



1  
00:00:04,904 --> 00:00:06,673  
Welcome to Watch  
this Space.

2  
00:00:06,740 --> 00:00:09,609  
I'm NASA Administrator  
Jim Bridenstine.

3  
00:00:09,676 --> 00:00:12,679  
Today I want to start by  
celebrating the amazing

4  
00:00:12,746 --> 00:00:16,750  
accomplishments of our  
Opportunity rover on Mars.

5  
00:00:16,816 --> 00:00:20,420  
Originally planned for  
just 90-days, Opportunity

6  
00:00:20,487 --> 00:00:23,156  
explored the Red Planet  
for an astonishing

7  
00:00:23,223 --> 00:00:24,958  
15-years.

8  
00:00:25,024 --> 00:00:28,561  
Along with its sister  
rover Spirit, which also

9  
00:00:28,628 --> 00:00:31,698  
far outlived its original  
mission, Opportunity

10  
00:00:31,765 --> 00:00:34,167  
brought us new discoveries  
about our planetary

11

00:00:34,234 --> 00:00:37,704  
neighbor that will inform  
future robotic missions

12  
00:00:37,771 --> 00:00:40,740  
and even human  
missions to Mars.

13  
00:00:40,807 --> 00:00:43,343  
We gave an update on  
the mission February

14  
00:00:43,410 --> 00:00:45,779  
thirteenth at our Jet  
Propulsion Laboratory.

15  
00:00:46,379 --> 00:00:49,949  
Last night the team  
made its final planned

16  
00:00:50,016 --> 00:00:50,683  
commands.

17  
00:00:50,750 --> 00:00:53,586  
At the time part of the  
team went up to Mission

18  
00:00:53,653 --> 00:00:57,824  
Control to send up more  
commands to ask the rover

19  
00:00:57,891 --> 00:00:59,058  
to respond.

20  
00:00:59,125 --> 00:01:01,795  
One-way light time is  
about thirteen and a half

21  
00:01:01,861 --> 00:01:02,629  
minutes.

22

00:01:02,695 --> 00:01:04,597

It took thirteen and a  
half minutes to get a

23

00:01:04,664 --> 00:01:09,002

signal up to Mars and if  
the rover did respond it

24

00:01:09,068 --> 00:01:10,770

would take another  
thirteen and a half

25

00:01:10,837 --> 00:01:11,871

minutes to come back.

26

00:01:11,938 --> 00:01:15,575

To find out more on what  
the outcome was from last

27

00:01:15,642 --> 00:01:18,178

night, I'd like to  
introduce you to the panel

28

00:01:18,244 --> 00:01:18,845

right now.

29

00:01:18,912 --> 00:01:21,815

We begin with  
introductions, our JPL

30

00:01:21,881 --> 00:01:25,685

Director, Mike Watkins,  
the NASA Administrator Jim

31

00:01:25,752 --> 00:01:28,955

Bridenstine, and also the  
Associate Administrator

32

00:01:29,022 --> 00:01:30,390  
Thomas Zurbuchen.

33  
00:01:30,457 --> 00:01:34,027  
Thomas we'll  
start with you.

34  
00:01:34,093 --> 00:01:37,397  
Thank you so much, I was  
there yesterday and I was

35  
00:01:37,464 --> 00:01:40,900  
there with the team as  
these commands went out

36  
00:01:40,967 --> 00:01:45,538  
into the deep sky, and I  
learned this morning that

37  
00:01:45,605 --> 00:01:47,574  
we had not heard back.

38  
00:01:47,640 --> 00:01:52,378  
And our Opportunity  
remained silent.

39  
00:01:52,445 --> 00:01:57,884  
It is therefore that I am  
standing here with a sense

40  
00:01:57,951 --> 00:02:02,789  
of deep appreciation and  
gratitude that I declare

41  
00:02:02,856 --> 00:02:05,558  
that the Opportunity  
mission as complete.

42  
00:02:05,625 --> 00:02:08,962  
And with it the Mars

## Exploration Rover mission

43

00:02:09,028 --> 00:02:10,497  
as complete.

44

00:02:10,563 --> 00:02:14,801  
This is a celebration of  
so many achievements.

45

00:02:14,868 --> 00:02:18,805  
I'll just start by saying  
that when this little

46

00:02:18,872 --> 00:02:22,242  
rover landed, the  
objective was to have it

47

00:02:22,308 --> 00:02:26,112  
be able to move eleven  
hundred yards and

48

00:02:26,179 --> 00:02:31,651  
survive for ninety days  
on Mars, ninety SOLs.

49

00:02:31,718 --> 00:02:35,688  
And instead here we are  
fourteen years later,

50

00:02:35,755 --> 00:02:38,992  
after twenty-eight miles  
of travel and today we get

51

00:02:39,058 --> 00:02:41,294  
to celebrate the  
end of this mission.

52

00:02:41,361 --> 00:02:44,230  
So its an honor for me as  
the NASA administrator to

53

00:02:44,297 --> 00:02:47,233

come out here to this  
amazing facility with so

54

00:02:47,300 --> 00:02:50,803

many amazingly talented  
people to say thank you

55

00:02:50,870 --> 00:02:54,407

for your great work, not  
just for our country, but

56

00:02:54,474 --> 00:02:56,409

for the science that  
people are going to be

57

00:02:56,476 --> 00:02:58,978

benefitting all over the  
world, their going to be

58

00:02:59,045 --> 00:03:01,447

benefitting from this  
science for years to come.

59

00:03:01,514 --> 00:03:04,017

Spirit and Opportunity may  
be gone, but they leave us

60

00:03:04,083 --> 00:03:07,186

a legacy, and that's a  
legacy of a new paradigm

61

00:03:07,253 --> 00:03:09,656

for solar system  
exploration.

62

00:03:09,722 --> 00:03:12,926

A robotic geologist on  
Mars and an integrated

63

00:03:12,992 --> 00:03:16,229  
science and engineering  
operations team here on Earth

64

00:03:16,296 --> 00:03:18,064  
all set out together on a  
mission of discovery.

65

00:03:18,131 --> 00:03:20,099  
They didn't know what they  
would find, they didn't

66

00:03:20,166 --> 00:03:21,968  
know which direction they  
would go, sometimes from

67

00:03:22,035 --> 00:03:24,704  
one day to the next,  
and they made it work.

68

00:03:24,771 --> 00:03:27,307  
And they made it work  
longer than any of us

69

00:03:27,373 --> 00:03:29,809  
thought possible, by both  
brilliant scientific

70

00:03:29,876 --> 00:03:31,878  
deduction of where to go,  
and brilliant engineering

71

00:03:31,945 --> 00:03:33,880  
to keep the rovers alive.

72

00:03:36,215 --> 00:03:42,221  
Cheering!

73

00:03:45,024 --> 00:03:47,594

Opportunity hit a  
hole-in-one when she landed.

74

00:03:47,660 --> 00:03:50,129

The airbag system rolled  
into this small crater

75

00:03:50,196 --> 00:03:53,099

called Eagle Crater, and  
when the rover first

76

00:03:53,166 --> 00:03:56,002

turned on its cameras, it  
saw that the rim of the of

77

00:03:56,069 --> 00:03:58,972

the small crater was lined  
with exposed bedrock.

78

00:03:59,038 --> 00:04:00,506

So we took out our  
microscope for the first

79

00:04:00,573 --> 00:04:03,343

time and we took a picture  
and the surface of Mars at

80

00:04:03,409 --> 00:04:05,979

that location is littered  
with an uncountable number

81

00:04:06,045 --> 00:04:07,380

of little round things.

82

00:04:07,447 --> 00:04:09,215

They were called  
blueberries because they

83

00:04:09,282 --> 00:04:11,317

looked like blueberries  
in a muffin.

84

00:04:11,384 --> 00:04:14,187

What we discovered was  
that those are features

85

00:04:14,253 --> 00:04:16,823

that form in water and  
they were a really

86

00:04:16,889 --> 00:04:19,959

definitive sign that there  
had been liquid water on

87

00:04:20,026 --> 00:04:22,795

the surface of Mars  
sometime in the past.

88

00:04:22,862 --> 00:04:24,897

And after we left Eagle  
Crater we went to

89

00:04:24,964 --> 00:04:27,333

Endurance Crater and  
that's the crater that we

90

00:04:27,400 --> 00:04:28,167

drove down in.

91

00:04:28,234 --> 00:04:31,037

And there we did what  
the geologist call and

92

00:04:31,104 --> 00:04:32,772

in-sequence  
stratigraphic section.

93

00:04:32,839 --> 00:04:35,575

Which is essentially

reading the chapters of

94

00:04:35,642 --> 00:04:37,844

the Martian history  
book in reverse order.

95

00:04:37,910 --> 00:04:39,445

That rover became  
a stratigrapher.

96

00:04:39,512 --> 00:04:42,348

The first time we had a  
stratigrapher on Mars.

97

00:04:44,550 --> 00:04:47,220

We knew we wanted to  
go after Endurance to

98

00:04:47,286 --> 00:04:47,987

Victoria.

99

00:04:48,054 --> 00:04:50,690

We put pedal to the metal  
and we started heading

100

00:04:50,757 --> 00:04:52,425

there, tens of  
kilometers away.

101

00:04:52,492 --> 00:04:56,029

We had to literally surf  
across these dunes of

102

00:04:56,095 --> 00:04:59,666

windblown material and the  
rover got stuck in one of

103

00:04:59,732 --> 00:05:00,366

those.

104  
00:05:00,433 --> 00:05:02,802  
We had to get the  
rover unstuck.

105  
00:05:02,869 --> 00:05:05,004  
What we found is that the  
best way to get it out is

106  
00:05:05,071 --> 00:05:07,907  
just to put it into  
reverse and gun it.

107  
00:05:07,974 --> 00:05:09,275  
The rover eventually  
popped out.

108  
00:05:09,342 --> 00:05:13,413  
And so we changed our  
driving strategy so we

109  
00:05:13,479 --> 00:05:15,782  
recognized these  
ripples as hazards.

110  
00:05:15,848 --> 00:05:19,218  
We get to this giant  
half-mile diameter crater,

111  
00:05:19,285 --> 00:05:21,854  
Victoria Crater, and we  
want to figure out, gee,

112  
00:05:21,921 --> 00:05:23,723  
how can we go  
into this thing?

113  
00:05:23,790 --> 00:05:25,391  
All the sudden we  
got HiRISE images.

114

00:05:25,458 --> 00:05:27,827

We could see the  
rover in the image.

115

00:05:27,894 --> 00:05:30,797

And that was the very  
first image that we got,

116

00:05:30,863 --> 00:05:33,900

from space, showing  
one of our rovers.

117

00:05:33,966 --> 00:05:37,537

We spent a year scouting  
the edge of that crater to

118

00:05:37,603 --> 00:05:40,807

decide where we wanted  
to go in to get the best

119

00:05:40,873 --> 00:05:42,108

stratigraphic section.

120

00:05:42,175 --> 00:05:44,844

We found a place to go  
in and we drove down in.

121

00:05:44,911 --> 00:05:48,581

We spent about a year  
inside Victoria Crater.

122

00:05:48,648 --> 00:05:50,550

The science team was  
really excited about the

123

00:05:50,616 --> 00:05:53,119

idea of driving to  
Endeavour Crater, over

124

00:05:53,186 --> 00:05:54,320  
twenty kilometers away.

125  
00:05:54,387 --> 00:05:55,922  
That was a long  
drive to do.

126  
00:05:55,988 --> 00:05:58,157  
It was going to take  
multiple years, but they

127  
00:05:58,224 --> 00:05:59,358  
decided to do it anyway.

128  
00:05:59,425 --> 00:06:02,361  
There were too many of  
these dangerous ripples in

129  
00:06:02,428 --> 00:06:04,864  
our way and we actually  
had to take this

130  
00:06:04,931 --> 00:06:08,034  
circuitous route that at  
times took us away from

131  
00:06:08,101 --> 00:06:11,270  
the crater only then to  
cut back and then approach

132  
00:06:11,337 --> 00:06:12,505  
it more directly.

133  
00:06:12,572 --> 00:06:14,107  
And then we pull up to  
Endeavour Crater and all

134  
00:06:14,173 --> 00:06:15,808  
the sudden there's all  
these new things to look

135

00:06:15,875 --> 00:06:16,476  
at.

136

00:06:16,542 --> 00:06:19,479  
We first discovered  
the Homestake vein.

137

00:06:19,545 --> 00:06:22,682  
It was this very, very  
bright linear feature.

138

00:06:22,749 --> 00:06:25,718  
It turns out that there  
was a big gypsum vein and

139

00:06:25,785 --> 00:06:27,954  
we see these gypsum  
veins now all over.

140

00:06:28,020 --> 00:06:30,289  
So it was our first taste  
of what was a really

141

00:06:30,356 --> 00:06:31,824  
important process on Mars.

142

00:06:31,891 --> 00:06:35,628  
We were driving to a  
valley and along the way

143

00:06:35,695 --> 00:06:37,797  
there we realized that  
right about the point we

144

00:06:37,864 --> 00:06:39,465  
were about to get to this  
valley that was when we

145

00:06:39,532 --> 00:06:41,000  
were going to cross  
the marathon mark.

146  
00:06:41,067 --> 00:06:41,701  
So we said "Well  
that's cool.

147  
00:06:41,768 --> 00:06:43,836  
We're just going to name  
this valley after that,

148  
00:06:43,903 --> 00:06:45,238  
call it Marathon Valley."

149  
00:06:45,304 --> 00:06:47,039  
That was when we  
reached the distance of a

150  
00:06:47,106 --> 00:06:49,675  
marathon, twenty-six point  
two miles on another

151  
00:06:49,742 --> 00:06:50,343  
planet.

152  
00:06:50,409 --> 00:06:53,246  
We continued driving  
through some slopes down a

153  
00:06:53,312 --> 00:06:56,249  
little bit on the interior  
of the crater rim until we

154  
00:06:56,315 --> 00:06:58,451  
came back out so we could  
continue on to the next

155  
00:06:58,518 --> 00:07:00,920  
valley, Perseverance

Valley, where the rover

156

00:07:00,987 --> 00:07:04,056  
was exploring when  
we lost contact.

157

00:07:04,123 --> 00:07:06,893  
We said we are going to  
operate this vehicle until

158

00:07:06,959 --> 00:07:08,961  
the day where we can't,  
and that's exactly what we

159

00:07:09,028 --> 00:07:11,230  
did and I'm really proud.

160

00:07:11,297 --> 00:07:14,233  
We set a foundation that  
will serve as the basis

161

00:07:14,300 --> 00:07:16,569  
for future exploration.

162

00:07:20,706 --> 00:07:23,609  
NASA is committed to  
sending humans forward to

163

00:07:23,676 --> 00:07:26,946  
the Moon in the next  
decade, and this time,

164

00:07:27,013 --> 00:07:28,347  
we're going to stay.

165

00:07:28,414 --> 00:07:31,317  
We want to establish a  
permanent, sustainable

166

00:07:31,384 --> 00:07:34,587

presence beyond Earth as  
we push farther into the

167

00:07:34,654 --> 00:07:35,988

solar system.

168

00:07:36,055 --> 00:07:38,558

To do that, we're going to  
need the next generation

169

00:07:38,624 --> 00:07:39,926

of lunar landers.

170

00:07:39,992 --> 00:07:42,628

We've already kicked off  
that process, and we held

171

00:07:42,695 --> 00:07:45,798

an industry day at NASA  
Headquarters on February

172

00:07:45,865 --> 00:07:48,601

fourteenth to discuss  
the next steps.

173

00:07:48,668 --> 00:07:58,744

■ ■

174

00:07:58,811 --> 00:08:03,816

Today we're highlighting a  
broad agency announcement

175

00:08:03,883 --> 00:08:05,985

about putting humans back  
on the surface of the

176

00:08:06,052 --> 00:08:06,986

Moon.

177

00:08:07,053 --> 00:08:09,555

And of course you're here  
today because one of your,

178

00:08:09,622 --> 00:08:13,259

your company is interested  
in participating in this

179

00:08:13,326 --> 00:08:14,427

activity.

180

00:08:14,493 --> 00:08:16,929

And we're very interested  
in your participation in a

181

00:08:16,996 --> 00:08:20,933

way that maybe  
historically NASA hasn't

182

00:08:21,000 --> 00:08:23,069

involved commercial  
industry in the way we're

183

00:08:23,135 --> 00:08:24,003

involving it today.

184

00:08:24,070 --> 00:08:26,138

And I'm going to tell  
you why we are doing it.

185

00:08:26,205 --> 00:08:28,875

The President issued what  
we call Space Policy

186

00:08:28,941 --> 00:08:30,343

Directive One.

187

00:08:30,409 --> 00:08:31,978

It says that we are going

to go back to the Moon,

188

00:08:32,044 --> 00:08:34,380

and I like to say we are  
going to go forward to the

189

00:08:34,447 --> 00:08:35,047

Moon.

190

00:08:35,114 --> 00:08:37,083

We're going to go to the  
Moon in a way that we have

191

00:08:37,149 --> 00:08:38,684

never gone to  
the Moon before.

192

00:08:38,751 --> 00:08:41,053

We are going to go with  
international partners.

193

00:08:41,120 --> 00:08:43,789

We are going to go with  
commercial partners.

194

00:08:43,856 --> 00:08:45,591

And here's the key  
element, we are going to

195

00:08:45,658 --> 00:08:47,260

go sustainably.

196

00:08:47,326 --> 00:08:50,596

In other words, this time  
when we go to the Moon, we

197

00:08:50,663 --> 00:08:51,831

are going to stay.

198

00:08:51,898 --> 00:08:54,166

We're not going back to  
the Moon to leave flags

199

00:08:54,233 --> 00:08:56,435

and footprints and then  
not go back for another

200

00:08:56,502 --> 00:08:58,437

fifty years, we're going  
to go sustainably, to

201

00:08:58,504 --> 00:08:59,538

stay.

202

00:08:59,605 --> 00:09:03,609

With landers and robots  
and rovers and humans and

203

00:09:03,676 --> 00:09:05,611

that's what we are here  
to talk about today.

204

00:09:05,678 --> 00:09:07,146

We're going to put humans  
on the surface of the

205

00:09:07,213 --> 00:09:07,813

Moon.

206

00:09:07,880 --> 00:09:09,448

We're going to build an  
architecture where we can

207

00:09:09,515 --> 00:09:12,985

go back and forth again  
and again and again.

208

00:09:13,052 --> 00:09:16,289

Another piece of Space

Policy Directive One is

209

00:09:16,355 --> 00:09:20,459  
actually using the  
resources of the Moon.

210

00:09:20,526 --> 00:09:23,529  
It was discovered back  
in 2008 that there was

211

00:09:23,596 --> 00:09:26,299  
potentially water ice on  
the surface of the Moon.

212

00:09:26,365 --> 00:09:29,702  
In 2009 NASA did a study  
and we've now discovered

213

00:09:29,769 --> 00:09:32,471  
that there's hundreds of  
billions of tons of water

214

00:09:32,538 --> 00:09:34,106  
ice on the surface  
of the Moon.

215

00:09:34,173 --> 00:09:37,510  
So, new American policy,  
we're going to utilize the

216

00:09:37,576 --> 00:09:38,978  
resources of the Moon.

217

00:09:39,045 --> 00:09:42,214  
Water ice represents  
oxygen, air to breath.

218

00:09:42,281 --> 00:09:45,151  
It represents water to  
drink, in other words,

219

00:09:45,217 --> 00:09:46,352  
life support.

220

00:09:46,419 --> 00:09:49,288  
But it also represents  
rocket fuel, hydrogen and

221

00:09:49,355 --> 00:09:51,490  
oxygen is the same fuel  
that powers the Space

222

00:09:51,557 --> 00:09:52,391  
Shuttle.

223

00:09:52,458 --> 00:09:54,994  
So all of that is abundant  
in hundreds of billions of

224

00:09:55,061 --> 00:09:56,996  
tons at the poles  
of the Moon.

225

00:09:57,063 --> 00:09:59,165  
So we're going to back to  
the Moon, we're going to

226

00:09:59,231 --> 00:10:00,933  
go forward to the Moon,  
we're going to go with

227

00:10:01,000 --> 00:10:02,635  
international partners,  
and with commercial

228

00:10:02,702 --> 00:10:04,203  
partners, we're going  
to go sustainably.

229

00:10:04,270 --> 00:10:07,039

We're going to utilize the  
resources of the Moon.

230

00:10:07,106 --> 00:10:08,274

We're going to  
retire risk.

231

00:10:08,341 --> 00:10:09,909

We're going to  
prove technology.

232

00:10:09,976 --> 00:10:11,711

And then we are going to  
take as much of this as

233

00:10:11,777 --> 00:10:15,848

possible and  
replicate it at Mars.

234

00:10:15,915 --> 00:10:19,151

And this all part of the  
President's Space Policy

235

00:10:19,218 --> 00:10:22,588

Directive One, that we  
here at NASA are charged

236

00:10:22,655 --> 00:10:23,990

with moving out on.

237

00:10:24,056 --> 00:10:26,392

And friends, we're  
moving out very quickly.

238

00:10:26,459 --> 00:10:28,995

This is the beginning  
where we really want, Jim

239

00:10:29,061 --> 00:10:31,330

and I wanted to kick off  
and kind of show you the

240

00:10:31,397 --> 00:10:33,933

bigger architecture the  
things we're planning and

241

00:10:34,000 --> 00:10:36,035

how we think this is very  
different that what we did

242

00:10:36,102 --> 00:10:38,204

before when we went to  
the Moon with humans.

243

00:10:38,270 --> 00:10:41,507

This really sustainable,  
this is going to be fast,

244

00:10:41,574 --> 00:10:43,209

we are going to need the  
best and brightest from

245

00:10:43,275 --> 00:10:45,077

you in industry, we're  
going to need the best and

246

00:10:45,144 --> 00:10:46,846

brightest from the  
international partner

247

00:10:46,912 --> 00:10:48,781

community to pull  
all this off.

248

00:10:48,848 --> 00:10:50,883

And we've got a great  
plan to do this.

249

00:10:50,950 --> 00:10:53,252

It all fits under Space  
Policy Directive One with

250  
00:10:53,319 --> 00:10:55,488  
sustainability, it  
fits under that.

251  
00:10:55,554 --> 00:10:58,391  
Win cooperation with  
industry, commercial

252  
00:10:58,457 --> 00:11:00,826  
partners and also  
international partners.

253  
00:11:02,294 --> 00:11:05,664  
I want to thank the entire  
NASA family for their hard

254  
00:11:05,731 --> 00:11:08,067  
work as we push the  
boundaries of human

255  
00:11:08,134 --> 00:11:11,704  
exploration, As we make  
new discoveries about our

256  
00:11:11,771 --> 00:11:15,441  
Earth, our solar system  
and the universe beyond,

257  
00:11:15,508 --> 00:11:20,012  
as we improve flight, and as  
we innovate new technologies.

258  
00:11:20,079 --> 00:11:22,748  
It's an exciting time  
and there's a lot on our

259  
00:11:22,815 --> 00:11:25,518

plate, but I know we'll  
continue to rise to the

260

00:11:25,584 --> 00:11:26,252  
challenge.

261

00:11:26,719 --> 00:11:29,155  
Thank you again for  
watching. Check out

262

00:11:29,221 --> 00:11:34,293  
[nasa.gov/watchthisspace](http://nasa.gov/watchthisspace)  
and follow me on Twitter

263

00:11:34,360 --> 00:11:35,361  
[@JimBridenstine](https://twitter.com/JimBridenstine).