
NASA EXPLORERS
THE SOUTH POLE

1
00:00:03,870 --> 00:00:05,105
(music
throughout) Imagine if you were an alien

2
00:00:05,105 --> 00:00:09,109
who was visiting the Earth
for the first time from some other galaxy.

3
00:00:09,442 --> 00:00:13,613
Imagine only visiting the United States
and never visiting any other part

4
00:00:13,613 --> 00:00:14,914
of the Earth's surface.

5
00:00:14,914 --> 00:00:17,951
That's essentially what we've done
with the Apollo missions, really been able

6
00:00:17,951 --> 00:00:21,988
to do wonderful and groundbreaking science
with the samples collected

7
00:00:21,988 --> 00:00:23,089
during the Apollo missions.

8
00:00:23,089 --> 00:00:28,328
But again, we visited only a very small
part of the lunar surface.

9
00:00:28,628 --> 00:00:31,097
The way that I think about it
is it's the equivalent of,

10
00:00:31,331 --> 00:00:35,835
you know, landing on Earth
and getting rocks from Kansas.

11
00:00:36,002 --> 00:00:39,506

It would give us insight
into one particular location on the earth,

12
00:00:39,506 --> 00:00:42,675
but not at all the diversity of what

13
00:00:42,675 --> 00:00:45,779
we see on the Earth,
what we know is present on the Earth.

14
00:00:46,046 --> 00:00:50,583
So the ability to go to a different site,
a different location, get different

15
00:00:50,717 --> 00:00:56,256
samples, will just enrich what we've
already learned from our Apollo samples.

16
00:00:57,490 --> 00:00:59,159
There's
a lot left to be learned about the moon,

17
00:00:59,159 --> 00:01:11,538
and it starts with the South Pole,

18
00:01:11,538 --> 00:01:15,308
Artemis astronauts will fulfill

19
00:01:15,308 --> 00:01:18,445
a different mission
in a unique environment.

20
00:01:18,445 --> 00:01:22,315
While the Apollo astronauts who visited
the moon's surface between 1969

21
00:01:22,315 --> 00:01:24,751
and 1972 landed near the equator.

22

00:01:25,351 --> 00:01:28,688
Artemis Astronauts will venture
to the moon's South Pole region

23
00:01:29,255 --> 00:01:32,559
frigid, rugged
and with unique light and darkness,

24
00:01:32,559 --> 00:01:35,862
conditions that make it an ideal location
for exploration.

25
00:01:35,962 --> 00:01:39,866
The South Pole region is also home
to the rim of the moon's largest,

26
00:01:40,166 --> 00:01:43,236
oldest and deepest crater
called South Pole Aitken.

27
00:01:44,070 --> 00:01:48,341
It takes up almost a quarter of the moon
and is so deep it

28
00:01:48,341 --> 00:01:52,645
exposes portions of the moon's interior.

29
00:01:52,779 --> 00:01:56,349
Yeah, the South Pole is it's fascinating.

30
00:01:56,483 --> 00:02:01,221
There are some very unique types of rocks
that are at the South Pole

31
00:02:01,521 --> 00:02:04,524
that will allow us to understand

32
00:02:04,524 --> 00:02:08,294
the entire history, not just of the moon,
but potentially of the solar system

33
00:02:09,729 --> 00:02:11,631
very early on in lunar history.

34
00:02:11,631 --> 00:02:16,002
We think that there was this
increased period or very intense

35
00:02:16,002 --> 00:02:20,874
period of huge material
hitting the surface of the moon, creating

36
00:02:20,874 --> 00:02:23,710
these really large craters or

37
00:02:24,010 --> 00:02:27,080
giant holes,
which we actually call basins.

38
00:02:27,113 --> 00:02:31,050
So getting a sample of impact
melt from this basin

39
00:02:31,518 --> 00:02:34,921
would kind of help us bracket
that early period of time.

40
00:02:35,355 --> 00:02:39,826
The Moon's South Pole region has resources
that are vital for long term exploration

41
00:02:40,560 --> 00:02:43,329
because the moon is barely tilted
relative to the sun.

42
00:02:43,730 --> 00:02:46,633
The sun hovers over the horizon
at the South Pole.

43

00:02:47,133 --> 00:02:49,869
Imagine a flashlight
turned on laying on a table.

44
00:02:50,336 --> 00:02:52,472
That's how the sun illuminates
the South Pole.

45
00:02:53,072 --> 00:02:55,808
Light at the South Pole
strikes at such a low angle,

46
00:02:55,808 --> 00:02:59,913
it brushes only areas of higher elevation,
such as crater rims.

47
00:03:00,647 --> 00:03:04,717
These locations have sunlight for extended
periods of time to harness for power.

48
00:03:05,318 --> 00:03:07,754
At the same time, the bottoms of some deep

49
00:03:07,754 --> 00:03:10,423
craters are shrouded in constant darkness.

50
00:03:11,191 --> 00:03:12,192
Scientists have measured

51
00:03:12,192 --> 00:03:15,461
the coldest temperatures
in the solar system inside these craters,

52
00:03:15,962 --> 00:03:20,733
which have become known as perfect environments for preserving water for eons.

53
00:03:23,670 --> 00:03:24,571
Over time,

54

00:03:24,571 --> 00:03:29,142
there is individual molecules of water
and carbon dioxide

55
00:03:29,142 --> 00:03:33,646
and other gases that actually bounce
around the surface of the moon.

56
00:03:33,813 --> 00:03:37,684
And when they get to one of these
cold spots, they actually get stuck.

57
00:03:37,784 --> 00:03:40,420
Though we call those places cold traps.

58
00:03:40,420 --> 00:03:44,290
And if you do that for millions
and even billions of years, you can

59
00:03:44,290 --> 00:03:49,862
actually build up a pretty significant
deposit of water and other ices.

60
00:03:50,463 --> 00:03:53,533
From an exploration perspective,
if we can understand

61
00:03:53,800 --> 00:03:55,401
just how much water there is

62
00:03:55,401 --> 00:03:58,738
and where it is and how to get it
out of the regolith of the moon,

63
00:03:58,938 --> 00:04:02,008
we can turn it into really important
things like drinking water

64
00:04:02,008 --> 00:04:05,144
for astronauts and even rocket fuel

to take them back home.

65
00:04:05,178 --> 00:04:08,481
So really understanding these resources
and how to use them

66
00:04:08,715 --> 00:04:10,917
is one of the objectives
of the Artemis program

67
00:04:10,917 --> 00:04:13,253
and it's what makes the South
Pole of the moon so exciting.

68
00:04:15,021 --> 00:04:17,156
We know the moon in incredible detail,

69
00:04:17,156 --> 00:04:21,427
thanks in large part to NASA's
Lunar Reconnaissance Orbiter, or LRO.

70
00:04:22,695 --> 00:04:25,498
LRO has been circling the moon since 2009.

71
00:04:26,132 --> 00:04:28,534
It's the longest lived spacecraft there.

72
00:04:28,935 --> 00:04:32,472
Through tens of thousands of orbits
and data from seven instruments,

73
00:04:32,939 --> 00:04:37,510
LRO has mapped the moon's temperature,
geology, radiation environment

74
00:04:37,510 --> 00:04:40,813
and is providing insight
on how the moon is changing over

75

00:04:40,813 --> 00:04:43,049
time.

76
00:04:44,450 --> 00:04:45,685
LRO is led by Dr.

77
00:04:45,685 --> 00:04:48,721
Noah Petro,
a planetary geologist at NASA's

78
00:04:48,721 --> 00:04:51,724
Goddard Space Flight Center.

79
00:04:53,860 --> 00:04:56,329
LRO is this incredible machine.

80
00:04:56,529 --> 00:05:01,734
It was launched in 2009 as the opportunity
to go back to the moon, to create this

81
00:05:02,035 --> 00:05:05,571
three dimensional, high resolution,
high definition atlas of the Moon.

82
00:05:06,039 --> 00:05:09,442
Where are there safe landing
sites for human and robotic explorers?

83
00:05:09,509 --> 00:05:13,346
So what LRO is doing
is really giving us the tools,

84
00:05:13,613 --> 00:05:19,052
the material, the data
we need to make those missions successful.

85
00:05:20,553 --> 00:05:20,987
For many

86

00:05:20,987 --> 00:05:25,591
years, LRO's elliptical orbit was closest
to the moon during the spacecraft's

87
00:05:25,591 --> 00:05:29,762
pass over the South Pole.

88
00:05:29,762 --> 00:05:33,032
So scientists have more information
about the South Pole region

89
00:05:33,032 --> 00:05:36,436
than any other region of the moon.

90
00:05:37,837 --> 00:05:39,739
We know that that we can do

91
00:05:39,739 --> 00:05:42,642
more and build upon the legacy of Apollo.

92
00:05:42,909 --> 00:05:45,378
But to do that,
we needed a higher resolution dataset.

93
00:05:45,378 --> 00:05:47,380
So we wanted to know
where the hazards were.

94
00:05:47,380 --> 00:05:50,650
We wanted to know where the geologic
features were that we want to go explore.

95
00:05:50,650 --> 00:05:52,618
And so LRO has created that database.

96
00:05:52,618 --> 00:05:57,557
Incidentally, the LRO data
volume is now over 1.3 petabytes.

97

00:05:58,424 --> 00:06:01,060
It's the largest volume of data
that NASA has ever collected

98
00:06:01,394 --> 00:06:03,830
from any planetary body.

99
00:06:03,830 --> 00:06:04,263
It's remarkable.

100
00:06:04,263 --> 00:06:05,131
And so

101
00:06:05,865 --> 00:06:08,000
what we've done now in support of Artemis.

102
00:06:08,034 --> 00:06:12,739
It's a part of other NASA's missions
to the moon as we created special maps.

103
00:06:12,772 --> 00:06:14,340
We share them with the public
and we share them

104
00:06:14,340 --> 00:06:18,177
with the various engineers and scientists
who are going to help enact and make

105
00:06:18,478 --> 00:06:19,112
Artemis a reality.

106
00:06:20,747 --> 00:06:21,047
You know,

107
00:06:21,047 --> 00:06:24,050
this is basically a Google
Maps of the moon

108
00:06:24,050 --> 00:06:27,286

taken from pictures from the Lunar
Reconnaissance Orbiter Camera.

109
00:06:27,320 --> 00:06:32,959
And you can just zoom in and see a five
meter boulder on the surface of the moon.

110
00:06:33,192 --> 00:06:33,893
It's just crazy.

111
00:06:33,893 --> 00:06:37,296
I could spend all day
and I have spent all day sometimes

112
00:06:37,296 --> 00:06:41,467
just browsing around different parts
of the moon, just looking up at the rocks.

113
00:06:43,236 --> 00:06:45,705
This wealth of information
will make it easier

114
00:06:45,705 --> 00:06:50,810
to find ideal locations for NASA Basecamp
and to quickly identify

115
00:06:50,843 --> 00:06:54,647
scientifically interesting areas
to visit nearby.

116
00:06:55,148 --> 00:06:58,684
So it's my my real belief
that we have an opportunity with Artemis

117
00:06:58,684 --> 00:07:00,052
to do something different than Apollo.

118
00:07:00,052 --> 00:07:04,457
We build on Apollo, we learn from Apollo,
but we want to expand

119
00:07:04,457 --> 00:07:08,161
what Apollo was able to do and build this
this presence on the moon

120
00:07:08,161 --> 00:07:12,932
that is more than just three days, more
than just six individual missions,

121
00:07:13,399 --> 00:07:16,936
but a much larger program
that eventually will result in the ability

122
00:07:16,936 --> 00:07:17,837
to go on to Mars.

123
00:07:18,838 --> 00:07:21,641
Mars is is quite a bit longer away
from our own planet.

124
00:07:21,641 --> 00:07:23,075
Then, of course, the moon is.

125
00:07:23,075 --> 00:07:25,645
It takes several months
in some cases to get to Mars.

126
00:07:25,645 --> 00:07:27,847
And it's therefore
going to be really critical

127
00:07:27,847 --> 00:07:30,750
when we have astronauts
walking around on the surface of Mars

128
00:07:31,017 --> 00:07:33,085
to be able to stay there
for longer periods of time.

129

00:07:33,119 --> 00:07:35,154
You've just spent six or so months
to get there.

130
00:07:35,354 --> 00:07:37,790
You want to really be able
to explore the surface around you

131
00:07:37,790 --> 00:07:41,627
and having the ability
to live off the land and know how to

132
00:07:41,828 --> 00:07:45,164
conduct exploration for longer
periods of time is going to be critical

133
00:07:45,164 --> 00:07:46,566
for Martian exploration.

134
00:07:46,566 --> 00:07:50,403
And lessons learned
for that sustainable type of exploration

135
00:07:50,603 --> 00:07:52,038
start right here at the moon.

136
00:07:52,038 --> 00:07:54,941
So there's still so much for us to learn
from going back

137
00:07:54,941 --> 00:07:58,978
to the moon from a scientific perspective,
that it's a no brainer in my head.

138
00:08:00,012 --> 00:08:01,681
But with Mars in the horizon

139
00:08:01,681 --> 00:08:07,353
as our kind of end goal
this is an important step for us to take.

140
00:08:07,653 --> 00:08:10,122
And then also,
just kind of from a human aspect,

141
00:08:10,156 --> 00:08:13,426
we all have this kind of intrinsic desire
to explore.

142
00:08:13,459 --> 00:08:16,829
I think it's it's in all of us
and certainly in us as a society.

143
00:08:16,863 --> 00:08:19,031
And so I think setting our sights
on something

144
00:08:19,031 --> 00:08:23,069
and accomplishing
this goal together is really important

145
00:08:23,069 --> 00:08:27,173
just for international relations, for,
you know, just coming together

146
00:08:27,273 --> 00:08:30,209
as a human, humankind,
you know, the human spirit.

147
00:08:30,243 --> 00:08:35,848
I think that that's a piece of what
we're doing that we can't ignore as well.

148
00:08:38,351 --> 00:08:41,921
I have three kids aged ten, six and two.

149
00:08:43,222 --> 00:08:46,492
I talk about space often with them.

150

00:08:46,492 --> 00:08:49,028
The great thing
that my parents did for me.

151
00:08:49,028 --> 00:08:53,232
It was, let me find my path.

152
00:08:53,432 --> 00:08:56,302
I also look at my daughter and I, I think,

153
00:08:57,036 --> 00:09:00,039
okay Amelia, you know, she keeps saying
she wants to be a firefighter

154
00:09:00,239 --> 00:09:02,441
and a construction worker
and an astronaut.

155
00:09:02,608 --> 00:09:07,647
I said, Amelia, you can do all three
and be an astronaut.

156
00:09:08,548 --> 00:09:10,883
Well, I mean, when you're an astronaut,
you'll learn how to fight a fire in space.

157
00:09:10,883 --> 00:09:12,952
You get to learn how to build something.
You've got to do all those things.

158
00:09:14,487 --> 00:09:15,354
What they'll become.

159
00:09:15,354 --> 00:09:17,189
I'm so excited to find out.

160
00:09:17,189 --> 00:09:18,824
I have no idea what they're going to.

161

00:09:18,824 --> 00:09:22,328
They're going to end up
gravitating towards.

162
00:09:22,562 --> 00:09:25,097
So why is the moon
my favorite body to study?

163
00:09:25,865 --> 00:09:28,568
I think growing up, you can
you know, you can always

164
00:09:28,568 --> 00:09:32,305
see it in the sky.

165
00:09:32,305 --> 00:09:34,440
You can see some beautiful stars.

166
00:09:34,440 --> 00:09:37,877
And maybe Mars
or Jupiter is like small little dots,

167
00:09:37,877 --> 00:09:40,413
but the moon is just there
in all its glory.

168
00:09:40,413 --> 00:09:42,448
It's like our nearest
and dearest neighbor.

169
00:09:42,882 --> 00:09:45,685
And you can even even

170
00:09:46,052 --> 00:09:49,455
with the naked eye, you could start
picking out features on the moon.

171
00:09:49,755 --> 00:09:50,957
I felt I was really cool.

172
00:09:50,957 --> 00:09:54,727
You know, this is thousands of miles away

173
00:09:54,727 --> 00:09:59,765
and you can still kind of be a geologist
from the ground if you want to.

174
00:10:00,132 --> 00:10:01,267
And I felt that's really cool.

175
00:10:01,267 --> 00:10:05,538
And that's why I always
wanted to study the moon.

176
00:10:08,140 --> 00:10:09,241
Just seeing

177
00:10:09,241 --> 00:10:13,713
people walk on the moon
on this foreign planetary body.

178
00:10:13,913 --> 00:10:18,951
You know, looking at images
like the one behind me here is the thing

179
00:10:18,951 --> 00:10:22,021
that always blows my mind.

180
00:10:23,155 --> 00:10:25,925
I will say with my two year old,
what I have noticed recently

181
00:10:25,925 --> 00:10:28,794
and this is wonderful,
is that when he sees the moon,

182
00:10:29,328 --> 00:10:33,299
we're out for a walk, we're driving around
or outside a window of a moon moon.