.

213

00:09:26,665 --> 00:09:28,567
You can see InSight
here in the middle.

214
00:09:28,567 --> 00:09:31,336
The two MarCOs that have been
following the whole time,

215
00:09:31,336 --> 00:09:32,905
the whole seven months,

216
00:09:32,905 --> 00:09:34,640
will be tracking us
as we do our entry,

217
00:09:34,640 --> 00:09:37,075
and you can see Mars
Reconnaissance Orbiter,

218
00:09:37,075 --> 00:09:39,612
or MRO, coming up and
catching us as we go

219
00:09:39,612 --> 00:09:42,114
through the entry, descent,
and landing process.

220
00:09:42,114 --> 00:09:44,783
So that is basically how we're
gonna do the communication.

221
00:09:44,783 --> 00:09:46,652
It's gonna be very exciting.

222
00:09:46,652 --> 00:09:50,388
We have lots of different ways
to be hearing from InSight

223
00:09:50,388 --> 00:09:51,990
as we go through entry,

descent, and landing,

224
00:09:51,990 --> 00:09:53,959
and then once we're
on the surface.

225
00:09:53,959 --> 00:09:56,362
So what I'd like to do next
is introduce Stu Spath,

226
00:09:56,362 --> 00:09:59,064
who's the project
manager for InSight

227
00:09:59,064 --> 00:10:01,600
over the last seven years.

228
00:10:01,600 --> 00:10:02,868
So Stu?

229
00:10:02,868 --> 00:10:07,573
- Alright, thank you.
[audience applauding]

230
00:10:08,440 --> 00:10:09,608
Thank you very much, Tom.

231
00:10:09,608 --> 00:10:11,243
Lockheed Martin is, of course,

232
00:10:11,243 --> 00:10:13,078
thrilled to be part
of this mission.

233
00:10:13,078 --> 00:10:15,914
It's been a while going
to the red planet,

234
00:10:15,914 --> 00:10:19,751

and with just five days
to go we are very excited.

235
00:10:19,751 --> 00:10:22,787
As Tom said, I've been on
since the get-go with Tom,

236
00:10:22,787 --> 00:10:24,723
seven years ago, so I do have

237
00:10:24,723 --> 00:10:27,325
a lot of blood, sweat, and
tears invested in this,

238
00:10:27,325 --> 00:10:31,097
and I'm looking forward to a
nice safe touchdown on Monday.

239
00:10:32,331 --> 00:10:34,300
If we could roll the
first video, please,

240
00:10:34,300 --> 00:10:37,769
our role at Lockheed
Martin is to design, build,

241
00:10:37,769 --> 00:10:40,539
test, and operate the vehicle.

242
00:10:40,539 --> 00:10:43,709
Here you see us lowering down
into the thermal vac chamber,

243
00:10:43,709 --> 00:10:46,278
and here's a video
of us installing

244
00:10:46,278 --> 00:10:49,415
the heat shield
protective thermal system

245
00:10:49,415 --> 00:10:52,417
that keeps us safe during
the atmospheric entry.

246
00:10:52,417 --> 00:10:55,454
That was right before we
shipped to the launch site.

247
00:10:56,322 --> 00:10:57,556
The image you see here now

248
00:10:57,556 --> 00:11:01,126
is the fully dressed-out
version of the lander

249
00:11:01,126 --> 00:11:02,828
in the Denver high bay.

250
00:11:04,430 --> 00:11:06,231
Let me give you a few fun
facts about the lander.

251
00:11:06,231 --> 00:11:08,533
It stands about three
and a half feet high,

252
00:11:08,533 --> 00:11:10,035
or a little bit over belt high

253
00:11:10,035 --> 00:11:13,405
to the technicians that you
see working on it right here.

254
00:11:13,405 --> 00:11:14,874
The length tip to tip

255
00:11:14,874 --> 00:11:16,675
from solar array end

to solar array end

256
00:11:16,675 --> 00:11:18,443
is about 20 feet or so,

257
00:11:18,443 --> 00:11:22,047
which is about a '75
Lincoln Continental.

258
00:11:22,047 --> 00:11:25,050
And I should know, my dad
drove one for 10 years.

259
00:11:25,050 --> 00:11:29,387
And the mass is
about 830 pounds,

260
00:11:29,387 --> 00:11:32,191
so maybe think about a
Harley-Davidson, if you will,

261
00:11:32,191 --> 00:11:33,792
that's fully fueled.

262
00:11:33,792 --> 00:11:36,095
We will spend about
100 pounds of fuel

263
00:11:36,095 --> 00:11:39,398
getting to the surface during
our descent and landing.

264
00:11:40,633 --> 00:11:41,934
One of the critical things

265
00:11:41,934 --> 00:11:43,735
after we touch down,
of course, is power.

266

00:11:43,735 --> 00:11:46,572
So the solar arrays, as
you see in this image,

267
00:11:46,572 --> 00:11:48,240
are a critical portion.

268
00:11:48,240 --> 00:11:50,409
So if you'd roll the next video
I'll talk a little bit more

269
00:11:50,409 --> 00:11:52,044
about power and
the solar arrays.

270
00:11:53,212 --> 00:11:55,747
This video is a
time-lapse version

271
00:11:55,747 --> 00:11:58,384
of the actual deployment
in our Denver labs.

272
00:11:59,718 --> 00:12:02,354
You can see them unfurling
in this shot here.

273
00:12:02,354 --> 00:12:04,789
This is obviously much
faster than will happen.

274
00:12:04,789 --> 00:12:06,291
What we'll do when we touch down

275
00:12:06,291 --> 00:12:10,261
is wait 'til about
landing, plus 16 minutes,

276
00:12:10,261 --> 00:12:11,797
with no solar array deployment.

277
00:12:11,797 --> 00:12:15,167
The reason we do that is we
kick up quite a bit of dust

278
00:12:15,167 --> 00:12:16,435
during the landing process,

279
00:12:16,435 --> 00:12:18,937
so we wanna give that
a chance to settle out

280
00:12:18,937 --> 00:12:22,874
for 16 minutes, and then
we'll command the deployment

281
00:12:22,874 --> 00:12:25,377
for about 16 minutes
further from there.

282
00:12:25,377 --> 00:12:28,480
You see a nice closeup of
the solar arrays there.

283
00:12:28,480 --> 00:12:31,216
It's interesting to know
that the solar arrays

284
00:12:31,216 --> 00:12:34,553
have 3,200 individual
solar cells on them,

285
00:12:34,553 --> 00:12:38,290
so it is quite an effort
to get those all installed,

286
00:12:38,290 --> 00:12:41,693
and then they furl up like
a Chinese fan, if you will,

287
00:12:41,693 --> 00:12:43,195
tucked up under the lander.

288
00:12:44,596 --> 00:12:48,901
The power of the solar
arrays is about 1,800 watts

289
00:12:48,901 --> 00:12:52,571
on Earth on a nice,
clear, sunny day.

290
00:12:52,571 --> 00:12:54,806
But unfortunately,
Mars is not Earth,

291
00:12:54,806 --> 00:12:58,677
so at Mars range we're
actually only about 600 watts,

292
00:12:58,677 --> 00:13:01,847
which instead of a hair
dryer, 1,800 watts,

293
00:13:01,847 --> 00:13:06,117
it's more like a blender,
600 watts, at Mars.

294
00:13:06,117 --> 00:13:09,188
And on top of that, Mars
typically has a fair amount

295
00:13:09,188 --> 00:13:10,422
of dust in the atmosphere,

296
00:13:10,422 --> 00:13:11,723
so when you take
that into account,

297
00:13:11,723 --> 00:13:13,258

we're more like about 300 watts,

298
00:13:13,258 --> 00:13:15,427
or a little cake mixer.

299
00:13:15,427 --> 00:13:18,697
So a mission like this,
on a cake mixer power,

300
00:13:18,697 --> 00:13:20,532
is a big challenge.

301
00:13:20,532 --> 00:13:23,635
And we achieve that
by sleeping a lot.

302
00:13:23,635 --> 00:13:25,971
About 90%, greater
than 90% of the time,

303
00:13:25,971 --> 00:13:27,572
the spacecraft is
actually asleep

304
00:13:27,572 --> 00:13:29,541
and the science
instruments will be on,

305
00:13:29,541 --> 00:13:30,842
doing their business,

306
00:13:30,842 --> 00:13:33,611
and will wake up for
communication passes

307
00:13:33,611 --> 00:13:35,314
and health and status checks.

308
00:13:36,148 --> 00:13:37,650

Go to the next video.

309
00:13:39,084 --> 00:13:41,753
Obviously landing is what
we're all about here today,

310
00:13:41,753 --> 00:13:44,890
and so let me point
out a couple of views

311
00:13:44,890 --> 00:13:47,492
of some of the key
landing components.

312
00:13:47,492 --> 00:13:50,129
Tucked up underneath the lander
here is the main component,

313
00:13:50,129 --> 00:13:51,830
that's the landing radar.

314
00:13:51,830 --> 00:13:54,799
It provides us the
altitude above the surface,

315
00:13:54,799 --> 00:13:56,268
and any good pilot will tell you

316
00:13:56,268 --> 00:13:58,136
it's tough to land without
knowing your altitude,

317
00:13:58,136 --> 00:14:01,473
so that's a pivotal
part of the equation.

318
00:14:01,473 --> 00:14:04,510
These instruments right
here are descent thrusters.

319
00:14:04,510 --> 00:14:06,344
We have 12 of those.

320
00:14:06,344 --> 00:14:09,481
Each of them is about
68 pounds of thrust,

321
00:14:09,481 --> 00:14:12,751
and they pulse about
10 times per second

322
00:14:12,751 --> 00:14:16,154
to softly slow the
descent and get us down

323
00:14:16,154 --> 00:14:18,257
to about five miles
per hour at touchdown.

324
00:14:19,124 --> 00:14:20,592
That's a pivotal part.

325
00:14:20,592 --> 00:14:22,761
And finally, the legs here.

326
00:14:22,761 --> 00:14:25,731
You see it's a tripod
system, three landing legs.

327
00:14:26,898 --> 00:14:28,933
Think of those as shock
absorbers on your car.

328
00:14:28,933 --> 00:14:33,138
As this touches down, those
absorb the touchdown velocity

329
00:14:33,138 --> 00:14:35,840
and they can actually

compress up to 10 inches,

330
00:14:35,840 --> 00:14:39,745
which will account for
slopes and terrain, etc.

331
00:14:40,879 --> 00:14:43,282
Tom briefly talked about
the communications.

332
00:14:43,282 --> 00:14:47,552
This is the direct-to-Earth
medium-gain antenna,

333
00:14:47,552 --> 00:14:49,954
and over here is the UHF antenna

334
00:14:49,954 --> 00:14:53,124
that does send the data up to
Mars Reconnaissance Orbiter

335
00:14:53,124 --> 00:14:54,993
and Mars Odyssey.

336
00:14:54,993 --> 00:14:56,528
We work closely
with those teams.

337
00:14:56,528 --> 00:14:59,598
The spacecraft team
operating back in Denver

338
00:14:59,598 --> 00:15:01,333
and the teams here at JPL

339
00:15:01,333 --> 00:15:04,669
are closely in coordination
with the InSight team

340

00:15:04,669 --> 00:15:06,838
to make sure we get
all that data back.

341
00:15:06,838 --> 00:15:09,607
So that's kind of a snapshot
of what the lander's all about,

342
00:15:09,607 --> 00:15:12,710
and to hear more about the
actual timeline of events

343
00:15:12,710 --> 00:15:15,547
on landing day, let's
go to our EDL lead,

344
00:15:15,547 --> 00:15:16,949
Rob Grover from JPL.

345
00:15:22,521 --> 00:15:26,592
- Well, I have the
great privilege of
leading the EDL team,

346
00:15:26,592 --> 00:15:29,194
which is comprised of
some very talented people,

347
00:15:29,194 --> 00:15:31,964
not only from JPL, but
also from Lockheed Martin,

348
00:15:31,964 --> 00:15:33,432
Stu's organization,

349
00:15:33,432 --> 00:15:35,834
and also the NASA
Langley Research Center

350
00:15:35,834 --> 00:15:37,102

and NASA Ames.

351
00:15:37,102 --> 00:15:39,404
And the team has been
working for many years

352
00:15:39,404 --> 00:15:42,574
to make sure that the landing
goes successfully on Monday.

353
00:15:42,574 --> 00:15:45,510
And of course EDL means
entry, descent, and landing,

354
00:15:45,510 --> 00:15:47,846
and that means that
the team is responsible

355
00:15:47,846 --> 00:15:50,582
for taking the spacecraft
from the top of the atmosphere

356
00:15:50,582 --> 00:15:52,384
all the way down to the surface.

357
00:15:52,384 --> 00:15:56,021
We're gonna enter the atmosphere
at 12,000 miles per hour

358
00:15:56,021 --> 00:15:58,390
after our journey
from Earth to Mars,

359
00:15:58,390 --> 00:16:01,626
so that is a very high speed

360
00:16:01,626 --> 00:16:03,995
and the whole purpose
of the EDL system

361
00:16:03,995 --> 00:16:07,332
is to take that very high speed
down to five miles per hour

362
00:16:07,332 --> 00:16:09,000
when we get down to the surface.

363
00:16:09,000 --> 00:16:11,402
That all happens in
six and a half minutes,

364
00:16:11,402 --> 00:16:14,907
and that's gonna be the
main event on Monday.

365
00:16:14,907 --> 00:16:16,708
And I wanna spend a
little bit of time

366
00:16:16,708 --> 00:16:18,911
walking you through
what to expect,

367
00:16:18,911 --> 00:16:21,213
what's gonna happen during
those six and a half minutes

368
00:16:21,213 --> 00:16:23,682
from the top of the atmosphere
down to the surface.

369
00:16:23,682 --> 00:16:26,485
I'd like to roll the
animation, please.

370
00:16:27,719 --> 00:16:29,254
We will approach Mars,

371
00:16:29,254 --> 00:16:30,723

and the first thing we do is
get rid of our cruise stage,

372
00:16:30,723 --> 00:16:33,358
which will be about seven
minutes before entry.

373
00:16:33,358 --> 00:16:34,793
We enter the atmosphere,

374
00:16:34,793 --> 00:16:37,963
and of course at
12,000 miles per hour

375
00:16:37,963 --> 00:16:39,063
we're gonna generate
a lot of heat,

376
00:16:39,063 --> 00:16:41,967
up to 2,700 degrees Fahrenheit.

377
00:16:41,967 --> 00:16:44,869
When we get down to seven
and a half miles or so

378
00:16:44,869 --> 00:16:46,538
we'll deploy a
supersonic parachute,

379
00:16:46,538 --> 00:16:49,207
which is about 39
feet in diameter.

380
00:16:49,207 --> 00:16:50,743
That'll provide a lot

381
00:16:51,844 --> 00:16:53,645
of the remaining
braking for the system

382
00:16:53,645 --> 00:16:55,280
before we get to the surface.

383
00:16:55,280 --> 00:16:57,215
We drop the heat
shield off 15 seconds

384
00:16:57,215 --> 00:16:58,449
after we deploy the parachutes,

385
00:16:58,449 --> 00:17:01,419
and then the legs spring
open 10 seconds later.

386
00:17:01,419 --> 00:17:03,388
Our radar starts
looking for the ground,

387
00:17:03,388 --> 00:17:04,889
and when we're
about a little less

388
00:17:04,889 --> 00:17:05,857
than a mile above the ground,

389
00:17:05,857 --> 00:17:07,892
we separate from the parachute,

390
00:17:07,892 --> 00:17:09,360
fire up 12 descent engines,

391
00:17:09,360 --> 00:17:11,195
and those provide the
rest of the braking

392
00:17:11,195 --> 00:17:13,231
and take us down to the surface.

393

00:17:13,231 --> 00:17:14,899
We have a constant
velocity phase,

394
00:17:14,899 --> 00:17:17,402
which sets us up for touchdown,

395
00:17:17,402 --> 00:17:20,305
and you can see we will
then make a soft landing

396
00:17:20,305 --> 00:17:22,508
at five miles per hour.

397
00:17:22,508 --> 00:17:26,211
So there's a little bit of
time where the dust'll be...

398
00:17:27,645 --> 00:17:29,747
Have been generated, and so
we'll wait for that to settle.

399
00:17:29,747 --> 00:17:31,616
And we'll actually
take a first image

400
00:17:31,616 --> 00:17:32,651
shortly after we land,

401
00:17:32,651 --> 00:17:33,918
and it may look like this,

402
00:17:33,918 --> 00:17:36,154
if you go to the next image.

403
00:17:36,154 --> 00:17:39,724
This is what it will
very likely look like,

404

00:17:39,724 --> 00:17:40,959
a very flat place.

405
00:17:40,959 --> 00:17:43,228
Our landing site is
Elysium Planitia,

406
00:17:43,228 --> 00:17:47,131
which Elysium means in
Greek an afterlife paradise,

407
00:17:47,131 --> 00:17:48,467
although that may not
look like paradise.

408
00:17:48,467 --> 00:17:50,068
But it is very flat,

409
00:17:50,068 --> 00:17:52,404
which Planitia means flat.

410
00:17:52,404 --> 00:17:54,973
And so it's an excellent
place for a landing.

411
00:17:54,973 --> 00:17:57,809
As landing engineers, we
really like this landing site.

412
00:17:57,809 --> 00:18:00,278
It's flat, it doesn't
have many rocks,

413
00:18:00,278 --> 00:18:01,814
it's a very safe place to land.

414
00:18:02,948 --> 00:18:05,484
Once we've landed, once
we've touched down,

415
00:18:05,484 --> 00:18:07,518
we're not quite done yet.

416
00:18:07,518 --> 00:18:09,020
In order to be
completely successful,

417
00:18:09,020 --> 00:18:10,889
we have to deploy a
set of solar arrays,

418
00:18:10,889 --> 00:18:12,657
and if you go to
the next animation,

419
00:18:12,657 --> 00:18:13,991
you'll see a deployment.

420
00:18:13,991 --> 00:18:16,561
The solar arrays will deploy,

421
00:18:16,561 --> 00:18:17,495
they'll be commanded to deploy

422
00:18:17,495 --> 00:18:19,030
about 16 minutes after we land,

423
00:18:19,030 --> 00:18:22,600
and the deployment should
take 16 minutes itself.

424
00:18:22,600 --> 00:18:24,836
We should have the arrays
out about 32 minutes

425
00:18:24,836 --> 00:18:27,538
after landing, and we'll get
actually a confirmation of that

426
00:18:27,538 --> 00:18:28,974
about four hours after landing,

427
00:18:28,974 --> 00:18:31,110
that we know that
they're successfully out.

428
00:18:32,377 --> 00:18:34,512
We have a bunch of
activities going on this week

429
00:18:34,512 --> 00:18:36,314
as we approach Mars,
as you can imagine,

430
00:18:36,314 --> 00:18:39,250
and one of the important
ones is we have a team

431
00:18:39,250 --> 00:18:40,652
of weather forecasters,

432
00:18:40,652 --> 00:18:44,022
basically a team of atmospheric
scientists here at JPL,

433
00:18:44,022 --> 00:18:46,624
who are giving us
daily weather forecasts

434
00:18:46,624 --> 00:18:50,762
or the expected weather
at Elysium Planitia,

435
00:18:50,762 --> 00:18:52,230
on landing day.

436
00:18:52,230 --> 00:18:54,132
In fact, I just came from

the morning weather briefing.

437
00:18:54,132 --> 00:18:55,367
We have it every morning.

438
00:18:58,636 --> 00:19:00,672
They use the MRO spacecraft

439
00:19:00,672 --> 00:19:02,774
to take actually
temperature measurements

440
00:19:04,743 --> 00:19:05,911
of the globe, basically,

441
00:19:05,911 --> 00:19:08,413
and generate a
weather map of Mars,

442
00:19:08,413 --> 00:19:11,116
and I wanna show you that
in the next animation.

443
00:19:11,116 --> 00:19:12,950
This is a temperature map,

444
00:19:12,950 --> 00:19:15,253
and the orange and yellow areas

445
00:19:15,253 --> 00:19:18,123
in the temperature map of
Mars show dust activity,

446
00:19:18,123 --> 00:19:19,557
so we use it to observe

447
00:19:19,557 --> 00:19:21,259
whether there's dust
storms going on.

448
00:19:21,259 --> 00:19:24,562
And in this animation, this
starts back in early November

449
00:19:24,562 --> 00:19:26,698
and shows up until
a few days ago.

450
00:19:26,698 --> 00:19:28,700
You can see there was
a regional dust storm

451
00:19:28,700 --> 00:19:31,069
down around the south pole,
down at the bottom of the map,

452
00:19:31,069 --> 00:19:33,004
and that slowly dissipated.

453
00:19:33,004 --> 00:19:35,540
But over on the right you can
see the InSight landing site,

454
00:19:35,540 --> 00:19:37,442
and it has remained very stable

455
00:19:37,442 --> 00:19:40,278
and the green means
background conditions.

456
00:19:40,278 --> 00:19:42,880
And so for the last month or so,

457
00:19:42,880 --> 00:19:44,515
things have looked really good.

458
00:19:44,515 --> 00:19:48,419
If you go to the next graphic,

459
00:19:48,419 --> 00:19:52,191
which is, looks like we
may have skipped one there.

460
00:19:53,524 --> 00:19:55,193
There we go, okay.

461
00:19:55,193 --> 00:19:56,394
If you go to the next graphic,

462
00:19:56,394 --> 00:19:57,829
this is our most
recent weather map,

463
00:19:57,829 --> 00:20:00,198
so this gives a
good indication of,

464
00:20:00,198 --> 00:20:03,635
in five days we're hoping
it'll look much the same,

465
00:20:03,635 --> 00:20:06,238
but across the whole globe

466
00:20:06,238 --> 00:20:07,739
there's not much
dust activity at all,

467
00:20:07,739 --> 00:20:10,809
so we're expecting to have
a very plain day on Mars

468
00:20:10,809 --> 00:20:12,710
for the landing, and we're
very happy about that.

469
00:20:12,710 --> 00:20:13,979

And in fact,

470
00:20:15,746 --> 00:20:17,215
surface temperature when we land

471
00:20:17,215 --> 00:20:20,117
will be about four
degrees Fahrenheit,

472
00:20:20,117 --> 00:20:22,454
so it's gonna be nice and cold.

473
00:20:24,122 --> 00:20:26,191
Probably don't need an umbrella,
but you may need a coat,

474
00:20:26,191 --> 00:20:27,925
and definitely recommend
a spacesuit, too,

475
00:20:27,925 --> 00:20:29,294
if you're there at
the landing site.

476
00:20:29,294 --> 00:20:32,430
[audience members chuckling]

477
00:20:32,430 --> 00:20:35,434
In addition to observing
the weather this week,

478
00:20:35,434 --> 00:20:37,202
we're also paying
very close attention

479
00:20:37,202 --> 00:20:39,204
to where we're gonna land.

480
00:20:39,204 --> 00:20:41,206

And so, if you go
to the next graphic,

481
00:20:43,541 --> 00:20:46,577
we had just finished our last
course correction maneuver

482
00:20:46,577 --> 00:20:49,247
last Sunday, which was TCM-5,

483
00:20:49,247 --> 00:20:52,083
which is the first time
that we've actually been

484
00:20:52,083 --> 00:20:54,419
very close to our landing site.

485
00:20:54,419 --> 00:20:56,922
And actually, if you
go to the next slide...

486
00:21:00,725 --> 00:21:01,560
Well, okay.

487
00:21:04,563 --> 00:21:07,165
Up until TCM-5 on Sunday,

488
00:21:07,165 --> 00:21:09,801
we were about 100 miles
away from our landing site,

489
00:21:09,801 --> 00:21:10,735
our landing ellipse,

490
00:21:10,735 --> 00:21:12,670
and since we've executed TCM-5,

491
00:21:12,670 --> 00:21:14,605
our ellipse has

moved now very close

492
00:21:14,605 --> 00:21:16,741
to our desired landing target.

493
00:21:16,741 --> 00:21:19,011
Right now, in our latest...

494
00:21:21,246 --> 00:21:22,814
At least our navigators
are telling us

495
00:21:22,814 --> 00:21:24,315
that we're about
four miles away.

496
00:21:24,315 --> 00:21:26,151
So we're very close right now,

497
00:21:26,151 --> 00:21:27,385
and as Tom mentioned,

498
00:21:27,385 --> 00:21:29,521
we're gonna continue to
watch that this week.

499
00:21:29,521 --> 00:21:31,055
We're gonna get
more tracking data

500
00:21:31,055 --> 00:21:33,458
and the ellipse is probably
gonna move around a little bit.

501
00:21:33,458 --> 00:21:35,827
It'll get a little smaller
as we get more information

502
00:21:35,827 --> 00:21:37,395

about our trajectory,

503
00:21:37,395 --> 00:21:39,764
and we may not need our last
course correction maneuver,

504
00:21:39,764 --> 00:21:42,967
which is scheduled for Sunday,

505
00:21:42,967 --> 00:21:44,101
and we'll make that decision

506
00:21:44,101 --> 00:21:46,371
at the end of the day on Friday.

507
00:21:46,371 --> 00:21:48,206
We're very excited that
our landing ellipse

508
00:21:48,206 --> 00:21:50,341
is now very close to
the right location,

509
00:21:50,341 --> 00:21:51,943
so it's a great week.

510
00:21:51,943 --> 00:21:53,645
Things look very
good for the landing.

511
00:21:53,645 --> 00:21:54,879
The weather's cooperating

512
00:21:54,879 --> 00:21:57,548
and we're very close
to our landing target.

513
00:21:57,548 --> 00:22:00,352
We're looking forward

very much to Monday

514
00:22:00,352 --> 00:22:01,887
after many years of work.

515
00:22:03,288 --> 00:22:06,724
I'd like to now introduce
you to Anne Marinan,

516
00:22:06,724 --> 00:22:09,193
who is the MarCO-B
mission manager,

517
00:22:09,193 --> 00:22:11,263
and she's gonna tell
you more about MarCO.

518
00:22:17,001 --> 00:22:17,835
- Hi.

519
00:22:17,835 --> 00:22:19,070
MarCO is a mission

520
00:22:19,070 --> 00:22:21,639
that launched with the
InSight spacecraft.

521
00:22:21,639 --> 00:22:23,541
Same rocket, different mission.

522
00:22:23,541 --> 00:22:27,545
And MarCO, it's a mission
of two small satellites

523
00:22:27,545 --> 00:22:30,014
that will fly by Mars
on November 26th,

524
00:22:30,014 --> 00:22:31,449

the same day when InSight goes

525
00:22:31,449 --> 00:22:32,884
through its entry,
descent, and landing.

526
00:22:32,884 --> 00:22:34,353
And that was no accident.

527
00:22:36,420 --> 00:22:38,323
MarCO's a technology
demonstration mission,

528
00:22:38,323 --> 00:22:42,094
so the purpose of MarCO is
to fly two small satellites

529
00:22:42,094 --> 00:22:44,428
for the first time
in deep space.

530
00:22:44,428 --> 00:22:45,963
It's the first time
that satellites

531
00:22:45,963 --> 00:22:47,465
about the size of a briefcase

532
00:22:47,465 --> 00:22:49,935
have flown by themselves...

533
00:22:49,935 --> 00:22:52,536
Well, people on the Earth
are actually operating them,

534
00:22:52,536 --> 00:22:55,607
but they're flying by
themselves in deep space

535

00:22:55,607 --> 00:22:56,641
for the first time.

536
00:22:56,641 --> 00:22:58,210
They've been on orbit,

537
00:22:58,210 --> 00:23:02,881
in heliocentric orbit,
for about 200 days today,

538
00:23:02,881 --> 00:23:05,283
and right now both
spacecraft are working,

539
00:23:05,283 --> 00:23:07,185
the team is thrilled.

540
00:23:07,185 --> 00:23:08,586
There are a lot of
firsts with MarCO.

541
00:23:08,586 --> 00:23:10,722
So MarCO has to make
its own way to Mars.

542
00:23:10,722 --> 00:23:12,290
It has to do essentially
the same thing

543
00:23:12,290 --> 00:23:15,727
that the InSight spacecraft
does on its cruise.

544
00:23:15,727 --> 00:23:17,996
We had to go through trajectory
correction maneuvers.

545
00:23:17,996 --> 00:23:20,097
It has to generate
its own power.

546
00:23:20,097 --> 00:23:22,333
We have to talk to the
Deep Space Network,

547
00:23:22,333 --> 00:23:24,035
and talking to the
Deep Space Network

548
00:23:24,035 --> 00:23:27,005
and doing all of these
trajectory correction maneuvers

549
00:23:27,005 --> 00:23:29,073
in deep space,
it's the first time

550
00:23:29,073 --> 00:23:32,710
that this has been demonstrated
on a CubeSat platform.

551
00:23:32,710 --> 00:23:34,245
So the team is very excited,

552
00:23:34,245 --> 00:23:36,481
and if you play the animation...

553
00:23:39,384 --> 00:23:41,419
One of the things we
hope to demonstrate now

554
00:23:41,419 --> 00:23:43,455
that the MarCO satellites
are still working

555
00:23:43,455 --> 00:23:46,257
is a communications
relay architecture

556

00:23:46,257 --> 00:23:47,925
with the InSight lander.

557
00:23:47,925 --> 00:23:49,960
So as InSight goes through its
entry, descent, and landing,

558
00:23:49,960 --> 00:23:53,398
it will be sending up
UHF data, in green,

559
00:23:53,398 --> 00:23:56,300
and the MarCO satellites will
be listening to that data

560
00:23:56,300 --> 00:23:58,002
and relaying it back to Earth

561
00:23:58,002 --> 00:24:00,372
almost real-time, as
was mentioned earlier.

562
00:24:00,372 --> 00:24:02,540
The InSight spacecraft
is not dependent

563
00:24:02,540 --> 00:24:04,409
on MarCO for its
mission success.

564
00:24:04,409 --> 00:24:06,711
The Mars Reconnaissance
Orbiter will be flying by,

565
00:24:06,711 --> 00:24:08,413
collecting that same data,

566
00:24:08,413 --> 00:24:10,982
but not relaying it until
about three hours later.

567
00:24:10,982 --> 00:24:13,585
If it works, the
two MarCO spacecraft

568
00:24:13,585 --> 00:24:17,255
will relay the data for InSight
entry, descent, and landing

569
00:24:17,255 --> 00:24:19,090
almost as it's happening,

570
00:24:19,090 --> 00:24:21,025
which would be very cool
for both the MarCO team

571
00:24:21,025 --> 00:24:22,727
and the InSight
team to figure out

572
00:24:22,727 --> 00:24:25,330
what's going on with the
lander as soon as possible.

573
00:24:26,531 --> 00:24:28,399
MarCO is a technology
demonstration mission,

574
00:24:28,399 --> 00:24:30,901
so instead of having a
science instrument on board,

575
00:24:30,901 --> 00:24:33,505
it has a whole bunch of
different technologies

576
00:24:33,505 --> 00:24:34,939
that we're demonstrating,

577

00:24:34,939 --> 00:24:36,707
and I'll talk about
those a little bit later.

578
00:24:36,707 --> 00:24:40,078
But if you put up the
next image, please,

579
00:24:40,078 --> 00:24:42,012
we have an engineering
camera on board,

580
00:24:42,012 --> 00:24:43,514
and the camera was put on board

581
00:24:43,514 --> 00:24:46,684
to verify the deployment of
one of these new technologies,

582
00:24:46,684 --> 00:24:48,152
a reflectarray antenna.

583
00:24:48,152 --> 00:24:50,121
And so in this image
on the right-hand side,

584
00:24:50,121 --> 00:24:53,224
you can see the actual antenna,

585
00:24:53,224 --> 00:24:55,159
the top third of that antenna,

586
00:24:55,159 --> 00:24:56,694
partially illuminated
by the sun.

587
00:24:56,694 --> 00:24:59,864
On the left-hand side you
can see the antenna feed,

588
00:24:59,864 --> 00:25:01,166
also illuminated by the sun.

589
00:25:01,166 --> 00:25:02,867
And the cool thing
about this picture,

590
00:25:02,867 --> 00:25:05,036
if you go to the next slide,

591
00:25:05,036 --> 00:25:06,537
there's Mars.

592
00:25:06,537 --> 00:25:09,540
It's the first image of Mars
that was taken from a CubeSat.

593
00:25:09,540 --> 00:25:12,944
It was about eight million
miles away from Mars

594
00:25:12,944 --> 00:25:14,346
when this picture was taken.

595
00:25:15,280 --> 00:25:16,781
We're having fun
with the camera.

596
00:25:16,781 --> 00:25:19,951
We'll see what we can do
leading up to InSight EDL,

597
00:25:21,119 --> 00:25:22,754
but right now the
team is focused

598
00:25:22,754 --> 00:25:26,858
on getting to EDL and
supporting the InSight mission.

599
00:25:26,858 --> 00:25:28,093
So that's the
closest thing we get

600
00:25:28,093 --> 00:25:31,229
to kind of a selfie
of Mars on orbit.

601
00:25:31,229 --> 00:25:34,298
We have a two-scale
model of MarCO here,

602
00:25:34,298 --> 00:25:37,402
so when I say it's a
small satellite I mean it.

603
00:25:37,402 --> 00:25:39,136
This is the actual size.

604
00:25:39,136 --> 00:25:40,371
When everything is folded up,

605
00:25:40,371 --> 00:25:42,339
it's about the size
of a briefcase.

606
00:25:42,339 --> 00:25:47,111
Each MarCO satellite is
about 30 pounds each,

607
00:25:47,111 --> 00:25:49,648
and the two satellites
are virtually identical.

608
00:25:49,648 --> 00:25:52,650
And we fly two of them just
in case one of them fails.

609

00:25:52,650 --> 00:25:54,252
We can have another as backup.

610
00:25:55,620 --> 00:25:59,790
So this is the antenna
that you saw in that image.

611
00:25:59,790 --> 00:26:03,060
It works a lot like
the TV antennas

612
00:26:03,060 --> 00:26:04,662
you see on the side of a house.

613
00:26:04,662 --> 00:26:06,497
There's an active
element here, the feed,

614
00:26:06,497 --> 00:26:07,999
that actually sends the signal,

615
00:26:07,999 --> 00:26:11,302
and then this, like the dish
on the side of the house,

616
00:26:11,302 --> 00:26:14,572
reflects that and focuses
the signal back to Earth.

617
00:26:14,572 --> 00:26:17,508
This antenna was specially
engineered and designed

618
00:26:17,508 --> 00:26:19,210
to be completely flat

619
00:26:19,210 --> 00:26:21,278
so it makes very efficient
use of the volume

620
00:26:21,278 --> 00:26:23,581
and can fold up
and fit very nicely

621
00:26:23,581 --> 00:26:24,982
on top of this spacecraft

622
00:26:24,982 --> 00:26:27,819
when it's all folded
up for launch.

623
00:26:27,819 --> 00:26:30,321
The antenna that we use
to listen to InSight

624
00:26:30,321 --> 00:26:32,257
is on the bottom here.

625
00:26:32,257 --> 00:26:34,658
It deploys out and is
held in place by springs.

626
00:26:34,658 --> 00:26:37,461
This is tuned to the
InSight UHF frequency,

627
00:26:37,461 --> 00:26:40,264
so as MarCO flies over Mars,

628
00:26:40,264 --> 00:26:42,433
it will be listening to
that data from InSight

629
00:26:42,433 --> 00:26:45,136
and the radio on board, which
is another new technology

630
00:26:45,136 --> 00:26:48,038
that MarCO is demonstrating,

developed by JPL,

631
00:26:48,038 --> 00:26:50,508
that radio then takes that data

632
00:26:50,508 --> 00:26:53,311
and sends it back to Earth
on a different frequency

633
00:26:53,311 --> 00:26:54,979
using this antenna.

634
00:26:54,979 --> 00:26:58,382
And the camera that took the
image of these two objects

635
00:26:58,382 --> 00:27:00,418
is tucked away in the
corner right there.

636
00:27:01,586 --> 00:27:03,020
So as I mentioned,
MarCO has to do

637
00:27:03,020 --> 00:27:05,322
pretty much everything
that InSight does.

638
00:27:05,322 --> 00:27:08,493
About half of the
spacecraft volume

639
00:27:08,493 --> 00:27:10,528
is taken up by propellant.

640
00:27:10,528 --> 00:27:13,664
MarCO has done its own
trajectory correction maneuvers

641

00:27:13,664 --> 00:27:15,567
using fire extinguisher fluid.

642
00:27:16,434 --> 00:27:18,102
I'm not kidding.

643
00:27:18,102 --> 00:27:19,570
[audience members laugh]

644
00:27:19,570 --> 00:27:22,173
We heat up the fluid and it
comes out as little tiny puffs,

645
00:27:22,173 --> 00:27:24,208
but that is enough to
adjust the trajectory

646
00:27:24,208 --> 00:27:26,610
so that the MarCO
satellites fly by Mars

647
00:27:26,610 --> 00:27:29,847
in the exact position and time

648
00:27:29,847 --> 00:27:32,617
that it needs to listen to the
InSight signal as it lands.

649
00:27:32,617 --> 00:27:35,452
So there's tiny little
thrusters on this side

650
00:27:35,452 --> 00:27:38,656
of the spacecraft that
are used to do that.

651
00:27:38,656 --> 00:27:40,124
We also generate our own power.

652

00:27:40,124 --> 00:27:43,895
It is significantly less
than what InSight mentions.

653
00:27:43,895 --> 00:27:46,831
We have 42 solar cells.

654
00:27:46,831 --> 00:27:48,766
It generates about
17 watts of power,

655
00:27:48,766 --> 00:27:51,169
which is a couple night lights.

656
00:27:51,169 --> 00:27:52,937
So not even a blender.

657
00:27:52,937 --> 00:27:54,639
[audience laughs]

658
00:27:54,639 --> 00:27:57,174
MarCO has crammed a
lot of new technologies

659
00:27:57,174 --> 00:27:59,978
and new capabilities
into a very small volume.

660
00:27:59,978 --> 00:28:02,379
The team is thrilled with
how it's done so far,

661
00:28:02,379 --> 00:28:05,149
and given how well
it's done so far,

662
00:28:05,149 --> 00:28:07,685
we're really hoping that
this becomes a pathfinder

663
00:28:07,685 --> 00:28:10,054
for even more small satellites

664
00:28:10,054 --> 00:28:12,090
to go into interplanetary space.

665
00:28:12,090 --> 00:28:13,524
We are excited for Monday.

666
00:28:13,524 --> 00:28:15,093
So back to you, Veronica.

667
00:28:15,093 --> 00:28:19,030
- Alright, thank you, Anne.
[audience clapping]

668
00:28:19,030 --> 00:28:20,698
I'd like to invite
all of the speakers

669
00:28:20,698 --> 00:28:21,899
to come back up on stage.

670
00:28:21,899 --> 00:28:23,634
We're gonna take questions now.

671
00:28:23,634 --> 00:28:25,770
We will take questions
here in the auditorium.

672
00:28:25,770 --> 00:28:28,239
We are also taking questions
from the phone line

673
00:28:28,239 --> 00:28:29,473
from news media.

674
00:28:29,473 --> 00:28:32,477

If you are on that phone
line, please hit *1.

675
00:28:32,477 --> 00:28:36,013
That will put you into the
queue for the questions.

676
00:28:36,013 --> 00:28:38,382
We are also taking
questions over social media,

677
00:28:38,382 --> 00:28:41,152
so if you have a question,
I believe we've been

678
00:28:41,152 --> 00:28:43,187
requesting them all day
already on social media,

679
00:28:43,187 --> 00:28:44,655
but if you have a question,

680
00:28:44,655 --> 00:28:47,192
post that to your social
media account with #askNASA.

681
00:28:48,593 --> 00:28:50,060
We will answer some of
those during the briefing,

682
00:28:50,060 --> 00:28:52,764
and we will continue to
answer those during the day,

683
00:28:52,764 --> 00:28:54,499
even after the broadcast.

684
00:28:54,499 --> 00:28:57,067
I'm going to start.

685
00:28:57,067 --> 00:28:59,803
Let me check here to see if
we have one in the auditorium.

686
00:28:59,803 --> 00:29:02,306
If not, I will go
to the phone line.

687
00:29:02,306 --> 00:29:04,775
We're gonna start with one
here in the auditorium.

688
00:29:04,775 --> 00:29:06,911
Go ahead and state your name
and affiliation, please.

689
00:29:06,911 --> 00:29:08,112
- Hi there.

690
00:29:08,112 --> 00:29:09,947
Ian O'Neill with
Scientific American

691
00:29:09,947 --> 00:29:11,649
and HowStuffWorks.com.

692
00:29:11,649 --> 00:29:13,384
This is an EDL question.

693
00:29:14,752 --> 00:29:16,487
I suppose Rob,

694
00:29:16,487 --> 00:29:19,390
how does the EDL for InSight

695
00:29:19,390 --> 00:29:21,493
differ from the Phoenix EDL?

696

00:29:23,193 --> 00:29:24,428
- That's a very good question.

697
00:29:24,428 --> 00:29:27,932
How does InSight EDL
differ from Phoenix EDL?

698
00:29:27,932 --> 00:29:30,668
The answer is, very little.

699
00:29:30,668 --> 00:29:33,504
The spacecraft itself
is nearly identical.

700
00:29:33,504 --> 00:29:35,106
There are a few differences,

701
00:29:36,474 --> 00:29:38,843
but the spacecraft itself
is nearly identical.

702
00:29:38,843 --> 00:29:41,012
The difference in
the landing challenge

703
00:29:41,012 --> 00:29:43,414
is that Phoenix
was a little more

704
00:29:43,414 --> 00:29:46,250
than a kilometer and a half
lower landing site elevation.

705
00:29:46,250 --> 00:29:47,752
So the InSight landing,

706
00:29:47,752 --> 00:29:49,820
we have a little bit less
time to get things done,

707
00:29:49,820 --> 00:29:52,924
and that's probably one
of the biggest things.

708
00:29:52,924 --> 00:29:54,992
The other is that we're landing
during dust storm season,

709
00:29:54,992 --> 00:29:57,094
so we've had to
design the system

710
00:29:57,094 --> 00:29:59,864
to be successful in a variety

711
00:29:59,864 --> 00:30:01,632
of different
atmosphere conditions,

712
00:30:01,632 --> 00:30:02,834
although it looks like right now

713
00:30:02,834 --> 00:30:03,968
that we're not
gonna have to have

714
00:30:03,968 --> 00:30:05,737
any dust storm
activity to deal with.

715
00:30:06,704 --> 00:30:07,605
- [Ian] Thank you.

716
00:30:09,073 --> 00:30:11,509
- We're gonna take one
more here in the audience.

717
00:30:11,509 --> 00:30:13,010
- Thank you.

718
00:30:13,010 --> 00:30:14,311
Hi, I'm Ryann Blackshere
Vargas from Spectrum News.

719
00:30:14,311 --> 00:30:17,515
Any chance that it'll
land early or late?

720
00:30:19,717 --> 00:30:20,985
- You go ahead.

721
00:30:20,985 --> 00:30:24,989
- Sure, yeah.
[audience laughs]

722
00:30:24,989 --> 00:30:27,191
There is, if we're a
little bit shallower

723
00:30:27,191 --> 00:30:29,126
or a little bit steeper in
our entry flight path angle,

724
00:30:29,126 --> 00:30:30,828
we have a little bit
of tolerance there,

725
00:30:30,828 --> 00:30:33,865
we can land a little
bit in a different time.

726
00:30:33,865 --> 00:30:37,067
The landing time can vary
by about a minute or so,

727
00:30:37,067 --> 00:30:39,436
plus or minus, depending
on what happens.

728
00:30:39,436 --> 00:30:41,572
The fact that we're
kind of narrowed down

729
00:30:41,572 --> 00:30:43,240
and kind of know our atmosphere

730
00:30:43,240 --> 00:30:45,443
will make that
uncertainty even less,

731
00:30:45,443 --> 00:30:47,445
so we're in good shape.

732
00:30:48,513 --> 00:30:49,480
- [Ryann] Thank you.

733
00:30:52,850 --> 00:30:54,485
- Okay, we're gonna take one
more here in the audience,

734
00:30:54,485 --> 00:30:56,053
and then I'll take a couple
from the phone lines.

735
00:30:56,053 --> 00:30:58,089
If you're waiting on the
phone line, please stand by.

736
00:30:58,089 --> 00:30:59,023
Go ahead.

737
00:30:59,023 --> 00:31:00,324
- Steve Gorman at Reuters.

738
00:31:00,324 --> 00:31:04,128
How high up will
the spacecraft be

739
00:31:04,128 --> 00:31:07,031
at the time that
it begins entry?

740
00:31:08,366 --> 00:31:09,200
- Go ahead, Rob.

741
00:31:09,200 --> 00:31:10,034
- Sure.

742
00:31:11,402 --> 00:31:14,905
We generally consider
it about 77 miles

743
00:31:14,905 --> 00:31:18,309
above the surface,
or 125 kilometers.

744
00:31:18,309 --> 00:31:21,512
- Okay, and the decision on
the final course correction

745
00:31:21,512 --> 00:31:22,780
will be made Friday,

746
00:31:23,647 --> 00:31:24,882
even though the correction,

747
00:31:24,882 --> 00:31:27,352
if you do it with TCM,
will be done on Sunday?

748
00:31:27,352 --> 00:31:28,686
Is that right?

749
00:31:28,686 --> 00:31:30,187
- That's right, yeah.

750

00:31:30,187 --> 00:31:32,756
- [Steve] Do you know what
time Friday we'll know?

751
00:31:32,756 --> 00:31:34,325
- Well, our decision meeting

752
00:31:34,325 --> 00:31:36,461
is in the early
evening on Friday,

753
00:31:36,461 --> 00:31:37,594
so that's when we'll
make the decision.

754
00:31:37,594 --> 00:31:39,229
- [Steve] Thanks.

755
00:31:39,229 --> 00:31:41,132
- Alright, I'm gonna take a
question from the phone line,

756
00:31:41,132 --> 00:31:42,700
and then we'll come
back here into the room.

757
00:31:42,700 --> 00:31:44,502
But let's go ahead
with Irish TV.

758
00:31:44,502 --> 00:31:46,170
Go ahead with your question.

759
00:31:47,337 --> 00:31:48,572
- [Leo] Thanks very
much, Veronica,

760
00:31:48,572 --> 00:31:50,341
it's Leo Enright here.

761
00:31:50,341 --> 00:31:53,844
I'm just wondering about
the call-outs post-landing.

762
00:31:53,844 --> 00:31:57,815
I don't recall chewing my
knuckles for four hours

763
00:31:57,815 --> 00:32:02,153
to know whether Phoenix had
deployed its solar arrays,

764
00:32:02,153 --> 00:32:05,389
so I just wonder how
the call-outs, the
real-time call-outs,

765
00:32:05,389 --> 00:32:08,259
are gonna work, how
soon will we know that,

766
00:32:08,259 --> 00:32:11,262
for instance, the deployment
has happened, all of that?

767
00:32:12,829 --> 00:32:14,265
- I'll address that question.

768
00:32:15,700 --> 00:32:18,870
The reason that we don't
have immediate information

769
00:32:18,870 --> 00:32:20,905
about the solar arrays
is, as Stu said,

770
00:32:20,905 --> 00:32:23,941
we have to wait literally
for the dust to settle

771
00:32:23,941 --> 00:32:26,577
for about 16 minutes, and then
it takes another 16 minutes

772
00:32:26,577 --> 00:32:29,113
or so for the solar
arrays to actually deploy.

773
00:32:29,113 --> 00:32:32,349
At that point MRO
has gone behind Mars,

774
00:32:32,349 --> 00:32:34,318
so we can't get any
more information

775
00:32:34,318 --> 00:32:36,320
up to MRO from the spacecraft.

776
00:32:36,320 --> 00:32:38,855
And MarCOs have
continued on their flyby

777
00:32:38,855 --> 00:32:40,124
and they're also out of range,

778
00:32:40,124 --> 00:32:42,192
so the next asset,
orbital asset,

779
00:32:42,192 --> 00:32:45,530
that we can communicate
with is Mars Odyssey,

780
00:32:45,530 --> 00:32:47,765
and that comes up in about
five and a half hours

781
00:32:47,765 --> 00:32:49,033

after we land.

782
00:32:49,033 --> 00:32:51,168
So it's basically
orbital dynamics

783
00:32:51,168 --> 00:32:54,205
is why we can't get information
any sooner than that.

784
00:32:54,205 --> 00:32:55,739
With Phoenix, it
was at the pole,

785
00:32:55,739 --> 00:32:58,142
so it got much more
frequent overflights.

786
00:32:58,142 --> 00:33:00,344
So that was the main
difference between InSight

787
00:33:00,344 --> 00:33:03,514
being at the equator or
Phoenix being at the pole.

788
00:33:03,514 --> 00:33:04,315
I think that--

789
00:33:04,315 --> 00:33:05,783
- I'll just add, Tom,

790
00:33:05,783 --> 00:33:08,619
that the solar arrays, the
spacecraft's entirely capable

791
00:33:08,619 --> 00:33:11,555
of taking care of itself
during that period.

792
00:33:11,555 --> 00:33:13,323
It'll autonomously
command the deployment

793
00:33:13,323 --> 00:33:15,726
of the solar arrays,
and if for some reason

794
00:33:15,726 --> 00:33:17,261
it doesn't correctly deploy,

795
00:33:17,261 --> 00:33:20,798
then it has opportunities,
three more opportunities,

796
00:33:20,798 --> 00:33:25,569
on its own to re-command those
actuators to deploy those.

797
00:33:25,569 --> 00:33:27,671
So it's not like
it's gonna try once

798
00:33:27,671 --> 00:33:28,939
and then wait for the ground.

799
00:33:28,939 --> 00:33:31,642
It'll be on its own,
and it's been tested

800
00:33:31,642 --> 00:33:32,944
and ready to fly that way.

801
00:33:34,378 --> 00:33:35,813
- [Leo] So if I may follow up,

802
00:33:35,813 --> 00:33:38,749
we will know that the
landing has been successful?

803
00:33:38,749 --> 00:33:39,950
We won't have to wait

804
00:33:39,950 --> 00:33:42,119
five and a half hours
for that, I hope.

805
00:33:42,119 --> 00:33:43,621
- Yeah, that's correct.

806
00:33:43,621 --> 00:33:46,056
Especially if the MarCOs
are working as planned,

807
00:33:46,056 --> 00:33:48,825
we'll get very close to
real-time information

808
00:33:48,825 --> 00:33:50,995
that we've landed successfully.

809
00:33:50,995 --> 00:33:53,564
We also have on the
spacecraft an X-band beep

810
00:33:53,564 --> 00:33:55,265
that we'll be sending

811
00:33:55,265 --> 00:33:57,201
roughly about seven
minutes after we land.

812
00:33:57,201 --> 00:33:59,637
That'll be the spacecraft
telling the Earth

813
00:33:59,637 --> 00:34:01,706
that everything looks good.

814
00:34:01,706 --> 00:34:03,841
But then we'll have to
wait for that Odyssey pass

815
00:34:03,841 --> 00:34:05,443
to finally know that
the solar arrays

816
00:34:05,443 --> 00:34:06,777
have been fully deployed.

817
00:34:06,777 --> 00:34:07,711
There's no getting around that,

818
00:34:07,711 --> 00:34:09,414
just, it's orbital dynamics.

819
00:34:10,614 --> 00:34:11,815
- Alright, we're gonna
take one more question

820
00:34:11,815 --> 00:34:13,083
on the phone right now.

821
00:34:13,083 --> 00:34:15,019
SpaceNews, go ahead
with your question.

822
00:34:16,387 --> 00:34:18,956
- [Jeff] Hi, Jeff
Foust with SpaceNews.

823
00:34:18,956 --> 00:34:20,257
Question for Anne.

824
00:34:20,257 --> 00:34:21,625
I don't know if
there's any thoughts

825
00:34:21,625 --> 00:34:24,128
about any sort of
extended mission

826
00:34:24,128 --> 00:34:27,198
for the MarCO CubeSat
after the Mars flyby?

827
00:34:27,198 --> 00:34:28,432
- Not right now.

828
00:34:28,432 --> 00:34:30,568
The team is focusing
on getting to EDL.

829
00:34:32,436 --> 00:34:35,339
[audience laughs]

830
00:34:35,339 --> 00:34:38,208
- Hey Jeff, that's the
answer I asked to be given.

831
00:34:38,208 --> 00:34:40,511
[audience laughs]

832
00:34:40,511 --> 00:34:43,280
I'm a strong believer that
focus is what creates success,

833
00:34:43,280 --> 00:34:44,915
and I think you should know

834
00:34:44,915 --> 00:34:48,319
that we've had, of
course, discussions
about what's possible

835
00:34:48,319 --> 00:34:49,753

and we're gonna have
these discussions

836
00:34:49,753 --> 00:34:51,989
at the back end of
this exciting weekend.

837
00:34:55,559 --> 00:34:57,394
- Okay, one more phone call

838
00:34:57,394 --> 00:34:59,430
and then we're gonna go here
in the room to social media,

839
00:34:59,430 --> 00:35:02,099
and then more questions
from the audience.

840
00:35:02,099 --> 00:35:05,102
We have AP on the phone
line, please go ahead.

841
00:35:05,102 --> 00:35:08,573
- [Marcia] Yes, hi,
Marcia Dunn here for Rob.

842
00:35:09,941 --> 00:35:13,845
You mentioned it will be
about four degrees Fahrenheit

843
00:35:13,845 --> 00:35:15,313
at touchdown.

844
00:35:15,313 --> 00:35:17,915
The press kit talks
about 18 degrees.

845
00:35:17,915 --> 00:35:20,217
I'm wondering, do you
have the latest forecast?

846
00:35:20,217 --> 00:35:23,287
Is that's what revising
the temperatures down?

847
00:35:23,287 --> 00:35:26,190
And if so, what are the
lowest lows going to be?

848
00:35:27,257 --> 00:35:29,760
- Well, I'm not actually
the right person

849
00:35:29,760 --> 00:35:30,961
to know all that information.

850
00:35:30,961 --> 00:35:34,065
I got that estimate
from our power engineer,

851
00:35:35,499 --> 00:35:36,934
the four Fahrenheit.

852
00:35:36,934 --> 00:35:39,303
Which is actually at
the lander deck height,

853
00:35:39,303 --> 00:35:41,072
and so I think it
varies quite a bit

854
00:35:41,072 --> 00:35:43,374
depending on where you
are above the surface.

855
00:35:43,374 --> 00:35:45,709
And so I think at night

856
00:35:45,709 --> 00:35:49,179

it could be as cold as 180
or something like that,

857
00:35:49,179 --> 00:35:50,581
minus 180 Fahrenheit.

858
00:35:50,581 --> 00:35:53,583
- Yeah, I think actually
at the surface level

859
00:35:53,583 --> 00:35:55,919
it's closer to like
40 degrees Fahrenheit,

860
00:35:55,919 --> 00:35:59,290
so there is a huge variation
just in that three feet.

861
00:36:01,892 --> 00:36:03,594
But one of the things we
actually will be doing

862
00:36:03,594 --> 00:36:06,830
is we have a temperature
sensor on board the spacecraft.

863
00:36:06,830 --> 00:36:08,299
We didn't really talk
about that at all,

864
00:36:08,299 --> 00:36:10,601
but we have a bunch of
sensors for pressure,

865
00:36:10,601 --> 00:36:13,771
wind, thermal,
and a magnetometer

866
00:36:13,771 --> 00:36:16,173
that we'll be using basically

over the first week,

867
00:36:16,173 --> 00:36:18,241
especially to characterize
our landing site.

868
00:36:18,241 --> 00:36:20,311
So we'll be able to give
you a much better idea

869
00:36:20,311 --> 00:36:22,180
of what the temperature
is every day.

870
00:36:23,214 --> 00:36:24,482
- [Marcia] Great, thanks.

871
00:36:25,883 --> 00:36:28,018
- Okay, we're gonna take some
questions from social now.

872
00:36:28,018 --> 00:36:30,253
So Stephanie, do you have
some good questions coming in?

873
00:36:30,253 --> 00:36:32,923
- Absolutely, we're having an
extremely lively discussion

874
00:36:32,923 --> 00:36:34,458
in the YouTube chat,

875
00:36:34,458 --> 00:36:36,927
and the #askNASA questions
are pouring in on Twitter.

876
00:36:36,927 --> 00:36:39,296
Laura Reeve on Twitter
has a great question

877
00:36:39,296 --> 00:36:40,864
for mission managers here.

878
00:36:40,864 --> 00:36:44,501
On behalf of her middle
school students, she asks,

879
00:36:44,501 --> 00:36:46,870
how does communication work
between different parts

880
00:36:46,870 --> 00:36:49,473
of the design and building
teams for a project like this,

881
00:36:49,473 --> 00:36:52,309
and how important is
that communication?

882
00:36:52,309 --> 00:36:55,179
- Oh, I'll let Stu
answer this as well,

883
00:36:55,179 --> 00:36:57,848
but that communication
is critical, actually.

884
00:36:57,848 --> 00:36:59,283
Especially, as I mentioned,

885
00:36:59,283 --> 00:37:02,786
we have international partners,
we have domestic partners.

886
00:37:02,786 --> 00:37:05,222
Very rarely are we all
co-located together,

887
00:37:05,222 --> 00:37:08,225

so we have to come up with all
kinds of different techniques

888
00:37:08,225 --> 00:37:09,927
and methods of communicating

889
00:37:09,927 --> 00:37:11,862
what's going on
every single day.

890
00:37:11,862 --> 00:37:14,732
As we have design progressing,

891
00:37:14,732 --> 00:37:16,200
or any issues that
we have to work,

892
00:37:16,200 --> 00:37:17,834
we have to get together

893
00:37:17,834 --> 00:37:21,839
via all kinds of
interactive things online,

894
00:37:21,839 --> 00:37:23,940
plus we try to do as
many trips as we can

895
00:37:23,940 --> 00:37:25,776
to actually do
face-to-face communication,

896
00:37:25,776 --> 00:37:28,612
'cause there's nothing that
really substitutes for that.

897
00:37:28,612 --> 00:37:30,347
So Stu, why don't
you talk a little bit

898
00:37:30,347 --> 00:37:32,116
about what you do on
the spacecraft side?

899
00:37:32,116 --> 00:37:34,785
- Yeah, definitely, I'm dating
myself a little bit here,

900
00:37:34,785 --> 00:37:37,220
but I go all the way back
to the Magellan time frame,

901
00:37:37,220 --> 00:37:40,190
and any time there was
a big critical meeting,

902
00:37:40,190 --> 00:37:41,625
the entire Lockheed Martin team

903
00:37:41,625 --> 00:37:43,994
would fly out to
JPL or vice versa,

904
00:37:43,994 --> 00:37:47,064
and it was much more of a
face-to-face environment.

905
00:37:47,064 --> 00:37:48,331
We still preserve that,

906
00:37:48,331 --> 00:37:50,868
but with the new
technologies these days,

907
00:37:50,868 --> 00:37:53,203
we can all be at our
home institutions,

908
00:37:53,203 --> 00:37:57,241

including our European
partners, and get a lot done.

909
00:37:57,241 --> 00:38:01,578
And really, it's a
good team environment

910
00:38:01,578 --> 00:38:04,515
where we're able to
share information
very collaboratively.

911
00:38:06,450 --> 00:38:07,618
It's really a
badgeless environment

912
00:38:07,618 --> 00:38:09,186
where everyone's working
to a common goal,

913
00:38:09,186 --> 00:38:11,588
so there's no turf wars
or anything like that.

914
00:38:11,588 --> 00:38:12,822
It's a good team.

915
00:38:12,822 --> 00:38:15,459
- Alright, and we've got
a question for Dr. Z.

916
00:38:15,459 --> 00:38:17,862
MartianManish on Twitter
would like to know,

917
00:38:17,862 --> 00:38:20,531
how will InSight
help potential future

918
00:38:20,531 --> 00:38:22,967

human space exploration
to the red planet?

919
00:38:24,201 --> 00:38:25,635
- What InSight will do

920
00:38:25,635 --> 00:38:27,538
is really give a much
better understanding

921
00:38:27,538 --> 00:38:29,306
of the inside of
the entire planet,

922
00:38:29,306 --> 00:38:32,242
and with it, as we're gonna
learn from the science panel

923
00:38:32,242 --> 00:38:35,479
coming right next,

924
00:38:35,479 --> 00:38:37,180
with it, about the
history of the planet

925
00:38:37,180 --> 00:38:39,449
and also its entire environment,

926
00:38:39,449 --> 00:38:41,151
geologically and otherwise.

927
00:38:41,151 --> 00:38:43,954
We will learn major ingredients

928
00:38:43,954 --> 00:38:47,424
about the history, but
also the current state

929
00:38:47,424 --> 00:38:49,893

of the planet, you
know, its geology.

930
00:38:49,893 --> 00:38:51,929
And together with
the information

931
00:38:51,929 --> 00:38:54,131
that we have at the surface,

932
00:38:54,131 --> 00:38:56,166
really get a much
better understanding

933
00:38:56,166 --> 00:38:59,670
of the entire environment
that will be faced by humans.

934
00:38:59,670 --> 00:39:01,172
That's what we want.

935
00:39:01,172 --> 00:39:03,607
Before we go with humans,
we want to know everything.

936
00:39:03,607 --> 00:39:05,775
We want to know the
radiation from the top.

937
00:39:05,775 --> 00:39:08,712
We want to know whether
there's gonna be

938
00:39:08,712 --> 00:39:11,348
volcanic activities
from the bottom.

939
00:39:11,348 --> 00:39:13,083
We want to understand
whether there's water

940
00:39:13,083 --> 00:39:14,919
on the surface,
below the surface.

941
00:39:14,919 --> 00:39:17,521
We want to know whether
there's resources.

942
00:39:17,521 --> 00:39:20,290
So it's just part
of that knowledge

943
00:39:20,290 --> 00:39:24,561
that's such a critical
element of human exploration.

944
00:39:24,561 --> 00:39:26,530
- And Anne made it clear
that you're very focused

945
00:39:26,530 --> 00:39:28,265
on the MarCO team
on getting to EDL,

946
00:39:28,265 --> 00:39:30,433
but Emily Lakdawalla from
The Planetary Society

947
00:39:30,433 --> 00:39:32,869
in our YouTube chat is asking,

948
00:39:32,869 --> 00:39:36,006
what does happen to the MarCO
CubeSats after landing day,

949
00:39:36,006 --> 00:39:39,410
and how long can we remain
in contact with them?

950
00:39:39,410 --> 00:39:40,878
- That's a good question.

951
00:39:40,878 --> 00:39:42,379
The MarCO satellites,
they don't go into orbit.

952
00:39:42,379 --> 00:39:44,081
There's not enough of that
fire extinguisher fluid

953
00:39:44,081 --> 00:39:46,517
on board to do that, so
they will just fly by Mars

954
00:39:46,517 --> 00:39:47,784
and they'll end up
kind of in an orbit

955
00:39:47,784 --> 00:39:49,920
between Earth and Mars.

956
00:39:51,455 --> 00:39:53,390
It will start getting
farther and farther away,

957
00:39:53,390 --> 00:39:56,026
and I don't have a good timeline

958
00:39:56,026 --> 00:39:58,395
of how long we could
actually get that signal,

959
00:39:58,395 --> 00:40:00,597
but eventually it
will be too weak

960
00:40:00,597 --> 00:40:03,000
for us to actually be able

to hear from it anymore.

961
00:40:04,134 --> 00:40:05,168
- Okay, we're gonna take it back

962
00:40:05,168 --> 00:40:06,803
into the rest of the audience.

963
00:40:06,803 --> 00:40:08,672
We'll come back to social
in just a couple minutes,

964
00:40:08,672 --> 00:40:10,641
and I understand we have
a question here from ABC.

965
00:40:10,641 --> 00:40:11,875
Go ahead.

966
00:40:11,875 --> 00:40:14,011
- Hi, Stephen Coleman,
KABC, channel seven.

967
00:40:15,413 --> 00:40:18,449
What happens if one of
the arrays or both of them

968
00:40:18,449 --> 00:40:20,583
fail to deploy?

969
00:40:20,583 --> 00:40:23,420
Can you continue the
mission without them?

970
00:40:23,420 --> 00:40:25,655
- Yeah, we definitely
need to have

971
00:40:25,655 --> 00:40:28,692

at least one of the
solar arrays deployed

972
00:40:28,692 --> 00:40:30,994
because we are
100% solar-powered.

973
00:40:30,994 --> 00:40:35,332
Our battery is not gonna last
more than about one Mars day

974
00:40:35,332 --> 00:40:37,834
without the solar
arrays fully deployed.

975
00:40:37,834 --> 00:40:39,202
If we get partial deployment,

976
00:40:39,202 --> 00:40:40,404
we will have to look and see

977
00:40:40,404 --> 00:40:42,672
exactly how much energy
we are generating.

978
00:40:42,672 --> 00:40:45,643
Stu mentioned in his discussion

979
00:40:45,643 --> 00:40:46,943
that we have a little
bit of variation

980
00:40:46,943 --> 00:40:48,245
in how much power we might see

981
00:40:48,245 --> 00:40:49,980
over the different
points and times,

982

00:40:49,980 --> 00:40:52,015
so we're just gonna have to
take an engineering assessment

983
00:40:52,015 --> 00:40:54,018
and see what kind of a
mission we still have.

984
00:40:54,018 --> 00:40:57,921
But clearly Lockheed Martin
has done an excellent job

985
00:40:57,921 --> 00:40:59,489
of making sure that
we are gonna get

986
00:40:59,489 --> 00:41:01,024
those solar arrays deployed,

987
00:41:01,024 --> 00:41:02,726
so I have full confidence
that that's gonna happen.

988
00:41:02,726 --> 00:41:03,960
And hopefully we
don't have to worry

989
00:41:03,960 --> 00:41:05,496
about any of the contingencies.

990
00:41:05,496 --> 00:41:06,796
I don't know, Stu, if
you want to add anything?

991
00:41:06,796 --> 00:41:08,365
- No, that was well summarized.

992
00:41:08,365 --> 00:41:10,266
We've done a lot of testing

993
00:41:10,266 --> 00:41:12,036
during the first at low period,

994
00:41:12,036 --> 00:41:13,403
then a bunch of retesting

995
00:41:13,403 --> 00:41:15,673
during the second
integration and test period,

996
00:41:15,673 --> 00:41:18,041
so we're highly confident
they're in good shape

997
00:41:18,041 --> 00:41:20,044
and they're good to go.

998
00:41:21,578 --> 00:41:23,113
- Okay, we're going
back to the phone line.

999
00:41:23,113 --> 00:41:24,849
Leo Enright has a
follow-up question.

1000
00:41:24,849 --> 00:41:25,683
Go ahead, Leo.

1001
00:41:26,850 --> 00:41:28,085
- [Leo] Thanks very
much, Veronica.

1002
00:41:28,085 --> 00:41:30,221
I hope this isn't
too much detail,

1003
00:41:30,221 --> 00:41:32,556
but in the video

1004
00:41:32,556 --> 00:41:36,293
we saw MarCO doing
real-time relay,

1005
00:41:36,293 --> 00:41:40,164
and MRO rising, but there
seemed to be three MROs.

1006
00:41:40,164 --> 00:41:44,234
Now, unless I've been
asleep, there's only one.

1007
00:41:44,234 --> 00:41:47,203
The two that I saw
were middle and south,

1008
00:41:47,203 --> 00:41:49,340
so I was a bit
puzzled as to how come

1009
00:41:49,340 --> 00:41:50,774
there's three MROs.

1010
00:41:50,774 --> 00:41:53,277
Or was there something
I completely missed?

1011
00:41:53,277 --> 00:41:55,579
- No, no, you did
see three MROs.

1012
00:41:55,579 --> 00:41:56,813
What that's representing

1013
00:41:56,813 --> 00:41:58,916
is the different
times in which MRO

1014
00:41:58,916 --> 00:42:00,851

might actually be visible

1015
00:42:00,851 --> 00:42:03,354
depending on exactly when
we're entering the atmosphere.

1016
00:42:03,354 --> 00:42:05,655
So it's basically
sort of a best-case

1017
00:42:05,655 --> 00:42:07,891
and middle-case and worst-case

1018
00:42:07,891 --> 00:42:10,660
in terms of the coverage that
we're gonna get from MRO.

1019
00:42:10,660 --> 00:42:12,228
So there really is only one MRO.

1020
00:42:12,228 --> 00:42:14,631
It's sort of in
that range of areas

1021
00:42:14,631 --> 00:42:16,433
where it probably will be

1022
00:42:16,433 --> 00:42:18,769
when we do our entry,
descent, and landing.

1023
00:42:20,670 --> 00:42:22,673
- Okay, any other
questions in the room?

1024
00:42:24,541 --> 00:42:27,043
If we don't any other questions
from media here in the room,

1025

00:42:27,043 --> 00:42:28,345
oh, go ahead, we'll take yours

1026
00:42:28,345 --> 00:42:30,214
and then we'll go
back to social.

1027
00:42:30,214 --> 00:42:31,414
Go ahead.

1028
00:42:31,414 --> 00:42:32,449
- Did you say it
would be four hours

1029
00:42:32,449 --> 00:42:33,683
or five and a half hours,

1030
00:42:33,683 --> 00:42:36,020
or is that a range for
how long it would take--

1031
00:42:36,020 --> 00:42:37,954
- I believe you're talking
about when we're gonna get--

1032
00:42:37,954 --> 00:42:39,756
- To confirm the--
- Information from Odyssey?

1033
00:42:39,756 --> 00:42:41,892
It's gonna be about five and
a half hours after touchdown.

1034
00:42:41,892 --> 00:42:43,127
- [Steve] Okay.

1035
00:42:44,595 --> 00:42:46,696
- Okay, we have time for
one more social question.

1036
00:42:46,696 --> 00:42:48,699
Stephanie, go ahead.
- Alright.

1037
00:42:48,699 --> 00:42:51,368
So Phil Moyer over
on Twitter says,

1038
00:42:51,368 --> 00:42:53,904
with InSight's
design service life

1039
00:42:53,904 --> 00:42:56,406
and given the record
of your Mars probes

1040
00:42:56,406 --> 00:42:59,109
far exceeding their
expected lifetimes,

1041
00:42:59,109 --> 00:43:01,312
how long do you think
InSight will live?

1042
00:43:02,980 --> 00:43:07,083
- Well, we have not designed
any life-limiting features

1043
00:43:07,083 --> 00:43:09,385
into InSight, so
basically it's a function

1044
00:43:09,385 --> 00:43:13,324
of how long we continue
to collect solar power

1045
00:43:13,324 --> 00:43:16,126
and be able to run the
mission that we wanna run.

1046
00:43:16,126 --> 00:43:18,162
We're designed to
last one Mars year,

1047
00:43:18,162 --> 00:43:20,129
so that's 26 Earth months,

1048
00:43:20,129 --> 00:43:22,499
and so we think that
with the accumulation

1049
00:43:22,499 --> 00:43:23,733
of dust on the solar arrays,

1050
00:43:23,733 --> 00:43:26,069
that we'll make it at
least one Mars year

1051
00:43:26,069 --> 00:43:27,771
and get back the science
that you're gonna hear about

1052
00:43:27,771 --> 00:43:29,639
in just a little bit.

1053
00:43:29,639 --> 00:43:31,474
But we'll have to
evaluate where we are

1054
00:43:31,474 --> 00:43:33,576
after that year and how
much science we've got back

1055
00:43:33,576 --> 00:43:35,712
and make a case for continuing

1056
00:43:35,712 --> 00:43:37,647
if we're making truly
groundbreaking science

1057
00:43:37,647 --> 00:43:39,083
that we expect to be getting.

1058
00:43:41,117 --> 00:43:43,453
- Okay, we're going to
wrap it up at this time

1059
00:43:43,453 --> 00:43:45,955
with this panel
describing the spacecraft.

1060
00:43:45,955 --> 00:43:47,924
We are going to be back
at the top of the hour

1061
00:43:47,924 --> 00:43:51,027
at 11:00 a.m. Pacific Time,
2:00 p.m. Eastern Time,

1062
00:43:51,027 --> 00:43:53,263
to discuss the
science of the mission

1063
00:43:53,263 --> 00:43:54,731
and the science instruments.

1064
00:43:54,731 --> 00:43:57,934
So there's a lot of really
cool stuff on this spacecraft.

1065
00:43:57,934 --> 00:43:59,502
Please come back.

1066
00:43:59,502 --> 00:44:00,871
Also wanted to promote for you

1067
00:44:00,871 --> 00:44:03,307
that the next news

briefing following today

1068
00:44:03,307 --> 00:44:06,009
will be on Sunday, just
one day before landing,

1069
00:44:06,009 --> 00:44:07,511
and we'll get a final update

1070
00:44:07,511 --> 00:44:10,080
on the status of the
spacecraft at that time.

1071
00:44:10,080 --> 00:44:14,118
And then landing day, again,
it's Monday, November 26th.

1072
00:44:14,118 --> 00:44:17,487
Our commentary will begin
at 11:00 a.m. Pacific Time,

1073
00:44:17,487 --> 00:44:18,922
2:00 p.m. Eastern Time,

1074
00:44:18,922 --> 00:44:21,391
with landing taking place
about an hour later.

1075
00:44:21,391 --> 00:44:22,826
And again, there's
multiple websites

1076
00:44:22,826 --> 00:44:24,728
where you can watch
the landing live.

1077
00:44:24,728 --> 00:44:26,230
You can go to NASA.gov/live

1078

00:44:27,397 --> 00:44:29,466
if that's the easiest
one for you to remember.

1079
00:44:29,466 --> 00:44:30,834
On our toolkit page,

1080
00:44:30,834 --> 00:44:34,638
go.nasa.gov/InSightToolkit,

1081
00:44:34,638 --> 00:44:36,106
you'll see two tabs there.

1082
00:44:36,106 --> 00:44:37,907
One is how to watch online.

1083
00:44:37,907 --> 00:44:41,211
It has a chart with numerous
platforms where you can watch,

1084
00:44:41,211 --> 00:44:43,246
on YouTube, on
Twitter, on Facebook.

1085
00:44:43,246 --> 00:44:45,315
Again, our 360-degree broadcast

1086
00:44:45,315 --> 00:44:47,051
will be on our YouTube channel.

1087
00:44:47,051 --> 00:44:50,587
There's also how to watch
the landing in person.

1088
00:44:50,587 --> 00:44:53,857
There are numerous events
taking place across the country.

1089
00:44:53,857 --> 00:44:56,293

You can check from
California to New York

1090
00:44:56,293 --> 00:44:57,527
to Times Square in New York.

1091
00:44:57,527 --> 00:44:59,096
You can even be
standing in Times Square

1092
00:44:59,096 --> 00:45:01,698
and see our landing commentary
on the NASDAQ Tower.

1093
00:45:01,698 --> 00:45:04,434
There's even some viewing
parties in Europe.

1094
00:45:04,434 --> 00:45:07,136
So those are all marked,
again, at that toolkit page.

1095
00:45:07,136 --> 00:45:10,173
Just click on watch in person.

1096
00:45:10,173 --> 00:45:13,009
We will resume at 11:00 a.m.,

1097
00:45:13,009 --> 00:45:16,313
so in the meantime we're going
to replay some of the videos

1098
00:45:16,313 --> 00:45:17,881
for this particular mission,

1099
00:45:17,881 --> 00:45:20,550
starting with a
description, again,

1100

00:45:20,550 --> 00:45:23,253
of entry, descent, and landing

1101
00:45:23,253 --> 00:45:26,823
and the nerveracking,
white-knuckle six
and a half minutes

1102
00:45:26,823 --> 00:45:28,491
to get to the surface of Mars.

1103
00:45:28,491 --> 00:45:31,428
That'll wrap for now and we'll
be back in about 15 minutes.

1104
00:45:31,428 --> 00:45:32,662
Thank you for joining us.

1105
01:00:00,996 --> 01:00:04,834
[dramatic instrumental music]

1106
01:00:25,621 --> 01:00:28,156
- Welcome back, we're at NASA's
Jet Propulsion Laboratory

1107
01:00:28,156 --> 01:00:30,293
in Pasadena, California,
and we're here to talk

1108
01:00:30,293 --> 01:00:31,860
about the InSight mission.

1109
01:00:31,860 --> 01:00:33,996
The InSight mission
has a date with Mars,

1110
01:00:33,996 --> 01:00:36,365
come Monday, November 26th,

1111

01:00:36,365 --> 01:00:38,267
it will be landing
on the red planet.

1112
01:00:38,267 --> 01:00:41,170
That landing takes place
at about noon Pacific time,

1113
01:00:41,170 --> 01:00:43,506
3:00 p.m. Eastern
with commentary

1114
01:00:43,506 --> 01:00:47,276
broadcast live about
an hour before that.

1115
01:00:47,276 --> 01:00:49,278
We're gonna talk to
the science team now,

1116
01:00:49,278 --> 01:00:52,148
the science panel, and they
are going to explain to us

1117
01:00:52,148 --> 01:00:55,117
how the InSight mission
will be detecting

1118
01:00:55,117 --> 01:00:57,352
the vital signs of the planet.

1119
01:00:57,352 --> 01:00:58,921
We have instruments
that we'll be placing

1120
01:00:58,921 --> 01:01:01,724
on the surface of Mars
to tell us more about

1121
01:01:01,724 --> 01:01:05,361

how Mars formed, and in fact,
how all rocky planets formed.

1122
01:01:06,729 --> 01:01:10,098
I'm going to begin by
introducing Dr. Lori Glaze.

1123
01:01:10,098 --> 01:01:12,268
She is the acting director of

1124
01:01:12,268 --> 01:01:15,471
NASA's Planetary
Sciences Division.

1125
01:01:15,471 --> 01:01:16,672
- Great.

1126
01:01:16,672 --> 01:01:18,540
[audience applauding]

1127
01:01:18,540 --> 01:01:20,208
Thanks, Veronica.

1128
01:01:20,208 --> 01:01:22,011
I'm excited, I know you are too.

1129
01:01:22,011 --> 01:01:24,279
I was already excited
when I got here,

1130
01:01:24,279 --> 01:01:27,116
and then sitting through the
mission briefing this morning,

1131
01:01:27,116 --> 01:01:29,085
I'm even more excited
than I was before.

1132
01:01:29,085 --> 01:01:31,020

How exciting, five more
days and we'll be there,

1133
01:01:31,020 --> 01:01:33,756
we'll be landing yet
another planetary mission

1134
01:01:33,756 --> 01:01:35,857
on the surface of Mars.

1135
01:01:35,857 --> 01:01:37,393
Each of the planetary missions,

1136
01:01:37,393 --> 01:01:39,495
each of NASA's
planetary missions

1137
01:01:39,495 --> 01:01:42,698
is on a quest to answer
important questions

1138
01:01:42,698 --> 01:01:45,000
about how our solar
system formed,

1139
01:01:45,000 --> 01:01:48,204
and how it changed over
time after it formed.

1140
01:01:49,672 --> 01:01:51,807
We've sent lots of different
missions to different worlds

1141
01:01:51,807 --> 01:01:53,509
and different corners
of the solar system,

1142
01:01:53,509 --> 01:01:55,911
and they're each trying to
answer that same question

1143
01:01:55,911 --> 01:01:58,213
in different ways, different
types of observations

1144
01:01:58,213 --> 01:02:00,416
at different types of worlds.

1145
01:02:00,416 --> 01:02:03,185
Some of the most fundamental
questions that we have

1146
01:02:03,185 --> 01:02:06,321
about how our solar system
formed and how it evolved

1147
01:02:06,321 --> 01:02:08,724
have to do with how
did the rocky planets

1148
01:02:08,724 --> 01:02:11,026
in our solar system
form and evolve?

1149
01:02:11,026 --> 01:02:13,428
The rocky planets,
Mercury, Venus,

1150
01:02:13,428 --> 01:02:15,932
Earth, Mars, and even our Moon.

1151
01:02:15,932 --> 01:02:19,435
Each of them are similar,
they're rocky planets,

1152
01:02:19,435 --> 01:02:23,039
some of them have atmospheres,
and they have structures

1153

01:02:23,039 --> 01:02:24,573
that have similarities
and differences.

1154
01:02:24,573 --> 01:02:26,909
If I could have
the first graphic.

1155
01:02:26,909 --> 01:02:28,877
This graphic actually
shows a cut away

1156
01:02:28,877 --> 01:02:31,380
of Earth and Mars, and the Moon.

1157
01:02:31,380 --> 01:02:35,050
And what you can see inside
of each of these rocky planets

1158
01:02:35,050 --> 01:02:38,087
is that they have at
their center, a core.

1159
01:02:38,087 --> 01:02:41,490
And that core can be
solid or it can be molten,

1160
01:02:41,490 --> 01:02:44,560
and then outside of that
core there's a middle section

1161
01:02:44,560 --> 01:02:46,895
that we call the mantle,
which makes up the bulk,

1162
01:02:46,895 --> 01:02:49,531
most of the mass of each
of the rocky planets.

1163
01:02:49,531 --> 01:02:50,732

And each of those rocky planets

1164
01:02:50,732 --> 01:02:54,102
is covered with a thin crust.

1165
01:02:54,102 --> 01:02:56,805
What we really want to know
is what are the similarities?

1166
01:02:56,805 --> 01:02:58,474
How are they different,
how are they the same?

1167
01:02:58,474 --> 01:03:01,977
What're the relative sizes
of those different parts

1168
01:03:01,977 --> 01:03:04,613
of the interiors of
those rocky planets?

1169
01:03:04,613 --> 01:03:06,248
The different
sizes, is the core,

1170
01:03:06,248 --> 01:03:08,017
is it molten or is it solid?

1171
01:03:08,017 --> 01:03:10,352
is that the same for
each of the planets?

1172
01:03:10,352 --> 01:03:11,787
That we need to know.

1173
01:03:11,787 --> 01:03:13,823
Most of the missions
we've already sent to Mars

1174

01:03:13,823 --> 01:03:16,225
are either making
observations from orbit,

1175
01:03:16,225 --> 01:03:17,859
getting at the
surface conditions,

1176
01:03:17,859 --> 01:03:19,061
trying to understand
what's happening

1177
01:03:19,061 --> 01:03:21,130
within the atmosphere
on the surface.

1178
01:03:21,130 --> 01:03:23,165
Sending landers
and rovers, again,

1179
01:03:23,165 --> 01:03:24,867
just scratching at the surface

1180
01:03:24,867 --> 01:03:27,336
to understand that
surface environment.

1181
01:03:27,336 --> 01:03:29,638
If we wanna understand
what the insides

1182
01:03:29,638 --> 01:03:31,607
of these rocky planets are like,

1183
01:03:31,607 --> 01:03:33,575
we have to make different
kinds of observations

1184
01:03:33,575 --> 01:03:35,344
that can really

penetrate down into

1185
01:03:35,344 --> 01:03:37,212
the center of the planets.

1186
01:03:37,212 --> 01:03:38,881
The types of measurements
we make on Earth

1187
01:03:38,881 --> 01:03:41,283
are things like
seismic measurements,

1188
01:03:41,283 --> 01:03:43,618
understanding the level
of seismic activity,

1189
01:03:43,618 --> 01:03:45,120
thermal measurements, heat flow,

1190
01:03:45,120 --> 01:03:46,956
understanding the amount
of heat that's getting out

1191
01:03:46,956 --> 01:03:49,124
and being released
from the planet.

1192
01:03:49,124 --> 01:03:50,926
We do this on Earth
on a regular basis.

1193
01:03:50,926 --> 01:03:52,194
We've actually even done these

1194
01:03:52,194 --> 01:03:54,430
types of measurements
on the Moon.

1195

01:03:54,430 --> 01:03:56,499
With the Apollo program,
we had astronauts

1196
01:03:56,499 --> 01:03:58,100
that brought these
types of experiments

1197
01:03:58,100 --> 01:04:00,602
and deployed them on
the surface of the Moon.

1198
01:04:00,602 --> 01:04:02,738
But if we wanna make these
kinds of measurements at Mars,

1199
01:04:02,738 --> 01:04:05,741
we haven't sent
astronauts to Mars yet,

1200
01:04:05,741 --> 01:04:07,609
they will be going at
some point in the future,

1201
01:04:07,609 --> 01:04:10,613
and a lot of what we're doing
is in preparation for that.

1202
01:04:10,613 --> 01:04:12,147
But if we wanna do
this on Mars today,

1203
01:04:12,147 --> 01:04:13,715
we have to do it robotically.

1204
01:04:13,715 --> 01:04:17,586
And so with that I'm going to
introduce Dr. Bruce Banerdt,

1205
01:04:17,586 --> 01:04:19,688

the PI for the InSight mission,

1206
01:04:19,688 --> 01:04:21,189
to tell us a lot
about the science.

1207
01:04:21,189 --> 01:04:24,527
And when I go off the stage,
I just wanna say, go InSight!

1208
01:04:24,527 --> 01:04:25,928
- [Man] Yeah!

1209
01:04:25,928 --> 01:04:30,566
[audience applauding
and whooping]

1210
01:04:30,566 --> 01:04:32,901
- Okay so, InSight
is going to Mars

1211
01:04:32,901 --> 01:04:35,204
to study the deep
interior of Mars

1212
01:04:35,204 --> 01:04:38,006
in order to understand how
all the planets formed.

1213
01:04:38,006 --> 01:04:41,043
I mean, we know a little
bit about how planets form,

1214
01:04:41,043 --> 01:04:44,880
they've accrete
from a solar nebula.

1215
01:04:44,880 --> 01:04:47,349
As they accrete, they
get hotter and hotter,

1216
01:04:47,349 --> 01:04:49,618
both from the energy
of the impacts

1217
01:04:49,618 --> 01:04:51,620
and from radioactive decay.

1218
01:04:51,620 --> 01:04:56,491
And then they melt and transform
from sort of a uniform ball

1219
01:04:56,491 --> 01:05:00,262
of meteoritic material
into the diverse planets

1220
01:05:00,262 --> 01:05:01,496
that we see today.

1221
01:05:01,496 --> 01:05:05,333
Some of those planets
are a little bit harsh.

1222
01:05:05,333 --> 01:05:08,570
You know, Venus is hot
enough to melt lead.

1223
01:05:08,570 --> 01:05:13,576
Mercury has a sunbaked surface.

1224
01:05:14,710 --> 01:05:15,944
Mars is pretty cold
today, but Earth

1225
01:05:15,944 --> 01:05:17,479
is a nice place to
take a vacation.

1226
01:05:17,479 --> 01:05:21,083

So we'd really like to know
why one planet goes one way,

1227
01:05:21,083 --> 01:05:22,551
and another planet
goes another way.

1228
01:05:22,551 --> 01:05:26,622
And those answers are in
the details of the structure

1229
01:05:26,622 --> 01:05:29,258
that's formed very early
in the planet's history.

1230
01:05:29,258 --> 01:05:32,327
On Mars, that structure's
been preserved

1231
01:05:32,327 --> 01:05:34,196
over the last four and
half billion years,

1232
01:05:34,196 --> 01:05:37,232
whereas on the Earth
where we actually can

1233
01:05:37,232 --> 01:05:39,067
study it pretty easily,

1234
01:05:39,067 --> 01:05:42,003
that structure's all
been sort of scrambled up

1235
01:05:42,003 --> 01:05:44,840
both by plate tectonics,
by mantle convection.

1236
01:05:44,840 --> 01:05:48,177
And so the evidence of the

very earliest processes

1237
01:05:48,177 --> 01:05:50,312
has been wiped
away on the Earth.

1238
01:05:50,312 --> 01:05:53,949
We wanna go to Mars to do
that, to study those processes,

1239
01:05:53,949 --> 01:05:57,586
to look at how those
processes came about

1240
01:05:57,586 --> 01:05:59,955
very early in the
planet's history.

1241
01:05:59,955 --> 01:06:02,959
The main way that we're gonna
do that is with seismology.

1242
01:06:03,892 --> 01:06:05,961
And the way we use seismology,

1243
01:06:05,961 --> 01:06:08,197
when you wanna study something,

1244
01:06:08,197 --> 01:06:09,931
the first thing you
wanna do is look at it.

1245
01:06:09,931 --> 01:06:13,636
And they way you look at it
is you bounce light off of it,

1246
01:06:13,636 --> 01:06:16,472
it goes into your eyes and
your brain can interpret it

1247
01:06:16,472 --> 01:06:21,309
as an image and see a 3D image
of what you're looking at.

1248
01:06:21,309 --> 01:06:22,677
If you're looking at
the center of planet,

1249
01:06:22,677 --> 01:06:24,813
light doesn't help you very much

1250
01:06:24,813 --> 01:06:26,515
'cause it doesn't go
very far through rock.

1251
01:06:26,515 --> 01:06:30,285
So what we do is we use
seismic waves, vibrations,

1252
01:06:30,285 --> 01:06:34,523
that are created by
earthquakes on the Earth,

1253
01:06:34,523 --> 01:06:35,390
marsquakes on Mars.

1254
01:06:35,390 --> 01:06:36,625
Also meteorite strikes,

1255
01:06:36,625 --> 01:06:38,860
anything that starts
a planet vibrating

1256
01:06:38,860 --> 01:06:40,563
and sends those waves
through the planet.

1257
01:06:40,563 --> 01:06:42,198
If I could have the first

1258
01:06:44,933 --> 01:06:46,168
animation.

1259
01:06:46,168 --> 01:06:49,138
This shows a seismic
event on a planet,

1260
01:06:49,138 --> 01:06:52,007
and it's showing the waves
that travel through the planet,

1261
01:06:52,007 --> 01:06:55,077
the blue P waves,
the red S waves,

1262
01:06:55,077 --> 01:06:56,745
and these waves travel
through the planet

1263
01:06:56,745 --> 01:06:59,948
the same way light would
travel through a lens

1264
01:06:59,948 --> 01:07:01,483
or something like that.

1265
01:07:01,483 --> 01:07:05,654
And so a marsquake is sort of
like a flashbulb that goes off

1266
01:07:05,654 --> 01:07:07,455
and illuminates the
inside of a planet,

1267
01:07:07,455 --> 01:07:10,091
and our seismometer
is the eye that we use

1268

01:07:10,091 --> 01:07:11,693
to see what's inside the planet.

1269
01:07:11,693 --> 01:07:14,230
And by looking at
those seismograms

1270
01:07:14,230 --> 01:07:18,500
that you've seen on television,
those wiggles on a graph,

1271
01:07:18,500 --> 01:07:20,436
scientists have learned
how to interpret

1272
01:07:20,436 --> 01:07:23,305
the shape of those waves,
the time which they come in,

1273
01:07:23,305 --> 01:07:26,241
in order to
understand the medium

1274
01:07:26,241 --> 01:07:27,710
through which
those waves travel.

1275
01:07:27,710 --> 01:07:29,844
We can figure out what
the inside of the planet's

1276
01:07:29,844 --> 01:07:31,513
made out of, we can figure out

1277
01:07:31,513 --> 01:07:34,683
where the different boundaries
are between the rocky mantle,

1278
01:07:34,683 --> 01:07:36,551
the iron core, and so forth.

1279
01:07:36,551 --> 01:07:40,656
And so a seismometer allows us
to look deep into the planet

1280
01:07:40,656 --> 01:07:42,625
and understand the
detailed structure.

1281
01:07:43,825 --> 01:07:45,360
We also have a few
other instruments,

1282
01:07:45,360 --> 01:07:49,932
a few other investigations
on this mission.

1283
01:07:49,932 --> 01:07:54,036
One is a radio tracking
experiment, we actually track

1284
01:07:54,036 --> 01:07:56,372
the planet very precisely,
and in particular,

1285
01:07:56,372 --> 01:07:59,942
we're tracking the
north pole of the planet

1286
01:07:59,942 --> 01:08:02,778
and watching it wobble
as the planet rotates.

1287
01:08:02,778 --> 01:08:05,881
And the wobble of that
north pole is tied to

1288
01:08:05,881 --> 01:08:08,417
the interaction between
the planet and its core.

1289
01:08:08,417 --> 01:08:11,987
And by looking at the wobble,
its size, its frequency,

1290
01:08:11,987 --> 01:08:14,289
how fast it's wobbling,
we can actually determine

1291
01:08:14,289 --> 01:08:16,859
the size of the core and
what it's made out of.

1292
01:08:16,859 --> 01:08:19,695
And that's very critical
in terms of understanding

1293
01:08:19,695 --> 01:08:21,330
the history of the planet
and the way the planet

1294
01:08:21,330 --> 01:08:22,898
is operating today.

1295
01:08:22,898 --> 01:08:25,600
And finally we have
a heat flow probe.

1296
01:08:25,600 --> 01:08:27,970
It's a very interesting device,

1297
01:08:27,970 --> 01:08:29,604
Tillman Schwan's gonna
tell us a little bit more

1298
01:08:29,604 --> 01:08:32,875
about it later, it penetrates
down into below the surface,

1299

01:08:32,875 --> 01:08:35,344
about 10 to 15 feet
below the surface

1300
01:08:35,344 --> 01:08:37,946
and measures the
temperature as you go down.

1301
01:08:37,946 --> 01:08:40,048
And we're able to use
that to extrapolate

1302
01:08:40,048 --> 01:08:43,051
the center of the planet
and understand how hot it is

1303
01:08:43,051 --> 01:08:44,486
in the middle of the planet,

1304
01:08:44,486 --> 01:08:45,687
and how much heat is
coming out of the planet.

1305
01:08:45,687 --> 01:08:48,123
And that heat is
what actually drives

1306
01:08:48,123 --> 01:08:49,925
the geology at the surface.

1307
01:08:49,925 --> 01:08:53,061
And in particular,
it drives tectonics,

1308
01:08:53,061 --> 01:08:56,965
which is the quake
motion of the planet,

1309
01:08:56,965 --> 01:08:58,700
and it drives volcanism.

1310
01:08:58,700 --> 01:09:00,368
And here to talk
a little bit more

1311
01:09:00,368 --> 01:09:02,571
about these geological processes

1312
01:09:02,571 --> 01:09:05,307
and how InSight's going
to illuminate that,

1313
01:09:05,307 --> 01:09:09,778
is my deputy PI, Susan
Smrekar, from JPL.

1314
01:09:09,778 --> 01:09:10,613
- Right, thanks Bruce.

1315
01:09:10,613 --> 01:09:12,014
[audience applause]

1316
01:09:12,014 --> 01:09:15,684
[muffled speech]

1317
01:09:15,684 --> 01:09:19,588
Alright, well, every geologist
and geophysicist that I know

1318
01:09:19,588 --> 01:09:22,324
likes to climb mountains.

1319
01:09:22,324 --> 01:09:24,993
And if we could have
the first graphic.

1320
01:09:24,993 --> 01:09:26,828
You know, most of us
aren't lucky enough

1321
01:09:26,828 --> 01:09:29,297
to be able to climb
Mount Everest, however,

1322
01:09:29,297 --> 01:09:31,867
some of us are privileged
to be able to study

1323
01:09:31,867 --> 01:09:33,802
the mountains on Mars.

1324
01:09:33,802 --> 01:09:35,637
And as you can see,
the mountains on Mars

1325
01:09:35,637 --> 01:09:37,540
actually dwarf Mount Everest.

1326
01:09:38,940 --> 01:09:42,278
These volcanoes are not
only the tallest mountains,

1327
01:09:42,278 --> 01:09:45,447
but they're the tallest
volcanoes in our solar system.

1328
01:09:48,449 --> 01:09:50,218
These volcanoes actually formed

1329
01:09:50,218 --> 01:09:52,154
billions of years ago on Mars,

1330
01:09:54,756 --> 01:09:59,595
and when they formed on
Mars, they actually covered

1331
01:09:59,595 --> 01:10:00,829
about a 1/4 of the planet.

1332
01:10:00,829 --> 01:10:02,997
You can see Olympus right here,

1333
01:10:02,997 --> 01:10:06,234
and you can see this
whole volcanic region

1334
01:10:06,234 --> 01:10:08,236
that formed early in
the history of Mars.

1335
01:10:08,236 --> 01:10:09,804
And if we go to
the next graphic,

1336
01:10:09,804 --> 01:10:13,909
we can talk about how
these volcanoes formed.

1337
01:10:13,909 --> 01:10:16,811
And you know, for me really
the most compelling thing

1338
01:10:16,811 --> 01:10:18,881
about volcanoes is the fact that

1339
01:10:18,881 --> 01:10:20,949
they are really
conduits from materiel

1340
01:10:20,949 --> 01:10:24,753
way deep in the
planet to the surface.

1341
01:10:24,753 --> 01:10:28,090
Not only do volcanoes
spew lava on the surface,

1342

01:10:28,090 --> 01:10:30,526
they also release gases
into the atmosphere.

1343
01:10:30,526 --> 01:10:32,360
They release things
like water vapor,

1344
01:10:32,360 --> 01:10:34,696
carbon dioxide,
methane, all the things

1345
01:10:34,696 --> 01:10:37,633
that we need to actually
form an atmosphere.

1346
01:10:37,633 --> 01:10:42,638
So the best analogy between
the volcanoes on Mars

1347
01:10:43,504 --> 01:10:44,439
and the those we have on Earth,

1348
01:10:44,439 --> 01:10:46,508
are actually places like Hawaii.

1349
01:10:46,508 --> 01:10:51,112
So Hawaii is an example
of a hotspot volcano.

1350
01:10:51,112 --> 01:10:53,515
So material from
deep in the mantle,

1351
01:10:53,515 --> 01:10:55,317
actually at the core
mantle boundary,

1352
01:10:55,317 --> 01:11:00,122
rises up in a plume over

tens of millions of years,

1353
01:11:00,122 --> 01:11:03,425
and as they come up and
intersect with the crust,

1354
01:11:03,425 --> 01:11:05,360
it forms volcanism
at the surface.

1355
01:11:05,360 --> 01:11:07,996
Now, on Earth we
have plate tectonics.

1356
01:11:07,996 --> 01:11:11,567
So when that plume comes
up and hits the surface,

1357
01:11:11,567 --> 01:11:15,270
it actually is intersecting
a conveyor belt.

1358
01:11:15,270 --> 01:11:19,174
The plates are moving slowly,
slowly across that plume,

1359
01:11:19,174 --> 01:11:23,545
and so one volcano forms and
it's carried off downstream.

1360
01:11:23,545 --> 01:11:27,349
So actually at Hawaii, when
we see those few volcanoes

1361
01:11:27,349 --> 01:11:30,585
at the surface now
above the ocean,

1362
01:11:30,585 --> 01:11:34,623
but it really is just one

of a series of volcanoes,

1363
01:11:34,623 --> 01:11:37,426
dozens and dozens of
volcanoes that are now under

1364
01:11:37,426 --> 01:11:39,662
the surface of the ocean.

1365
01:11:40,795 --> 01:11:42,597
On Mars, we don't
have plate tectonics.

1366
01:11:42,597 --> 01:11:45,333
So when that plume comes
up and hits the crust,

1367
01:11:45,333 --> 01:11:46,768
it stays there in one place.

1368
01:11:46,768 --> 01:11:49,704
And so instead of making
it a line of volcanoes,

1369
01:11:49,704 --> 01:11:50,972
we have a series of volcanoes.

1370
01:11:50,972 --> 01:11:53,408
And you can see this
complex of volcanoes

1371
01:11:53,408 --> 01:11:55,310
that was formed
above a mantle plume

1372
01:11:55,310 --> 01:11:56,812
early in Mars's history.

1373
01:12:02,484 --> 01:12:04,485

So, the thing that we're
really looking forward to

1374
01:12:04,485 --> 01:12:08,590
for InSight, is being
able to go back in time.

1375
01:12:08,590 --> 01:12:10,959
Mars formed these volcanoes
in its first couple

1376
01:12:10,959 --> 01:12:12,994
billions of years at a time

1377
01:12:12,994 --> 01:12:14,563
when there was a magnetic field,

1378
01:12:14,563 --> 01:12:16,732
when there was liquid
water on the surface,

1379
01:12:16,732 --> 01:12:18,366
all of the conditions that
we think are important

1380
01:12:18,366 --> 01:12:19,902
for habitability of a planet.

1381
01:12:21,770 --> 01:12:24,605
For InSight we're gonna learn
about the interior structure,

1382
01:12:24,605 --> 01:12:26,575
the core, the crust, the mantle,

1383
01:12:26,575 --> 01:12:28,076
the heat sources
in the interior.

1384

01:12:28,076 --> 01:12:30,012
And with that information
we'll be able to

1385
01:12:30,012 --> 01:12:32,448
better understand how the
interior of the planet

1386
01:12:32,448 --> 01:12:35,016
affects the surface
environment on rocky bodies.

1387
01:12:35,016 --> 01:12:37,686
Not only in Mars, but
in our solar system

1388
01:12:37,686 --> 01:12:42,691
and on other rocky bodies
around other stars.

1389
01:12:43,825 --> 01:12:44,759
I personally have
been waiting for this

1390
01:12:44,759 --> 01:12:46,028
information for decades,

1391
01:12:46,028 --> 01:12:48,430
and I'm super excited
to start getting this

1392
01:12:49,631 --> 01:12:52,234
lander on the ground and
start taking this data.

1393
01:12:52,234 --> 01:12:54,903
Up next to tell you about
some of the instruments

1394
01:12:54,903 --> 01:12:59,908

that will acquire this data
for us is Philippe Laudet,

1395
01:13:01,343 --> 01:13:02,678
and he'll be telling us
about the SEIS instrument.

1396
01:13:04,179 --> 01:13:06,081
[audience applause]

1397
01:13:06,081 --> 01:13:06,915
Alright.

1398
01:13:06,915 --> 01:13:07,750
- Okay.

1399
01:13:09,417 --> 01:13:11,820
Good morning, my name
is Philippe Laudet

1400
01:13:11,820 --> 01:13:13,822
and I'm working for the
French Space Agency,

1401
01:13:13,822 --> 01:13:17,358
that we just call CNES, so
sorry for my French accent.

1402
01:13:17,358 --> 01:13:20,161
And I have been the project
manager of the SEIS instrument

1403
01:13:20,161 --> 01:13:21,830
for now more than seven years,

1404
01:13:21,830 --> 01:13:24,732
Since the preselection of

1405
01:13:24,732 --> 01:13:26,368

the Discovery program in 2011.

1406
01:13:27,802 --> 01:13:31,073
So as you have understood,
inside will make major amounts

1407
01:13:31,073 --> 01:13:35,544
of quakes and meteorite
strikes on the surface of Mars

1408
01:13:36,878 --> 01:13:39,414
and for that we will
use a seismometer,

1409
01:13:39,414 --> 01:13:43,785
SEIS, which is provided by
the French Space Agency, CNES,

1410
01:13:43,785 --> 01:13:48,791
and also by IPGP with a French
laboratory for geo-physic

1411
01:13:50,224 --> 01:13:52,161
research and it's French PI
for SEIS, Mr. Philip Lonionet

1412
01:13:55,030 --> 01:13:58,733
and as you can see, I don't
know where the film is

1413
01:13:58,733 --> 01:14:01,169
Oh, sorry, I didn't see
the screen, thank you.

1414
01:14:01,169 --> 01:14:03,871
So this instrument will
be deployed exactly

1415
01:14:03,871 --> 01:14:07,642
on the surface of Mars

in order to have better

1416
01:14:07,642 --> 01:14:10,678
and more accurate measurements
of the seismic waves.

1417
01:14:10,678 --> 01:14:14,949
And the major engineering
challenge we had

1418
01:14:14,949 --> 01:14:16,718
due to the position
on the surface,

1419
01:14:18,086 --> 01:14:22,390
is to protect the instrument
from thermal viations

1420
01:14:22,390 --> 01:14:26,294
and also from the wind of
Mars, which is very aggressive

1421
01:14:26,294 --> 01:14:27,896
for that kind of instrument.

1422
01:14:27,896 --> 01:14:31,733
So you have protection
on the seismometer itself

1423
01:14:31,733 --> 01:14:34,669
and another one is the
wind and thermal chill

1424
01:14:34,669 --> 01:14:37,506
which is being
deployed on the film

1425
01:14:37,506 --> 01:14:40,875
which is deployed a second
time by the same robotic arm

1426
01:14:40,875 --> 01:14:42,878
exactly on the seismometer.

1427
01:14:42,878 --> 01:14:47,082
There is absolutely no
mechanical contact between both,

1428
01:14:47,082 --> 01:14:51,553
because the wind shield
will move with the wind,

1429
01:14:51,553 --> 01:14:53,688
but not the
seismometer of course.

1430
01:14:53,688 --> 01:14:58,393
Okay, and as you
know, we are not

1431
01:14:58,393 --> 01:15:00,362
the only instrument
on the surface.

1432
01:15:00,362 --> 01:15:02,931
We have another one,
which is Gemon One HP3,

1433
01:15:02,931 --> 01:15:07,335
and I give the floor to
Tilman Spohn who is going to

1434
01:15:07,335 --> 01:15:10,638
talk about HP3, and so
I'll tell you goodbye,

1435
01:15:10,638 --> 01:15:12,741
thank you, and see
you on Mars next week.

1436
01:15:12,741 --> 01:15:13,975
Bye bye.

1437
01:15:13,975 --> 01:15:15,277
[laughter]

1438
01:15:15,277 --> 01:15:17,245
[applause]

1439
01:15:17,245 --> 01:15:19,080
- Hey, greetings from Germany.

1440
01:15:19,080 --> 01:15:21,182
I'm Tilman Spohn from the German

1441
01:15:21,182 --> 01:15:25,286
aerospace center,
DLR, and I'm the lead

1442
01:15:25,286 --> 01:15:29,391
of the Heatro probe,
the HP3 experiment.

1443
01:15:29,391 --> 01:15:31,693
DLR has been building
this instrument

1444
01:15:31,693 --> 01:15:33,962
and contributing
that to the mission.

1445
01:15:33,962 --> 01:15:38,666
Now, as Bruce already told
you, we're taking a set of

1446
01:15:38,666 --> 01:15:42,771
temperature sensors down
to the depths of 10-15 feet

1447
01:15:42,771 --> 01:15:44,606
to measure the
temperature of the heat

1448
01:15:44,606 --> 01:15:47,709
that's coming from the
interior towards the surface.

1449
01:15:47,709 --> 01:15:48,943
Now, how are we going down?

1450
01:15:48,943 --> 01:15:50,979
Let's play out my
first animation.

1451
01:15:53,948 --> 01:15:56,084
Can we have the first
animation please?

1452
01:15:58,019 --> 01:16:02,457
Okay, here's the mining
mechanism in the mole,

1453
01:16:02,457 --> 01:16:04,792
we nicknamed that
penetrator a mole,

1454
01:16:04,792 --> 01:16:07,696
that compresses a spring,
and when the spring

1455
01:16:07,696 --> 01:16:11,699
is released it hammers
towards the tip of the mole,

1456
01:16:11,699 --> 01:16:15,203
and then propels it
down into the ground.

1457

01:16:16,604 --> 01:16:20,742
Now we stop the penetration
at about two feet

1458
01:16:20,742 --> 01:16:23,712
and take a measurement of
the thermal conductivity

1459
01:16:25,113 --> 01:16:29,551
and then we continue that,
let's continue the animation.

1460
01:16:35,457 --> 01:16:39,460
Can you continue the
animation please?

1461
01:16:39,460 --> 01:16:44,466
And we heat the mole and
measure the thermal conductivity

1462
01:16:45,600 --> 01:16:48,603
and then we continue
the penetration,

1463
01:16:48,603 --> 01:16:52,107
and take another measurement
of the thermal conductivity,

1464
01:16:52,107 --> 01:16:54,609
and another measurement,
until we get

1465
01:16:54,609 --> 01:16:59,614
to the target depth of 15 feet.

1466
01:16:59,614 --> 01:17:03,352
When we're down there,
we will then activate

1467
01:17:05,120 --> 01:17:06,721

the temperature sensors.

1468
01:17:06,721 --> 01:17:09,458
15 temperature sensors that
measure the temperature

1469
01:17:09,458 --> 01:17:12,761
profile down to the
depths of 15 feet.

1470
01:17:12,761 --> 01:17:16,565
And by combing the
temperature increase with the

1471
01:17:16,565 --> 01:17:18,700
thermal conductivity,
we can actually

1472
01:17:18,700 --> 01:17:20,601
calculate the heat flow.

1473
01:17:20,601 --> 01:17:23,871
Now I'm very excited
to come here on Friday

1474
01:17:23,871 --> 01:17:26,741
and attend the landing event,

1475
01:17:26,741 --> 01:17:29,077
and then of course
the experiment.

1476
01:17:29,077 --> 01:17:31,779
The penetration first, and
then the measurement of the

1477
01:17:31,779 --> 01:17:33,682
temperature and the
thermal conductivity

1478
01:17:33,682 --> 01:17:36,984
and the heat flow,
because that will help us

1479
01:17:36,984 --> 01:17:41,356
decipher the enogenics or
the activity of the planet

1480
01:17:41,356 --> 01:17:43,658
and this is something that
geophysicist have been

1481
01:17:43,658 --> 01:17:46,695
look forward to for
a very long time.

1482
01:17:46,695 --> 01:17:50,598
And with that, I'd like
to head back to Veronica

1483
01:17:50,598 --> 01:17:52,767
to continue the presentation.

1484
01:17:52,767 --> 01:17:55,136
Thank you very much
for your attention.

1485
01:17:55,136 --> 01:17:57,439
- Alright, thank you so much
and stay where you are Tilman,

1486
01:17:57,439 --> 01:18:00,108
we're gonna bring the rest of
the panel back up on stage now

1487
01:18:00,108 --> 01:18:03,077
to do some questions
and answers.

1488

01:18:03,077 --> 01:18:05,246
A reminder that we will take
questions here in the room,

1489
01:18:05,246 --> 01:18:06,648
we have some media
on the phone line,

1490
01:18:06,648 --> 01:18:09,317
if you're on the phone
line, please hit *1,

1491
01:18:09,317 --> 01:18:11,553
that will put you into
the queue for a question.

1492
01:18:11,553 --> 01:18:14,055
We're also taking
questions on social media.

1493
01:18:14,055 --> 01:18:18,259
Just use #askNASA and
send those into us.

1494
01:18:18,259 --> 01:18:20,395
We'll take some during the
broadcast, we'll continue

1495
01:18:20,395 --> 01:18:23,698
to answer those even after
we go off the air today.

1496
01:18:23,698 --> 01:18:25,400
So we're gonna open it up here,

1497
01:18:25,400 --> 01:18:28,403
first in the auditorium,
and then we'll go

1498
01:18:28,403 --> 01:18:31,706

probably to phone lines
next, so go ahead.

1499
01:18:31,706 --> 01:18:34,209
Hi, Ryann Blackshere Vargas
again from Spectrum News.

1500
01:18:34,209 --> 01:18:35,443
You mentioned that
there's lots of questions

1501
01:18:35,443 --> 01:18:36,377
that will be answered.

1502
01:18:36,377 --> 01:18:37,546
What's the number one question

1503
01:18:37,546 --> 01:18:38,613
that you want answered
after two years?

1504
01:18:39,848 --> 01:18:41,382
- I think the
number one question

1505
01:18:41,382 --> 01:18:43,885
that we want to answer
is what's the structure

1506
01:18:43,885 --> 01:18:46,621
and the energetics of
the interior of mars.

1507
01:18:46,621 --> 01:18:50,858
So we have several things
that we want to measure.

1508
01:18:50,858 --> 01:18:53,027
We want to measure the
thickness of the crust,

1509
01:18:53,027 --> 01:18:56,430
the size of the core,
the density of the core,

1510
01:18:56,430 --> 01:19:00,168
and the seismic
velocity of the mantle,

1511
01:19:00,168 --> 01:19:03,071
which tells us what the
structure of the mantle is.

1512
01:19:03,071 --> 01:19:05,740
And those are kinda our
key questions, as well as

1513
01:19:05,740 --> 01:19:07,408
the amount of heat
coming out of the planet.

1514
01:19:07,408 --> 01:19:11,512
So when we proposed this
mission 8 years ago,

1515
01:19:11,512 --> 01:19:12,647
we put together what we call

1516
01:19:12,647 --> 01:19:14,148
our level one
science requirements.

1517
01:19:14,148 --> 01:19:17,318
And these are the things
that we promised NASA,

1518
01:19:17,318 --> 01:19:19,921
that if you choose our
mission, these are the things

1519
01:19:19,921 --> 01:19:21,389
that we're gonna
measure, and that's

1520
01:19:21,389 --> 01:19:23,091
kinda our list of measurements.

1521
01:19:23,091 --> 01:19:25,227
And then we're also
gonna measure how often

1522
01:19:26,628 --> 01:19:29,297
Marsquakes occur, and how
often meteorites strike Mars,

1523
01:19:29,297 --> 01:19:32,768
which is kinda a bonus.

1524
01:19:32,768 --> 01:19:34,335
- Then a follow up question,
how does all of this

1525
01:19:34,335 --> 01:19:36,838
help us to understand
life here on earth?

1526
01:19:36,838 --> 01:19:38,773
Will we understand
better about earthquakes?

1527
01:19:38,773 --> 01:19:40,708
Will we understand
volcanos better?

1528
01:19:40,708 --> 01:19:42,744
Will we understand...
you know, what everyday

1529
01:19:42,744 --> 01:19:45,513

parts of our lives here
will the InSight mission

1530
01:19:45,513 --> 01:19:47,148
help us to understand?

1531
01:19:47,148 --> 01:19:49,117
- Well what it really
helps us understand is

1532
01:19:49,117 --> 01:19:51,586
how we got to
where we are today.

1533
01:19:51,586 --> 01:19:55,590
How we got to an earth that
has an atmosphere which is

1534
01:19:55,590 --> 01:19:58,359
breathable, and
environment which is

1535
01:19:58,359 --> 01:20:01,028
in a temperature range which
is comfortable for life,

1536
01:20:01,028 --> 01:20:03,865
how we have a planet
that's covered with water.

1537
01:20:03,865 --> 01:20:08,069
These are all things that
are related to the activity

1538
01:20:08,069 --> 01:20:10,004
and the structure of the
inside of our planet.

1539
01:20:10,004 --> 01:20:13,775
It's not obvious to

everybody, but the fact

1540
01:20:13,775 --> 01:20:16,177
that we have an atmosphere
is because we've had

1541
01:20:16,177 --> 01:20:19,246
all these gases that have come
out the inside of the planet.

1542
01:20:19,246 --> 01:20:23,017
The reason we have an ocean
is because water has come out

1543
01:20:23,017 --> 01:20:27,255
from volcanic activity
over billions of years.

1544
01:20:27,255 --> 01:20:32,127
So that activity is tied
to the initial conditions

1545
01:20:32,127 --> 01:20:35,163
of the planet, so we'd like to
understand how that happened,

1546
01:20:35,163 --> 01:20:37,565
how we got to
where we are today.

1547
01:20:37,565 --> 01:20:39,067
- Thank you.

1548
01:20:39,067 --> 01:20:42,303
And if I could just add to
that, life started on earth

1549
01:20:42,303 --> 01:20:45,806
we think very early on, in
the first half billion years,

1550
01:20:45,806 --> 01:20:50,812
and that crust is almost gone
on the surface of the earth.

1551
01:20:52,180 --> 01:20:54,482
Whereas on Mars, that very
early crust is still preserved.

1552
01:20:54,482 --> 01:20:56,685
Those environments that
have formed super early

1553
01:20:56,685 --> 01:20:59,387
in the formation of
planets of our solar system

1554
01:20:59,387 --> 01:21:01,489
and so we can kind
of go back in time

1555
01:21:01,489 --> 01:21:03,658
and study those environments
on the surface of Mars

1556
01:21:03,658 --> 01:21:06,828
and understand how the
conditions inside the planet

1557
01:21:06,828 --> 01:21:08,563
created those environments.

1558
01:21:10,498 --> 01:21:13,668
- Okay we're going to take one
more here in the auditorium

1559
01:21:13,668 --> 01:21:14,735
and then I'm going to
go to the phone lines,

1560
01:21:14,735 --> 01:21:16,670
and then we'll be coming back.

1561
01:21:16,670 --> 01:21:19,173
- Hi, Ian O'Neill for
Scientific American

1562
01:21:19,173 --> 01:21:20,609
and HowStuffWorks.com.

1563
01:21:22,043 --> 01:21:25,346
Going back even further
than that question, how does

1564
01:21:25,346 --> 01:21:28,182
your assembly of
instruments and experiments

1565
01:21:28,182 --> 01:21:31,386
help explain the origins
of planets themselves?

1566
01:21:31,386 --> 01:21:35,957
I mean, it's almost like
a time probe looking back

1567
01:21:35,957 --> 01:21:38,659
four billion years ago,
but how do you hope that

1568
01:21:38,659 --> 01:21:42,096
this will add pieces
to that puzzle?

1569
01:21:42,096 --> 01:21:46,834
- Well, as you said, the
structure of the planet

1570
01:21:46,834 --> 01:21:49,470

is really formed in the
first few tens of millions

1571
01:21:49,470 --> 01:21:52,473
of years after the
planets accrete,

1572
01:21:52,473 --> 01:21:55,977
so we're not gonna have
much to say about how

1573
01:21:55,977 --> 01:21:58,713
the planet actually
accreted, but once it gets

1574
01:21:58,713 --> 01:22:02,817
formed from the solar
nebula, how it changes from

1575
01:22:02,817 --> 01:22:06,487
a uniform ball of
meteoritic material

1576
01:22:06,487 --> 01:22:08,990
which is all kind
of the same stuff,

1577
01:22:08,990 --> 01:22:11,192
into a planet which
is differentiated

1578
01:22:11,192 --> 01:22:16,197
which has a crust of
relatively light rocks

1579
01:22:17,599 --> 01:22:21,870
and a very dense core,
and a very complex system

1580
01:22:23,071 --> 01:22:24,271

of transferring he
heat from the center

1581
01:22:24,271 --> 01:22:26,074
of the planet to the surface.

1582
01:22:26,074 --> 01:22:28,009
These things are all
set up very early

1583
01:22:28,009 --> 01:22:30,945
in the planet's history,
and for the earth,

1584
01:22:30,945 --> 01:22:33,548
we don't really
have any evidence

1585
01:22:33,548 --> 01:22:35,650
of that system left anymore.

1586
01:22:35,650 --> 01:22:38,252
What we have is a
very evolved system

1587
01:22:38,252 --> 01:22:40,021
and so we want to
go to Mars to see

1588
01:22:40,021 --> 01:22:43,390
what that system looked like
very early in the process.

1589
01:22:43,390 --> 01:22:48,396
And so to better understand
the physics and the chemistry

1590
01:22:49,831 --> 01:22:53,434
of how you go from the very
initial set of conditions

1591
01:22:53,434 --> 01:22:57,572
with this sort of solar
dust and ice that's accreted

1592
01:22:57,572 --> 01:23:01,209
into the very complex
climates that we see today.

1593
01:23:01,209 --> 01:23:05,847
- And just one follow up, in
regards to meteorite impacts

1594
01:23:05,847 --> 01:23:07,915
how many meteorite
impacts do you expect

1595
01:23:07,915 --> 01:23:09,751
to detect with your
instrumentation?

1596
01:23:11,386 --> 01:23:12,821
Yeah, that's the question.

1597
01:23:15,323 --> 01:23:17,625
- One of the things
that we want to find out

1598
01:23:17,625 --> 01:23:19,761
is to actually
measure how many...

1599
01:23:21,162 --> 01:23:24,265
We're sort of expecting
maybe half a dozen

1600
01:23:24,265 --> 01:23:27,334
to a couple of dozen in the
two years that we're on Mars.

1601
01:23:27,334 --> 01:23:28,769
- [Ian] Cool, thank you so much.

1602
01:23:28,769 --> 01:23:30,071
- Sure.

1603
01:23:30,071 --> 01:23:32,540
- Okay, were going to
the phone lines next,

1604
01:23:32,540 --> 01:23:34,041
we've got about three
different callers right now,

1605
01:23:34,041 --> 01:23:36,310
we're gonna start
with the AP, go ahead.

1606
01:23:36,310 --> 01:23:39,180
- [Marsha] Yes hi, This
is Marsha down in AP,

1607
01:23:39,180 --> 01:23:41,015
I have a question I'd
like both Philippe

1608
01:23:41,015 --> 01:23:42,550
and Tilman to answer.

1609
01:23:42,550 --> 01:23:46,020
NASA has a long and rich
history of exploring Mars,

1610
01:23:46,020 --> 01:23:48,089
and as the relative
newcomers to this,

1611
01:23:48,089 --> 01:23:50,758
I'd like to know

from both of you,

1612
01:23:50,758 --> 01:23:53,494
what you find so
captivating and magical

1613
01:23:53,494 --> 01:23:55,930
about Mars versus other planets.

1614
01:23:55,930 --> 01:23:59,734
- I don't know the catch,
could you repeat it to me?

1615
01:23:59,734 --> 01:24:02,770
- She want's to know
what you find fascinating

1616
01:24:02,770 --> 01:24:07,776
and captivating about going
to Mars and studying Mars?

1617
01:24:08,643 --> 01:24:10,078
- Everything is captivating.

1618
01:24:10,078 --> 01:24:13,114
First, it's a dream, and
after there's a big challenge

1619
01:24:13,114 --> 01:24:17,685
because that instrument was
supposed to be so sensitive

1620
01:24:17,685 --> 01:24:21,989
that in the beginning it was
just impossible to build.

1621
01:24:21,989 --> 01:24:25,259
But we did it, with the
help of our partners

1622
01:24:25,259 --> 01:24:27,262
part-a-grey and GPL,
thanks for that.

1623
01:24:29,030 --> 01:24:30,765
- Would Tilman also
like to weigh in?

1624
01:24:31,966 --> 01:24:36,871
- Okay, to me, Mars
is a planet that is,

1625
01:24:38,273 --> 01:24:40,374
on the one hand, very
different from the earth,

1626
01:24:40,374 --> 01:24:42,543
and on the other hand
its quite similar.

1627
01:24:42,543 --> 01:24:45,312
You know, it's half
the size of the earth

1628
01:24:45,312 --> 01:24:48,782
but it's environment
on the surface is more

1629
01:24:48,782 --> 01:24:50,151
Earth-like than, for instance,

1630
01:24:50,151 --> 01:24:52,753
the atmosphere and the
environment on Venus.

1631
01:24:52,753 --> 01:24:55,556
And understanding the
difference between the Earth

1632

01:24:55,556 --> 01:24:58,893
and Mars will help us
understand the evolution of

1633
01:24:58,893 --> 01:25:02,096
terrestrial planets in general
and in particular, the Earth.

1634
01:25:02,096 --> 01:25:07,102
And this is what makes the
motivation for going to Mars.

1635
01:25:08,302 --> 01:25:09,570
And in addition to
that, it's easier

1636
01:25:09,570 --> 01:25:12,307
to explore Mars than Venus.

1637
01:25:13,608 --> 01:25:16,544
And therefor, Mars
is the first target

1638
01:25:16,544 --> 01:25:20,548
to do a physical observatory
like we now do on Mars.

1639
01:25:20,548 --> 01:25:24,919
So in timing, it's very
justified to do that now.

1640
01:25:26,787 --> 01:25:29,991
- Okay, our next question on
the phone line is from AFP.

1641
01:25:29,991 --> 01:25:31,126
Go ahead please.

1642
01:25:32,493 --> 01:25:35,162
- [Ivan] Hi, this is Ivan

Kronev of a-ju-so-france press.

1643
01:25:35,162 --> 01:25:39,234
You mentioned marsquakes
and meteorite strikes,

1644
01:25:39,234 --> 01:25:42,070
can you talk in detail abouts
about the other possible

1645
01:25:42,070 --> 01:25:45,740
sources of vibrations
that you might listen to?

1646
01:25:47,207 --> 01:25:51,278
- Sure, so those
are the two primary

1647
01:25:51,278 --> 01:25:54,115
sources of vibrations
that we hope to see.

1648
01:25:54,115 --> 01:25:59,120
We also will probably
see vibrations due to

1649
01:26:00,287 --> 01:26:01,789
the interaction of the
atmosphere with surface.

1650
01:26:01,789 --> 01:26:04,559
So when you have weather on
Mars, you have turbulence,

1651
01:26:04,559 --> 01:26:07,228
that actually is pushing
the surface up and down,

1652
01:26:07,228 --> 01:26:10,764
and that will create,

oh one hand, noise

1653
01:26:10,764 --> 01:26:12,467
that makes it harder
to see the marsquakes,

1654
01:26:12,467 --> 01:26:15,703
but on the other hand,
when you start beating

1655
01:26:15,703 --> 01:26:17,772
on a planet like that,
it will actually start

1656
01:26:17,772 --> 01:26:19,407
resonating at
certain frequencies.

1657
01:26:19,407 --> 01:26:23,010
And those resonances are
affected by the structure

1658
01:26:23,010 --> 01:26:24,712
of the planet, and
so we may be able

1659
01:26:24,712 --> 01:26:26,881
to get some
information from that.

1660
01:26:26,881 --> 01:26:30,218
And finally, what we should
also be able to measure is,

1661
01:26:32,119 --> 01:26:34,222
this is not exactly
a vibration, but it's

1662
01:26:34,222 --> 01:26:36,390
the motion of the

surface up and down

1663
01:26:36,390 --> 01:26:40,328
due to the tidal pull of
the martian moon Phobos.

1664
01:26:40,328 --> 01:26:43,130
So every time Phobos goes
overhead, it actually pulls

1665
01:26:43,130 --> 01:26:45,232
the surface up a little
bit, and then it goes

1666
01:26:45,232 --> 01:26:47,000
back down after Phobos leaves.

1667
01:26:47,000 --> 01:26:49,771
So we can actually measure that.

1668
01:26:49,771 --> 01:26:52,907
It goes about a
centimeter and a half,

1669
01:26:52,907 --> 01:26:55,776
a little over half
and inch up and down

1670
01:26:55,776 --> 01:26:57,244
when Phobos goes over.

1671
01:26:57,244 --> 01:27:00,581
It turns out that we can
use that measurement as well

1672
01:27:00,581 --> 01:27:01,783
to look at the
inside of the planet

1673

01:27:01,783 --> 01:27:03,818
because how much
that goes up and down

1674
01:27:03,818 --> 01:27:06,520
depends on the
elasticity of the planet

1675
01:27:06,520 --> 01:27:08,823
and whether the corse
is solid or liquid.

1676
01:27:08,823 --> 01:27:13,595
So we'll be able to use that
measurement as it happens

1677
01:27:14,494 --> 01:27:16,230
every seven hours or so on Mars

1678
01:27:16,230 --> 01:27:19,032
to probe the inside
of the planet.

1679
01:27:19,032 --> 01:27:21,302
- [Ivan] And if I may,
could there be some

1680
01:27:21,302 --> 01:27:24,105
magma movement at
all from the inside?

1681
01:27:25,506 --> 01:27:28,175
- There could be
Magma motion on Mars.

1682
01:27:28,175 --> 01:27:31,145
The are that we're landing
in is pretty featureless.

1683
01:27:31,145 --> 01:27:34,849

I mean, it was a lava
plane, but it was put down

1684
01:27:34,849 --> 01:27:36,084
several billion years ago.

1685
01:27:36,084 --> 01:27:39,353
So we're not
expecting any active

1686
01:27:39,353 --> 01:27:42,322
volcanic activity in our region.

1687
01:27:42,322 --> 01:27:43,657
It's possible that it could be

1688
01:27:43,657 --> 01:27:45,393
happening somewhere
else on Mars.

1689
01:27:46,994 --> 01:27:48,929
It's conceivable that
we could pick that up

1690
01:27:48,929 --> 01:27:52,933
with our seismic instruments,
but we're not expecting it.

1691
01:27:52,933 --> 01:27:56,070
- Yeah, but we are
in a good place.

1692
01:27:56,070 --> 01:27:59,373
It's about a thousand
kilometers to an area

1693
01:27:59,373 --> 01:28:02,309
that may have been
volcanically active in the last

1694
01:28:02,309 --> 01:28:05,313
10 million years, so for
Mars, that's like yesterday.

1695
01:28:05,313 --> 01:28:07,147
So we can hope.

1696
01:28:07,147 --> 01:28:08,983
We can hope that we might hear

1697
01:28:08,983 --> 01:28:10,684
some magma deep
under the ground.

1698
01:28:10,684 --> 01:28:12,920
Not at the surface,
but deep underground.

1699
01:28:12,920 --> 01:28:13,888
- [Ivan] Thank you.

1700
01:28:15,122 --> 01:28:17,424
- Okay, we're taking one
more from the phone line

1701
01:28:17,424 --> 01:28:18,726
and then we'll come
back into the room.

1702
01:28:18,726 --> 01:28:21,195
We're going now to
Space.com, go ahead.

1703
01:28:22,396 --> 01:28:23,798
- [Meghan] Thanks for
taking my question,

1704
01:28:23,798 --> 01:28:26,400
this is Meghan Bartels

from space.com.

1705
01:28:26,400 --> 01:28:28,802
I had a question for
Lori, I was hoping

1706
01:28:28,802 --> 01:28:31,639
you could talk sort
of big picture.

1707
01:28:31,639 --> 01:28:34,842
Why is it that we're
so fascinated with Mars

1708
01:28:34,842 --> 01:28:38,245
and we keep returning
with science missions?

1709
01:28:38,245 --> 01:28:41,181
What is it that really
captures us about the planet?

1710
01:28:41,181 --> 01:28:44,552
- That's a great question,
and Mars is an incredible

1711
01:28:44,552 --> 01:28:46,854
natural laboratory right
next door to earth.

1712
01:28:46,854 --> 01:28:49,557
And as I was eluding
to at the beginning,

1713
01:28:49,557 --> 01:28:53,761
we really want to understand
how we came up with

1714
01:28:53,761 --> 01:28:56,664
this diversity of rocky

planets in our solar system.

1715
01:28:56,664 --> 01:28:57,898
They're all very different.

1716
01:28:57,898 --> 01:29:00,768
Each one of them is
unique in it's own way

1717
01:29:00,768 --> 01:29:03,570
and trying to understand
how they ended up

1718
01:29:03,570 --> 01:29:05,706
so differently is a
really important question.

1719
01:29:05,706 --> 01:29:08,242
And Mars is a great
natural laboratory.

1720
01:29:08,242 --> 01:29:10,777
It's right there, it's
reasonably easy to get to,

1721
01:29:10,777 --> 01:29:13,047
we demonstrated that we can land

1722
01:29:13,047 --> 01:29:14,815
successfully on the
surface, we can conduct

1723
01:29:14,815 --> 01:29:18,685
scientific experiments for
long durations on the surface.

1724
01:29:18,685 --> 01:29:20,521
So it's very amenable to trying

1725

01:29:20,521 --> 01:29:22,323
to do these types
of investigations.

1726
01:29:22,323 --> 01:29:26,327
And in addition to that,
Mars has another piece of

1727
01:29:27,995 --> 01:29:32,233
intrigue for us, in that it
could potentially have had

1728
01:29:32,233 --> 01:29:35,069
a significant amount of
water there in the past.

1729
01:29:35,069 --> 01:29:37,838
We see lots of evidence
of that in the geology,

1730
01:29:37,838 --> 01:29:40,208
and so we do believe that
there was a lot of water there

1731
01:29:40,208 --> 01:29:42,643
and it could have
potentially been a place

1732
01:29:42,643 --> 01:29:46,247
where life could have formed
very early in Mars' history.

1733
01:29:46,247 --> 01:29:49,617
Of course, trying to
understand how life is or was

1734
01:29:49,617 --> 01:29:51,885
distributed across our
solar system is one of the

1735

01:29:51,885 --> 01:29:53,621
major questions that we have.

1736
01:29:53,621 --> 01:29:54,755
Are we alone?

1737
01:29:54,755 --> 01:29:57,024
Were we alone
sometime in the past?

1738
01:29:57,024 --> 01:29:59,060
So Mars is an
intriguing destination

1739
01:29:59,060 --> 01:30:01,929
for that purpose as well,
trying to really understand

1740
01:30:01,929 --> 01:30:04,899
what those conditions were
like 4 billion years ago.

1741
01:30:04,899 --> 01:30:09,570
Did life actually begin on
Mars in that time frame?

1742
01:30:09,570 --> 01:30:11,805
And if it did, is
there any preservation

1743
01:30:11,805 --> 01:30:13,641
of that left on the surface?

1744
01:30:13,641 --> 01:30:15,676
Of course, that's not the
focus of the InSight mission,

1745
01:30:15,676 --> 01:30:18,112
but it is the focus of a lot
of the other investigations

1746
01:30:18,112 --> 01:30:19,814
that we're interested
in on Mars.

1747
01:30:19,814 --> 01:30:23,084
So trying to better understand
Mars in that context

1748
01:30:23,084 --> 01:30:24,585
is important.

1749
01:30:24,585 --> 01:30:27,154
And then finally, as it
was alluded to this morning

1750
01:30:27,154 --> 01:30:30,024
in the mission briefing
by doctor Za-bu-ken,

1751
01:30:30,024 --> 01:30:33,494
we'd like to eventually
get humans back on Mars.

1752
01:30:33,494 --> 01:30:36,063
We're interested in a
campaign now in returning

1753
01:30:36,063 --> 01:30:38,665
humans to the moon,
and eventually,
getting humans to Mars.

1754
01:30:38,665 --> 01:30:41,536
Again, another destination
in our solar system

1755
01:30:41,536 --> 01:30:44,371
where we feel it is amenable
to human exploration

1756
01:30:44,371 --> 01:30:47,708
and a place where we could go
at some point in the future.

1757
01:30:47,708 --> 01:30:50,511
And science drives our
understanding that allows us

1758
01:30:50,511 --> 01:30:53,847
to get humans to
a place like Mars.

1759
01:30:53,847 --> 01:30:56,483
So the more exploration we
have, the better we understand

1760
01:30:56,483 --> 01:30:58,352
that environment, and
the better prepared

1761
01:30:58,352 --> 01:31:01,122
we'll be to send humans
to Mars in the future.

1762
01:31:02,523 --> 01:31:04,558
- [Meghan] Great,
thanks so much.

1763
01:31:04,558 --> 01:31:06,227
- Okay, we're gonna bring
it back into the room here

1764
01:31:06,227 --> 01:31:08,628
for questions from media,
and then from social media,

1765
01:31:08,628 --> 01:31:09,830
I see our team over here working

1766
01:31:09,830 --> 01:31:11,332
furiously collecting
your questions.

1767
01:31:11,332 --> 01:31:12,366
So stand by for that.

1768
01:31:12,366 --> 01:31:13,567
Go ahead with your question.

1769
01:31:13,567 --> 01:31:15,502
- Hey, Charley Shelton
with C. B. Weekly.

1770
01:31:15,502 --> 01:31:19,072
I have a question about
the Olympus Mons formation.

1771
01:31:19,072 --> 01:31:21,742
What is it that's
different between

1772
01:31:21,742 --> 01:31:24,779
earth and Mars about
tectonic motion?

1773
01:31:24,779 --> 01:31:27,615
Why do that plates not
move, and allow something

1774
01:31:27,615 --> 01:31:28,983
so big to build up?

1775
01:31:31,719 --> 01:31:33,687
- That's part of
what we hope to learn

1776
01:31:33,687 --> 01:31:35,022
from this mission in fact.

1777
01:31:37,191 --> 01:31:39,527
The shorter answer is
that Mars is a lot smaller

1778
01:31:39,527 --> 01:31:42,863
than the earth, and so it
doesn't have the same amount

1779
01:31:42,863 --> 01:31:47,034
of radiogenic material,
the same amount of heat

1780
01:31:47,034 --> 01:31:49,936
that it starts out with, so
just by being a smaller planet

1781
01:31:49,936 --> 01:31:52,206
it looses its heat more rapidly.

1782
01:31:52,206 --> 01:31:55,876
So you need to have a
ovigerous convection,

1783
01:31:55,876 --> 01:31:57,244
a lot of energy
inside the planet

1784
01:31:57,244 --> 01:32:00,514
to drive that motion
of plate tectonics.

1785
01:32:00,514 --> 01:32:04,385
People have proposed in the
past that maybe very early

1786
01:32:04,385 --> 01:32:06,319
in Mars' history, it
had plate tectonics.

1787
01:32:06,319 --> 01:32:08,689
Now, we don't have any
direct evidence of that,

1788
01:32:10,390 --> 01:32:12,593
and we don't expect to
see evidence of that

1789
01:32:12,593 --> 01:32:15,228
on Mars with our
mission, but you know,

1790
01:32:15,228 --> 01:32:16,730
it's always the things
that we don't expect

1791
01:32:16,730 --> 01:32:18,265
that turn out to be
the most intriguing.

1792
01:32:18,265 --> 01:32:22,436
So who knows what we'll
find in the interior.

1793
01:32:22,436 --> 01:32:23,971
- A follow up to that,

1794
01:32:23,971 --> 01:32:25,640
is there any way to tell,
either from aerial view

1795
01:32:25,640 --> 01:32:28,341
or from a mission like this,
maybe in a different area,

1796
01:32:28,341 --> 01:32:31,778
if there is a previously
active subduction zone

1797

01:32:31,778 --> 01:32:33,413
or any of those other things?

1798
01:32:33,413 --> 01:32:36,784
Or can you tell even where any
of the transform faults are?

1799
01:32:38,652 --> 01:32:42,422
- So people had proposed
that there might have been

1800
01:32:42,422 --> 01:32:46,060
subduction, and we do see
evidence transform faults

1801
01:32:46,060 --> 01:32:48,863
from the high resolution
typography data that we have.

1802
01:32:49,863 --> 01:32:51,431
In the past people had proposed

1803
01:32:51,431 --> 01:32:54,402
that there might be
subduction zones on Mars.

1804
01:32:54,402 --> 01:32:57,504
We think that...
that's not the leading

1805
01:32:57,504 --> 01:33:00,007
hypothesis for how the
Northern Planes formed.

1806
01:33:00,007 --> 01:33:03,243
It was previously
proposed as an option for

1807
01:33:03,243 --> 01:33:07,381
how that low typography in the

northern hemisphere formed.

1808
01:33:07,381 --> 01:33:10,517
We now think it's likely
due to the presence

1809
01:33:10,517 --> 01:33:12,953
of a huge impact early
in Mars' history,

1810
01:33:12,953 --> 01:33:16,890
and we've come to that
hypothesis based on

1811
01:33:16,890 --> 01:33:20,026
the typography, the
gravity data, the geology

1812
01:33:20,026 --> 01:33:22,229
and the faults that
we see at the surface.

1813
01:33:22,229 --> 01:33:24,531
InSight will actually be
adding to our knowledge

1814
01:33:24,531 --> 01:33:26,567
of how these to
hemispheres formed.

1815
01:33:26,567 --> 01:33:29,036
We'll be understanding
the thickness of the crust

1816
01:33:29,036 --> 01:33:31,472
which we don't
know very well now,

1817
01:33:31,472 --> 01:33:33,673
We'll see if

there's a difference

1818
01:33:33,673 --> 01:33:35,609
in the composition
and the thickness,

1819
01:33:35,609 --> 01:33:37,744
we know that there's a
thickness difference between

1820
01:33:37,744 --> 01:33:41,014
the north and south, but
getting the exact difference

1821
01:33:41,014 --> 01:33:42,483
between those two will help us

1822
01:33:42,483 --> 01:33:45,086
better interpret
these hypotheses.

1823
01:33:46,520 --> 01:33:48,389
We assume it's going to
support the impact theory,

1824
01:33:48,389 --> 01:33:50,824
but again, we'll find out.

1825
01:33:50,824 --> 01:33:51,992
- [Charley] Thank you.

1826
01:33:51,992 --> 01:33:52,793
- [Woman] Alright,
we're taking a question

1827
01:33:52,793 --> 01:33:54,395
right here, go ahead.

1828
01:33:54,395 --> 01:33:57,130

- Hello, Steve
Gorman from Reuters.

1829
01:33:57,130 --> 01:34:01,869
Two question: One, how
long after InSight lands

1830
01:34:01,869 --> 01:34:04,638
if it arrives safely
and settles safely,

1831
01:34:04,638 --> 01:34:08,809
will it begin to conduct
the seismometer and the

1832
01:34:08,809 --> 01:34:10,711
heat probe begin
to do its thing?

1833
01:34:11,945 --> 01:34:13,313
And also, a very
specific question

1834
01:34:13,313 --> 01:34:16,050
about the sensitivity
of the seismometer.

1835
01:34:16,050 --> 01:34:18,319
I believe you said in
the past, Dr. Banerdt,

1836
01:34:18,319 --> 01:34:22,256
that it would measure
seismic waves as small as

1837
01:34:22,256 --> 01:34:23,924
the diameter, or
half the diameter,

1838
01:34:23,924 --> 01:34:26,126

or half the radius
of a hydrogen atom.

1839
01:34:26,126 --> 01:34:27,928
Could you give me
that one more time?

1840
01:34:27,928 --> 01:34:29,864
- Yeah that's right.

1841
01:34:29,864 --> 01:34:33,267
The sensitivity of
the seismometer is,

1842
01:34:34,468 --> 01:34:37,704
in acceleration units,
our requirement is 10

1843
01:34:37,704 --> 01:34:41,876
to the minus nine meters
per second squared.

1844
01:34:44,011 --> 01:34:47,281
If you turn that into
displacement, that comes down to

1845
01:34:47,281 --> 01:34:52,052
less than 10 to the -10,
which depending on exactly

1846
01:34:52,052 --> 01:34:53,787
how you define it,
it's about half

1847
01:34:53,787 --> 01:34:55,823
the radius of a hydrogen atom.

1848
01:34:55,823 --> 01:34:57,224
- Radius?
- Yes.

1849
01:34:57,224 --> 01:34:58,658
And we're actually a
little bit better than that

1850
01:34:58,658 --> 01:34:59,793
over part of the frequency band.

1851
01:34:59,793 --> 01:35:01,662
Thank you very much Philippe.

1852
01:35:01,662 --> 01:35:02,896
[laughter]

1853
01:35:02,896 --> 01:35:04,497
We're about a factor of
five better than that

1854
01:35:04,497 --> 01:35:06,934
in some parts of the frequency.

1855
01:35:06,934 --> 01:35:10,337
So yes, we're pretty
dog on sensitive.

1856
01:35:10,337 --> 01:35:14,909
One of the issues
that that give us,

1857
01:35:14,909 --> 01:35:17,344
is that it makes us
sensitive to everything else

1858
01:35:17,344 --> 01:35:18,878
that's happening
in our environment.

1859
01:35:18,878 --> 01:35:20,514
If there's a little bit of wind,

1860
01:35:20,514 --> 01:35:22,215
if the temperature
changes a little bit,

1861
01:35:22,215 --> 01:35:25,218
even if a little
pressure front goes by,

1862
01:35:25,218 --> 01:35:28,856
it's gonna change the
seismometer around.

1863
01:35:28,856 --> 01:35:32,592
So that's why we have a
weather station on board,

1864
01:35:32,592 --> 01:35:33,961
which we haven't
talked about much today

1865
01:35:33,961 --> 01:35:37,097
because it's not a part
of our core mission,

1866
01:35:37,097 --> 01:35:39,867
but we have a very
competent weather station

1867
01:35:39,867 --> 01:35:42,002
that's gonna give us
temperature, wind,

1868
01:35:42,002 --> 01:35:45,639
and barometric pressure
24 and a half hours a day,

1869
01:35:45,639 --> 01:35:46,840
[laughter]

1870
01:35:46,840 --> 01:35:49,276
everyday on Mars.

1871
01:35:49,276 --> 01:35:52,812
So in addition to
doing all this science

1872
01:35:52,812 --> 01:35:54,047
about the deep interior of Mars,

1873
01:35:54,047 --> 01:35:55,849
we're actually gonna
be contributing a lot

1874
01:35:55,849 --> 01:35:59,687
to understanding the surface
environment of Mars as well.

1875
01:36:00,821 --> 01:36:03,556
And in terms of how
long it's going to take

1876
01:36:03,556 --> 01:36:05,793
to get the instruments going,

1877
01:36:05,793 --> 01:36:10,564
InSight's kind of a laid
back, slow motion mission

1878
01:36:10,564 --> 01:36:13,200
compared to a lot of things
that we've done before.

1879
01:36:13,200 --> 01:36:17,170
We have a two year
mission to do our science,

1880
01:36:17,170 --> 01:36:19,239
so to get that mission

started, we have to get

1881
01:36:19,239 --> 01:36:20,707
our instruments on the ground.

1882
01:36:20,707 --> 01:36:23,643
It's gonna take us about
two or three months at least

1883
01:36:23,643 --> 01:36:25,545
to get our instruments
down, and that's because

1884
01:36:25,545 --> 01:36:27,814
we have to do a survey
of the area in front

1885
01:36:27,814 --> 01:36:30,417
of the spacecraft, and
make sure that we don't

1886
01:36:30,417 --> 01:36:31,851
put the instruments
down on a rock,

1887
01:36:31,851 --> 01:36:34,087
or in a hole, or
something like that.

1888
01:36:34,087 --> 01:36:36,523
Then we're very careful about

1889
01:36:36,523 --> 01:36:38,358
how we put the instruments down.

1890
01:36:38,358 --> 01:36:41,595
You saw the animation
that had the robotic arm

1891

01:36:41,595 --> 01:36:44,364
going and picking up
the instruments and
putting them down.

1892
01:36:44,364 --> 01:36:46,400
It actually goes a lot
more slowly than that,

1893
01:36:46,400 --> 01:36:49,737
and we have a whole set of
activities that we go through

1894
01:36:49,737 --> 01:36:52,372
to ensure that when we put
those instruments on the ground

1895
01:36:52,372 --> 01:36:55,241
they're gonna be in a place
where they can operate properly

1896
01:36:55,241 --> 01:36:56,843
and get these kinds
of measurements.

1897
01:36:56,843 --> 01:37:00,747
So it's gonna take us,
probably a month or two

1898
01:37:00,747 --> 01:37:02,816
to get the seismometer down,
and another month or so

1899
01:37:02,816 --> 01:37:05,285
to get the heat flow probe down

1900
01:37:05,285 --> 01:37:07,254
and penetrating down
into the surface.

1901

01:37:08,588 --> 01:37:11,158
We're gonna get
some photos and some

1902
01:37:11,158 --> 01:37:13,060
preliminary data
back before that.

1903
01:37:13,060 --> 01:37:14,661
In order to really
get operating,

1904
01:37:14,661 --> 01:37:17,364
we're probably looking
at early next spring

1905
01:37:17,364 --> 01:37:19,265
when we're really gonna
start bringing back

1906
01:37:19,265 --> 01:37:21,168
that kind of science from Mars.

1907
01:37:21,168 --> 01:37:22,936
- [Steve] Thank you.

1908
01:37:22,936 --> 01:37:24,438
- Okay, we're going
to turn it over to the

1909
01:37:24,438 --> 01:37:26,673
social media team to tell
us some of the questions

1910
01:37:26,673 --> 01:37:28,175
that've been sent in.

1911
01:37:28,175 --> 01:37:30,744
- Well, Bruce anticipated
one of the hottest questions

1912
01:37:30,744 --> 01:37:32,312
out there, that
everyone was asking,

1913
01:37:32,312 --> 01:37:34,180
was how long until
we get the data.

1914
01:37:34,180 --> 01:37:35,883
And you mentioned the cameras.

1915
01:37:35,883 --> 01:37:38,552
Des-vain on Twitter asked,
"does InSight take pictures?

1916
01:37:38,552 --> 01:37:41,388
And if so, will we
be able to see them?"

1917
01:37:41,388 --> 01:37:43,524
- It does take pictures,
and you will definitely

1918
01:37:43,524 --> 01:37:44,458
be able to see them.

1919
01:37:44,458 --> 01:37:45,926
We have two cameras onboard.

1920
01:37:45,926 --> 01:37:48,895
We have one called our
instrument context camera,

1921
01:37:48,895 --> 01:37:50,164
and that's gonna take a picture

1922
01:37:50,164 --> 01:37:51,898
just a few minutes

after landing.

1923
01:37:51,898 --> 01:37:54,267
It's bolted to the
bottom of our deck

1924
01:37:54,267 --> 01:37:56,804
and it has a fisheye
view, so it's gonna show

1925
01:37:56,804 --> 01:38:01,809
about 120 degrees,
130 degrees of view

1926
01:38:02,976 --> 01:38:04,211
right in front of the
lander, and perhaps

1927
01:38:04,211 --> 01:38:06,079
even up a little bit
above the horizon

1928
01:38:06,079 --> 01:38:09,382
very close down
to the spacecraft.

1929
01:38:09,382 --> 01:38:11,451
That shows the entire
area that we're gonna be

1930
01:38:11,451 --> 01:38:14,855
trying to map out to
deploy our instruments on.

1931
01:38:14,855 --> 01:38:18,024
Then we also have
another camera,

1932
01:38:18,024 --> 01:38:20,160
it's actually attached

to the robotic arm.

1933
01:38:20,160 --> 01:38:23,697
It's a higher resolution camera,
and we use the arm itself

1934
01:38:23,697 --> 01:38:25,899
to point that camera, and
we're gonna be able to

1935
01:38:25,899 --> 01:38:28,502
put together mosaics of
both the area in front

1936
01:38:28,502 --> 01:38:31,405
of the spacecraft,
and the entire region

1937
01:38:31,405 --> 01:38:32,906
around the spacecraft.

1938
01:38:32,906 --> 01:38:35,342
And those images are gonna
go out onto the internet

1939
01:38:36,543 --> 01:38:39,079
more or less right away,
as soon as we get them.

1940
01:38:39,079 --> 01:38:41,582
So we'll have raw images
out on the internet

1941
01:38:41,582 --> 01:38:44,551
for people to look at as
the mission progresses.

1942
01:38:44,551 --> 01:38:46,019
- Fantastic.

1943
01:38:46,019 --> 01:38:49,857
Okay, so Winter, in our
youtube chat, wants to know

1944
01:38:49,857 --> 01:38:52,225
"how will the InSight
seismometer be able to map

1945
01:38:52,225 --> 01:38:56,363
the internal structure of Mars
in 3-D with just one sensor?

1946
01:38:56,363 --> 01:38:57,964
How is that accomplished?"

1947
01:38:57,964 --> 01:39:00,901
And Rabicooper over
on Twitter, follows up

1948
01:39:00,901 --> 01:39:02,736
"Don't we need two
or three to determine

1949
01:39:02,736 --> 01:39:04,804
the inner composition?"

1950
01:39:04,804 --> 01:39:06,006
- You would think, wouldn't you?

1951
01:39:06,006 --> 01:39:07,508
[laughter]

1952
01:39:07,508 --> 01:39:10,443
So usually, if anybody knows
anything about seismology,

1953
01:39:10,443 --> 01:39:11,778
you know that you need at least

1954
01:39:11,778 --> 01:39:14,581
three seismometers
to do seismology.

1955
01:39:14,581 --> 01:39:17,117
And that's true, unless you
get really clever about it.

1956
01:39:17,117 --> 01:39:18,752
So we had to get clever.

1957
01:39:18,752 --> 01:39:22,089
I mean, we actually had
lots of concepts of missions

1958
01:39:22,089 --> 01:39:24,357
that had three landers
or four landers.

1959
01:39:24,357 --> 01:39:27,394
We even had a concept with 18
landers on Mars at one time

1960
01:39:27,394 --> 01:39:31,798
and none of those got funded
because they're very expensive.

1961
01:39:31,798 --> 01:39:34,134
So we had to go back
to the drawing board

1962
01:39:34,134 --> 01:39:36,970
and figure out how
can you do seismology,

1963
01:39:36,970 --> 01:39:40,641
real, quantitative seismology,
with a single seismometer?

1964

01:39:40,641 --> 01:39:42,643
It turns out there are
quite a few techniques

1965
01:39:42,643 --> 01:39:44,311
that are available to us.

1966
01:39:46,480 --> 01:39:47,714
And people have used
this on the Earth,

1967
01:39:47,714 --> 01:39:52,353
but they get eclipsed
by the array seismology

1968
01:39:53,854 --> 01:39:55,889
that we normally do.

1969
01:39:55,889 --> 01:39:57,791
One of the things we do on
Mars, is we use the fact

1970
01:39:57,791 --> 01:40:00,560
that Mars is small
to our advantage.

1971
01:40:00,560 --> 01:40:03,630
And what happens is that,
in addition to the P waves

1972
01:40:03,630 --> 01:40:08,635
and the S waves that
you normally hear
about in seismology

1973
01:40:10,070 --> 01:40:11,605
is there's also something
called a surface wave.

1974
01:40:11,605 --> 01:40:13,373

That's a separate kind of
wave that travels along

1975
01:40:13,373 --> 01:40:14,874
the surface of the planet.

1976
01:40:14,874 --> 01:40:19,112
So in addition to the P
and the S wave, we also get

1977
01:40:19,112 --> 01:40:22,015
the surface wave, which
travels to the seismometer.

1978
01:40:22,015 --> 01:40:23,650
And there's another one
that goes the other way

1979
01:40:23,650 --> 01:40:25,418
around the planet, and
comes in the long way.

1980
01:40:25,418 --> 01:40:28,989
So there's two extra,
what we call rivals.

1981
01:40:28,989 --> 01:40:30,991
And finally, the one
that's gone all the way

1982
01:40:30,991 --> 01:40:32,626
around the planet
can go around again,

1983
01:40:32,626 --> 01:40:33,894
and hit our seismometer.

1984
01:40:33,894 --> 01:40:35,695
And these things can
keep going around.

1985
01:40:35,695 --> 01:40:37,865
They get a little bit
smaller and smaller

1986
01:40:37,865 --> 01:40:39,265
each time obviously.

1987
01:40:39,265 --> 01:40:42,769
So we use that extra information
to be able to figure out

1988
01:40:42,769 --> 01:40:47,107
how far away the marsquake
is, and we can actually use

1989
01:40:47,107 --> 01:40:49,376
what's called polarization
analysis to figure out

1990
01:40:49,376 --> 01:40:50,644
which direction
it's coming from.

1991
01:40:50,644 --> 01:40:53,580
So instead of having
to triangulate on it

1992
01:40:53,580 --> 01:40:57,851
using multiple seismometers,
we're able to use the

1993
01:40:57,851 --> 01:41:00,720
extra information that's
contained later on

1994
01:41:00,720 --> 01:41:03,089
in the seismogram in
order to get the distance

1995
01:41:03,089 --> 01:41:04,091
and the direction.

1996
01:41:05,893 --> 01:41:08,028
And it gets more
complicated than that,

1997
01:41:08,028 --> 01:41:12,265
but that's sorta
the basic method.

1998
01:41:12,265 --> 01:41:13,867
- We've got a mountain
of questions Veronica,

1999
01:41:13,867 --> 01:41:15,035
how much time do we have?

2000
01:41:15,035 --> 01:41:16,602
- I think we're good,
go for one more,

2001
01:41:16,602 --> 01:41:18,305
then I'll do a final
look in the room here

2002
01:41:18,305 --> 01:41:19,439
to see if there's
other questions.

2003
01:41:19,439 --> 01:41:21,007
Go ahead.

2004
01:41:21,007 --> 01:41:22,342
- Okay, I have a two-parter.

2005
01:41:22,342 --> 01:41:24,244
Oscer wants to know, is
there an opportunity for

2006
01:41:24,244 --> 01:41:28,415
citizen's science to
participate with this mission?

2007
01:41:30,650 --> 01:41:34,288
- Well, we will be putting
the seismic data out

2008
01:41:34,288 --> 01:41:39,259
on the internet within a few
months after acquisition.

2009
01:41:41,661 --> 01:41:43,396
If you're a citizen seismologist

2010
01:41:43,396 --> 01:41:46,032
you can certainly work on it.

2011
01:41:46,032 --> 01:41:47,166
[laughter]

2012
01:41:47,166 --> 01:41:49,235
We'll also be putting
the images out

2013
01:41:49,235 --> 01:41:54,241
and there's a very
vigorous community of photo

2014
01:41:55,408 --> 01:41:58,011
interpreters out there
that have been doing

2015
01:41:58,011 --> 01:42:01,815
photo interpretation on
Mars images for many years,

2016
01:42:01,815 --> 01:42:04,584

and our images will be
available for that as well.

2017
01:42:04,584 --> 01:42:08,688
We also have something called
Seismometers in the Schools,

2018
01:42:08,688 --> 01:42:11,124
and we're actually gonna
be sending the seismic data

2019
01:42:11,124 --> 01:42:14,794
out to schools who are
participating in our program

2020
01:42:14,794 --> 01:42:17,431
at the same time that our
scientists and our team

2021
01:42:17,431 --> 01:42:18,865
are going to get it.

2022
01:42:18,865 --> 01:42:23,737
So the students at various
middle schools and high schools

2023
01:42:23,737 --> 01:42:26,673
are gonna be getting our
data in close to real time

2024
01:42:26,673 --> 01:42:30,310
and they'll be able to try
their own interpretations

2025
01:42:30,310 --> 01:42:31,812
on it and so forth.

2026
01:42:31,812 --> 01:42:33,846
We're hoping that they
don't beat us to the punch

2027
01:42:33,846 --> 01:42:35,715
in any of the big discoveries.

2028
01:42:35,715 --> 01:42:36,649
[laughter]

2029
01:42:36,649 --> 01:42:38,551
But we'll see what happens.

2030
01:42:38,551 --> 01:42:40,586
- And additionally we have
the Mars weather service.

2031
01:42:40,586 --> 01:42:42,622
So you can get information about

2032
01:42:42,622 --> 01:42:44,391
the weather daily at our site.

2033
01:42:44,391 --> 01:42:47,994
You can get wind,
atmospheric temperatures,

2034
01:42:47,994 --> 01:42:49,595
surface tempuratures,
so you'll also

2035
01:42:49,595 --> 01:42:51,632
get a daily weather
report from our site.

2036
01:42:53,666 --> 01:42:55,502
- Okay, let me ask one more
time out here in the audience,

2037
01:42:55,502 --> 01:42:58,472
yes we do have a question here,
we'll get you a microphone.

2038
01:43:01,407 --> 01:43:03,710
- Scott Sullivan from
the Weather Network.

2039
01:43:03,710 --> 01:43:06,680
I'm really interested in knowing
about the weather on Mars.

2040
01:43:06,680 --> 01:43:11,117
So as far as I understand is
the first continuous weather

2041
01:43:11,117 --> 01:43:13,419
monitor that we've put on Mars.

2042
01:43:13,419 --> 01:43:16,155
Previous missions
have had weather,

2043
01:43:16,155 --> 01:43:19,459
but it's very distinct
measurements every day.

2044
01:43:19,459 --> 01:43:21,594
This is going to
be, as you said,

2045
01:43:21,594 --> 01:43:23,463
24 and a half hours of everyday.

2046
01:43:24,831 --> 01:43:27,134
Do you anticipate learning
anything really new

2047
01:43:27,134 --> 01:43:30,270
about Mars' weather that we
didn't know about before?

2048

01:43:30,270 --> 01:43:33,540
- The short answer is yes.

2049
01:43:33,540 --> 01:43:36,476
I don't know what it is,
we'll have to discover it,

2050
01:43:36,476 --> 01:43:37,911
but yes.

2051
01:43:37,911 --> 01:43:40,480
Every time we go to a
planet and look at something

2052
01:43:40,480 --> 01:43:43,317
differently with a
different set of instruments

2053
01:43:43,317 --> 01:43:46,419
in a different way, we always
discover something new.

2054
01:43:46,419 --> 01:43:50,890
This is, as you said, going
to be a unique data set

2055
01:43:50,890 --> 01:43:52,658
of continuous measurements.

2056
01:43:52,658 --> 01:43:56,196
Temperature, berametric
pressure, wind,

2057
01:43:56,196 --> 01:43:59,532
speed and direction,
all day long,

2058
01:43:59,532 --> 01:44:02,702
all night, over the
entire Mars season.

2059
01:44:02,702 --> 01:44:05,839
And that's obviously
going to, I think,

2060
01:44:05,839 --> 01:44:10,644
have an enormous wealth of
scientific information for us.

2061
01:44:12,813 --> 01:44:15,148
- Okay, we're gonna take one
more social media question

2062
01:44:15,148 --> 01:44:17,317
and a reminder that if you
have sent in a question

2063
01:44:17,317 --> 01:44:19,819
with #askNASA, we'll
continue to answer those

2064
01:44:19,819 --> 01:44:21,121
after we go off the air.

2065
01:44:21,121 --> 01:44:22,656
Go ahead Stephanie.

2066
01:44:22,656 --> 01:44:26,259
- Alright, so this is for all
of our scientists here today.

2067
01:44:26,259 --> 01:44:28,695
Anna M. on Youtube
would like to know,

2068
01:44:28,695 --> 01:44:31,231
"what would be more
exciting for you?

2069

01:44:31,231 --> 01:44:33,500
A result that meets
your expectations?

2070
01:44:33,500 --> 01:44:35,902
Or something
completely unexpected?"

2071
01:44:36,937 --> 01:44:38,572
[laughter]

2072
01:44:38,572 --> 01:44:39,772
- That's an easy one

2073
01:44:39,772 --> 01:44:41,674
unexpected is always
a lot more fun.

2074
01:44:41,674 --> 01:44:42,875
- Yeah, I would agree with that.

2075
01:44:42,875 --> 01:44:44,377
Absolutely.

2076
01:44:44,377 --> 01:44:46,913
- Meeting your expectations
gives you a nice, warm feeling

2077
01:44:46,913 --> 01:44:48,649
and then you say
well, what's next?

2078
01:44:49,816 --> 01:44:51,718
If you see something
that's unexpected,

2079
01:44:51,718 --> 01:44:56,422
that always opens up a whole
new doorway into something

2080
01:44:56,422 --> 01:44:58,925
that you never had
thought of before.

2081
01:44:58,925 --> 01:45:02,895
And that's what a
scientist lives for really.

2082
01:45:02,895 --> 01:45:05,631
- Yeah, that's the coolest part.

2083
01:45:05,631 --> 01:45:08,769
What we don't know now
is the coolest part.

2084
01:45:08,769 --> 01:45:10,670
- I was just going to say,
that's what we do as explorers.

2085
01:45:10,670 --> 01:45:12,272
That's why we're here, that's
why we're doing what we do.

2086
01:45:12,272 --> 01:45:15,341
It's to find those unexpected
treasures that are out there,

2087
01:45:15,341 --> 01:45:17,577
the new discoveries that
are going to drive the next

2088
01:45:17,577 --> 01:45:20,614
mission and send us to
the next destination.

2089
01:45:23,517 --> 01:45:25,485
- Yeah, the root motivation
is exactly what they said.

2090

01:45:25,485 --> 01:45:26,720
I have nothing to add.

2091
01:45:26,720 --> 01:45:27,921
[laughter]

2092
01:45:27,921 --> 01:45:30,424
Except perhaps when
pointing to a precise...

2093
01:45:31,491 --> 01:45:33,960
There is a technology
called things,

2094
01:45:35,395 --> 01:45:36,629
there is the challenge of
the science of the discovery

2095
01:45:36,629 --> 01:45:39,432
that we are going to
make and there is also

2096
01:45:39,432 --> 01:45:40,800
a very interesting
thing during all of the

2097
01:45:40,800 --> 01:45:42,935
development and also following.

2098
01:45:42,935 --> 01:45:45,905
And it is to work together
with a different culture,

2099
01:45:45,905 --> 01:45:49,342
with different languages,
different money.

2100
01:45:49,342 --> 01:45:50,610
[laughter]

2101
01:45:50,610 --> 01:45:54,147
and it's definitely very
interesting that people

2102
01:45:54,147 --> 01:45:57,083
on earth are able
to work together

2103
01:45:57,083 --> 01:46:01,054
before we wanted to talk
with Martians, for example.

2104
01:46:01,054 --> 01:46:03,323
[laughter]

2105
01:46:04,857 --> 01:46:07,293
- Okay, that concludes
our briefing for today,

2106
01:46:07,293 --> 01:46:10,363
thank you all so much
for spending time here.

2107
01:46:10,363 --> 01:46:12,032
[applause] Thank you
Tilman for joining us

2108
01:46:12,032 --> 01:46:14,400
all the way from Germany, we
look forward to having you

2109
01:46:14,400 --> 01:46:17,136
out here for landing.

2110
01:46:17,136 --> 01:46:18,438
- [Tilman] I'll be
coming on Friday!

2111
01:46:18,438 --> 01:46:19,272

- Okay!

2112
01:46:20,740 --> 01:46:23,410
Now, I want to remind you
about all of the different

2113
01:46:23,410 --> 01:46:26,946
activities we've got going
on up through landing.

2114
01:46:26,946 --> 01:46:31,250
So, to watch our
schedule on Sunday,

2115
01:46:31,250 --> 01:46:34,120
which will be our final mission

2116
01:46:34,120 --> 01:46:36,423
news conference before landing.

2117
01:46:36,423 --> 01:46:39,659
Then also that afternoon we
have a NASA social program

2118
01:46:39,659 --> 01:46:41,727
that will also be
televised on NASA TV.

2119
01:46:41,727 --> 01:46:45,832
So we have the news briefing
at 10 a.m. Pacific time,

2120
01:46:45,832 --> 01:46:49,769
1 p.m. Eastern time, followed
by the NASA social event

2121
01:46:49,769 --> 01:46:52,071
which again, is a great Q &
A, another great opportunity

2122
01:46:52,071 --> 01:46:54,173
like this to send
in more questions.

2123
01:46:54,173 --> 01:46:57,777
That will be at 1 p.m. Pacific
time, 4 p.m. Eastern time.

2124
01:46:57,777 --> 01:47:01,514
And then landing day itself,
Monday, November 26th,

2125
01:47:01,514 --> 01:47:03,749
we want you to join us.

2126
01:47:03,749 --> 01:47:06,585
The landing itself takes place
at about noon Pacific time,

2127
01:47:06,585 --> 01:47:09,722
3 p.m. Eastern, and
our commentary begins

2128
01:47:09,722 --> 01:47:11,757
one hour prior to that.

2129
01:47:11,757 --> 01:47:14,794
And there are multiple
ways that you can watch.

2130
01:47:14,794 --> 01:47:18,831
The easiest way
is NASA.gov/live.

2131
01:47:18,831 --> 01:47:20,800
Bookmark that now so
you have it for Monday.

2132
01:47:20,800 --> 01:47:22,402

You're gonna be
online Monday anyway

2133
01:47:22,402 --> 01:47:24,004
for cyber Monday, you're
gonna be shopping,

2134
01:47:24,004 --> 01:47:25,672
just have that
extra screen open.

2135
01:47:26,839 --> 01:47:30,377
We also have a very good
toolkit with a lot of

2136
01:47:30,377 --> 01:47:33,012
in depth information
about the mission,

2137
01:47:33,012 --> 01:47:36,348
a lot of fact sheets,
and a very good list

2138
01:47:36,348 --> 01:47:37,984
of multiple ways you can watch.

2139
01:47:37,984 --> 01:47:42,722
That url is
go.nasa.gov/InSightToolkit.

2140
01:47:44,757 --> 01:47:46,860
There are great tabs
there, you wanna click on

2141
01:47:46,860 --> 01:47:49,095
Watch Online, you will
get a full list of all

2142
01:47:49,095 --> 01:47:52,131
the different platforms where

you can watch our broadcast,

2143
01:47:52,131 --> 01:47:54,901
including our 360 degree camera

2144
01:47:54,901 --> 01:47:56,902
from inside Mission Control.

2145
01:47:56,902 --> 01:47:59,839
You will also find on that site

2146
01:47:59,839 --> 01:48:02,575
a tab that says Watch In Person.

2147
01:48:02,575 --> 01:48:04,911
That includes a long
list of public viewing

2148
01:48:04,911 --> 01:48:06,946
events across the country.

2149
01:48:06,946 --> 01:48:09,282
You've got viewing events
from here in Los Angeles

2150
01:48:09,282 --> 01:48:12,451
at Cal Tech, and the
California Science Center,

2151
01:48:12,451 --> 01:48:14,520
all the way across the
country to New York

2152
01:48:14,520 --> 01:48:16,656
in Times Square on
the Nasdaq Tower,

2153
01:48:16,656 --> 01:48:18,124
and all the way into Europe.

2154
01:48:18,124 --> 01:48:20,760
So please go to that site
if you want join into

2155
01:48:20,760 --> 01:48:23,929
a real conversation
about landing, do that.

2156
01:48:23,929 --> 01:48:26,165
And we look forward to
having you back here

2157
01:48:26,165 --> 01:48:29,769
on Sunday for the news briefing,
and Monday for landing.

2158
01:48:29,769 --> 01:48:33,072
And as we go into this
Thanksgiving holiday

2159
01:48:33,072 --> 01:48:36,075
in the United States, I
just want to wish everyone

2160
01:48:36,075 --> 01:48:38,711
a very safe and
happy Thanksgiving,

2161
01:48:38,711 --> 01:48:40,079
and thank you again
for joining us.

2162
01:48:40,079 --> 01:48:41,548
We'll see you on Sunday.

2163
01:48:43,016 --> 01:48:44,517
[applause]

2164

01:48:44,517 --> 01:48:45,685
We're gonna play back all
the graphics you've seen