
OBSERVE
the MOON
October 1st, 2022

1
00:00:00,000 --> 00:00:05,000
[graphics on screen]

2
00:00:05,500 --> 00:00:14,733
[Music]

3
00:00:14,733 --> 00:00:18,000
■ There you go, you got me believing ■

4
00:00:18,000 --> 00:00:23,100
■ In the power of a moonlit night. ■

5
00:00:23,100 --> 00:00:26,733
■ All I know is you give me that feelin' ■

6
00:00:26,733 --> 00:00:31,600
■ Like I never want to tell you lies. ■

7
00:00:31,600 --> 00:00:35,666
■ And I just wanna take a chance ■

8
00:00:35,666 --> 00:00:39,666
■ Never let go of your hand ■

9
00:00:39,666 --> 00:00:44,766
■ Travel to the stars and back with you. ■

10
00:00:44,766 --> 00:00:49,366
■ On another moonlit night ■

11
00:00:49,366 --> 00:00:53,266
■ Can you feel the magic here tonight? ■

12
00:00:53,266 --> 00:00:55,433
■ The hours seem to fly ■

13
00:00:55,433 --> 00:00:57,500

■ But hearts like yours and mine ■

14
00:00:57,500 --> 00:01:02,766
■ Always beat in perfect time - ■

15
00:01:02,766 --> 00:01:08,100
■ To the music of a moonlit night. ■■

16
00:01:08,100 --> 00:01:16,666
[Music]

17
00:01:24,233 --> 00:01:29,333
Welcome everyone to NASA’s International Observe the Moon Night broadcast.

18
00:01:29,333 --> 00:01:31,066
I’m your host Andrea Jones,

19
00:01:31,066 --> 00:01:34,500
and I’m here at NASA’s Goddard Space Flight Center in Maryland

20
00:01:34,500 --> 00:01:37,400
to help guide you through a great program.

21
00:01:37,400 --> 00:01:43,700
International Observe the Moon Night is a day each year that we invite everyone on Earth to observe the Moon

22
00:01:43,700 --> 00:01:49,000
to learn about the Moon, and to honor the cultural and personal connections we have to the Moon.

23
00:01:49,000 --> 00:01:54,066
It’s a day to catch up on what's been happening in lunar science and exploration,

24
00:01:54,066 --> 00:01:57,066
to celebrate the Moon in our arts and culture,

25
00:01:57,066 --> 00:02:01,466
and for lunar enthusiasts around the world to connect.

26
00:02:01,466 --> 00:02:08,400
This is our 13th International Observe the Moon Night, and we are so glad that you are here with us.

27
00:02:08,400 --> 00:02:16,133
While you are watching, or after the broadcast, you can check out our website: moon.nasa.gov/observe.

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00:02:16,133 --> 00:02:21,266
Here you'll find lots of information and resources, some creative observing ideas –

29
00:02:21,266 --> 00:02:24,700
because you can observe the Moon with senses other than sight -

30
00:02:24,700 --> 00:02:28,333
and our map of lunar observers around the world.

31
00:02:28,333 --> 00:02:32,033
You can add yourself to this map by registering!

32
00:02:32,033 --> 00:02:35,166
You can also find out how other people are participating,

33
00:02:35,166 --> 00:02:40,866
and share your own pictures and experiences, in the International Observe the Moon Night Flickr gallery

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00:02:40,866 --> 00:02:46,266
and by using the #ObserveTheMoon hashtag wherever you are on social media.

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00:02:46,266 --> 00:02:49,333
International Observe the Moon Night was inspired by events

36
00:02:49,333 --> 00:02:52,933
celebrating the arrival of NASA's Lunar Reconnaissance Orbiter

37
00:02:52,933 --> 00:02:57,866
and NASA's Lunar Crater Observing and Sensing Satellite, or LCROSS,

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00:02:57,866 --> 00:03:00,466

at the Moon in 2009.

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00:03:00,466 --> 00:03:04,400
Since then, LCROSS has successfully completed its mission

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00:03:04,400 --> 00:03:08,733
and LRO continues to teach us new things about the Moon.

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00:03:08,733 --> 00:03:13,866
I’m going to pass things over to the Project Scientist for LRO, Dr. Noah Petro,

42
00:03:13,866 --> 00:03:18,300
who will give an update on what’s been happening with the spacecraft and the mission.

43
00:03:19,466 --> 00:03:25,233
Hi! I'm Noah Petro, lunar enthusiast and project scientist for NASA’s Lunar Reconnaissance Orbiter,

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00:03:25,233 --> 00:03:28,233
a spacecraft we call LRO.

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00:03:28,233 --> 00:03:31,233
Imagine for a moment that you're about to take a long road trip.

46
00:03:31,233 --> 00:03:34,666
What sorts of information might you want to have before you go on that trip?

47
00:03:34,666 --> 00:03:39,400
You probably want to know the path, the route that you'll take, you’ll want to know where you can refuel,

48
00:03:39,400 --> 00:03:43,033
and where you can get out and stretch your legs and take in the view.

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00:03:43,033 --> 00:03:46,633
Well, in 2009 NASA sent LRO to do just that for the Moon -

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00:03:46,633 --> 00:03:50,933
to create a high-resolution digital atlas of our nearest neighbor in space.

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00:03:50,933 --> 00:03:55,733
On LRO we have instruments that collect high resolution images, map the topography of the Moon,

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00:03:55,733 --> 00:04:02,700
better than any other object in the solar system and tell us where those valuable resources exist at and near th

53
00:04:02,700 --> 00:04:07,100
In short, LRO has ushered in a completely new era in our understanding of the Moon,

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00:04:07,100 --> 00:04:11,833
how it changes and how it existed maybe four and a half billion years ago.

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00:04:11,833 --> 00:04:17,133
With this data we're prepared for a new generation of lunar explorers to get back to the lunar surface.

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00:04:17,133 --> 00:04:22,700
Both human and robotic explorers will use the data from LRO to not only safely navigate the lunar surface

57
00:04:22,700 --> 00:04:29,000
but conduct some of the most sophisticated science investigations of any planetary surface ever.

58
00:04:29,000 --> 00:04:31,800
Now what do you do when you've done all those exciting things at the Moon?

59
00:04:31,800 --> 00:04:36,733
Well, you prepare for other explorers. And over the next three years LRO has a new mission in store.

60
00:04:36,733 --> 00:04:40,533
So, let's learn a little bit more about that mission by watching this video let's take a look!

61
00:04:42,100 --> 00:04:45,266
This year the Lunar Reconnaissance Orbiter celebrates 13 years

62
00:04:45,266 --> 00:04:47,066
of orbit around our Moon.

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00:04:47,066 --> 00:04:50,400

And in that time, it has collected over a petabyte of data -

64
00:04:50,400 --> 00:04:52,066
the largest volume ever collected

65
00:04:52,066 --> 00:04:54,766
by a planetary science mission at NASA.

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00:04:54,766 --> 00:04:57,866
Due to its success and continued operational abilities,

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00:04:57,866 --> 00:05:00,300
NASA has awarded the spacecraft an additional

68
00:05:00,300 --> 00:05:03,166
extended mission phase so that it can continue

69
00:05:03,166 --> 00:05:05,466
gathering critical information on the Moon

70
00:05:05,466 --> 00:05:09,266
and help pave the way for future lunar missions.

71
00:05:09,266 --> 00:05:13,166
Going forward, the LRO mission will have four main areas of focus.

72
00:05:14,166 --> 00:05:17,100
The first is the study of volatiles, which are chemicals

73
00:05:17,100 --> 00:05:21,300
that easily evaporate or vaporize, such as water.

74
00:05:21,300 --> 00:05:24,566
In terms of lunar exploration, volatiles will be useful

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00:05:24,566 --> 00:05:26,466
for things like creating rocket fuel

76
00:05:26,466 --> 00:05:28,500
and making oxygen to breathe.

77
00:05:28,500 --> 00:05:30,066
So they are a primary resource

78
00:05:30,066 --> 00:05:34,266
that future astronauts will depend on having.

79
00:05:34,266 --> 00:05:37,800
LRO will continue to provide new data for identifying which areas

80
00:05:37,800 --> 00:05:40,900
are rich in volatiles, and for clueing us in to how they may

81
00:05:40,900 --> 00:05:43,400
move around the lunar surface.

82
00:05:43,400 --> 00:05:45,966
Current LRO data suggests they may be frozen in

83
00:05:45,966 --> 00:05:50,100
permanently shadowed craters, in areas that receive some sunlight,

84
00:05:50,100 --> 00:05:53,766
and may be chemically locked in minerals on the Moon.

85
00:05:53,766 --> 00:05:57,100
This is helping pave the way for future missions like VIPER,

86
00:05:57,100 --> 00:05:59,900
which will send a robotic rover to explore an area near

87
00:05:59,900 --> 00:06:01,366
the lunar South Pole,

88
00:06:01,366 --> 00:06:05,000

and ultimately, the astronaut-led Artemis missions.

89
00:06:05,000 --> 00:06:07,866
The second area of focus is on the Moon’s interior,

90
00:06:07,866 --> 00:06:11,566
volcanic features and the tectonics of the Moon’s surface –

91
00:06:11,566 --> 00:06:14,400
because understanding the lunar surface requires knowledge

92
00:06:14,400 --> 00:06:16,966
of what’s been going on underneath.

93
00:06:16,966 --> 00:06:18,566
Scientists want to figure out when the Moon

94
00:06:18,566 --> 00:06:22,266
was last volcanically active, and how current geologic processes,

95
00:06:22,266 --> 00:06:26,766
like moonquakes, could affect the safety of future exploration.

96
00:06:26,766 --> 00:06:29,366
They’ll do these things by studying lobate scarps,

97
00:06:29,366 --> 00:06:32,166
as well as deep crustal and mantle composition

98
00:06:32,166 --> 00:06:34,100
that are exposed at the surface.

99
00:06:35,100 --> 00:06:37,966
Studying the Moon’s history of volcanism and tectonics

100
00:06:37,966 --> 00:06:40,266
will also inform us about other planetary bodies

101
00:06:40,266 --> 00:06:43,866
in our solar system and beyond.

102
00:06:44,866 --> 00:06:47,366
The third area of focus is on the Moon’s surface –

103
00:06:47,366 --> 00:06:49,700
its regolith and impact craters.

104
00:06:49,700 --> 00:06:52,066
We want to know how impact craters break down,

105
00:06:52,066 --> 00:06:55,866
and if different ejected materials might degrade at different rates.

106
00:06:55,866 --> 00:06:58,400
These studies will give us a better understanding of the mineral

107
00:06:58,400 --> 00:07:03,100
and chemical makeup of the lunar surface and subsurface.

108
00:07:03,100 --> 00:07:05,400
This information can tell us how the Moon has changed

109
00:07:05,400 --> 00:07:09,466
over hundreds of millions, or billions of years.

110
00:07:09,466 --> 00:07:11,666
Studying the Moon’s regolith and impact craters

111
00:07:11,666 --> 00:07:14,366
also informs scientists about space weathering,

112
00:07:14,366 --> 00:07:16,900
which can help similar studies looking at the Earth,

113
00:07:16,900 --> 00:07:21,166

as well as on places like Mars, Mercury, or even asteroids.

114
00:07:23,166 --> 00:07:25,666
The last focus area for LRO going forward

115
00:07:25,666 --> 00:07:29,466
is support for future missions.

116
00:07:29,466 --> 00:07:31,566
NASA has plans for numerous missions to go

117
00:07:31,566 --> 00:07:35,866
to the lunar surface during LRO's extended phase.

118
00:07:35,866 --> 00:07:38,866
Sending missions to the lunar surface requires planning,

119
00:07:38,866 --> 00:07:40,366
not only to build the mission,

120
00:07:40,366 --> 00:07:44,066
but to find safe and interesting landing sites.

121
00:07:44,066 --> 00:07:46,500
LRO is in a unique position to directly assist

122
00:07:46,500 --> 00:07:50,166
with some of those operations and science objectives.

123
00:07:50,166 --> 00:07:53,266
LRO can help identify landing sites by making maps

124
00:07:53,266 --> 00:07:55,466
that tell us what the surface is like,

125
00:07:55,466 --> 00:07:57,566
where there may be hazards to landers,

126
00:07:57,566 --> 00:08:00,866
and where there are interesting features to explore.

127
00:08:00,866 --> 00:08:03,366
LRO is also capable of helping landed missions

128
00:08:03,366 --> 00:08:05,866
get simultaneous measurements from orbit

129
00:08:05,866 --> 00:08:09,266
while they gather data from the surface.

130
00:08:10,600 --> 00:08:14,266
After studying the Moon for 13 years, LRO has proven to be

131
00:08:14,266 --> 00:08:18,166
one of NASA’s most valuable tools for advancing lunar science.

132
00:08:18,166 --> 00:08:21,266
And as it continues collecting data, the spacecraft helps

133
00:08:21,266 --> 00:08:24,700
lead the way for future exploration of our Moon.

134
00:08:27,600 --> 00:09:03,066
[Music]

135
00:09:04,266 --> 00:09:05,533
Hi. I'm Surabhi,

136
00:09:05,533 --> 00:09:06,133
I'm Zoe.

137
00:09:06,133 --> 00:09:06,666
I'm Ben.

138
00:09:06,666 --> 00:09:08,300

I'm Chloe. And I'm Samuel.

139
00:09:08,300 --> 00:09:10,400
We are amateur astronomers.

140
00:09:10,400 --> 00:09:15,400
We are currently observing from Roundwood
County Wicklow, Ireland's highest village.

141
00:09:15,400 --> 00:09:19,166
Here is how we observe the Moon.
Or, as we say in Irish, “feachaint ar an ngealach”

142
00:09:19,333 --> 00:09:21,466
We are ready for Artemis!

143
00:09:22,633 --> 00:09:24,800
Hi. I'm Marry. I'm Erica.

144
00:09:24,800 --> 00:09:28,566
And I'm Frank. And we're from the Center
for Astrophysics, a collaboration between

145
00:09:28,566 --> 00:09:32,600
the Smithsonian Astrophysical Observatory
and the Harvard College Observatory.

146
00:09:32,600 --> 00:09:35,200
Our favorite way to observe
the Moon is with the MicroObservatory

147
00:09:35,200 --> 00:09:40,300
Robotic Telescope Network. A network of telescopes
like this one in Cambridge, Massachusetts.

148
00:09:40,300 --> 00:09:43,666
We also have telescopes in Arizona,
and even Chile.

149

00:09:43,666 --> 00:09:47,033
So join us observing at microobservatory.org.

150
00:09:47,033 --> 00:09:50,033
Choose - observing with NASA portal -

151
00:09:50,033 --> 00:09:52,300
select the target Moon
and an email of your picture

152
00:09:52,300 --> 00:09:55,066
of the Moon will arrive the next day. So join us!

153
00:09:55,500 --> 00:09:56,900
Hello, everyone.

154
00:09:56,900 --> 00:09:59,466
We are the NDLOVU choir from South Africa.

155
00:09:59,466 --> 00:10:06,233
And we are so excited to be celebrating an International Observe the Moon Night with . . . NASA!

156
00:10:08,233 --> 00:10:11,633
Welcome back! The Moon is near first quarter today,

157
00:10:11,633 --> 00:10:15,233
which means you can find it in the afternoon and evening sky.

158
00:10:15,233 --> 00:10:19,533
It’s a great phase to observe the Moon through a telescope or pair of binoculars.

159
00:10:19,533 --> 00:10:23,400
The line between day and night, which is called the terminator,

160
00:10:23,400 --> 00:10:28,533
is a great place to see the rugged lunar terrain really pop out.

161
00:10:28,533 --> 00:10:36,233

There are long shadows from crater rims and mountain peaks that are as high, or higher, than what we have o

162
00:10:36,233 --> 00:10:43,333
With a telescope you can catch glimpses of volcanoes, fractures, or big cracks, in the Moon’s surface,

163
00:10:43,333 --> 00:10:46,566
and even winding channels carved by lava!

164
00:10:46,566 --> 00:10:50,800
But you don’t need a telescope or pair of binoculars to observe the Moon.

165
00:10:50,800 --> 00:10:54,100
With just your eyes you can see dark and light patches.

166
00:10:54,100 --> 00:11:00,300
The dark patches are plains of solid lava called maria—the Latin word for seas—

167
00:11:00,300 --> 00:11:03,700
and the light patches are the rugged lunar highlands.

168
00:11:03,700 --> 00:11:07,166
There is a lot to learn from observing the lunar surface.

169
00:11:07,166 --> 00:11:10,866
Take a look at this next video for a view of an interesting site.

170
00:11:11,633 --> 00:11:28,066
[Music]

171
00:11:28,066 --> 00:11:31,700
Ariadaeus Rille is one of the Moon’s best examples

172
00:11:31,700 --> 00:11:33,700
of a straight rille.

173
00:11:33,700 --> 00:11:35,933
Running roughly east to west,

174
00:11:35,933 --> 00:11:39,700
it appears as a great fracture in the lunar crust,

175
00:11:39,700 --> 00:11:45,200
measuring about 220 kilometers long, 4 kilometers wide,

176
00:11:45,200 --> 00:11:48,566
and 0.8 kilometers deep.

177
00:11:48,566 --> 00:11:53,000
This is an example of a graben, where a long block of land

178
00:11:53,000 --> 00:11:56,466
drops down between two parallel faults.

179
00:11:56,466 --> 00:12:00,133
It may have been formed by a rising dyke of magma

180
00:12:00,133 --> 00:12:04,200
wedging open a crack in the lunar crust.

181
00:12:04,200 --> 00:12:11,766
[Music fades]

182
00:12:14,300 --> 00:13:08,933
[Music]

183
00:13:12,866 --> 00:13:18,166
Studying the Moon allows us to peer back into history in a number of ways.

184
00:13:18,166 --> 00:13:24,033
By studying the Moon’s geologic history, we can learn about its formation, and what happened over time,

185
00:13:24,033 --> 00:13:29,866
as well as about the geologic history of the Earth, and other Moons and planets in our solar system.

186
00:13:29,866 --> 00:13:35,300

NASA’s Apollo program made history by bringing the first humans to the lunar surface,

187
00:13:35,300 --> 00:13:40,000
allowing us to experience, first-hand, what the Moon is really like.

188
00:13:40,000 --> 00:13:43,600
This year marks the 50th anniversary of Apollo 17,

189
00:13:43,600 --> 00:13:47,433
which was the last of the Apollo missions to visit the lunar surface.

190
00:13:47,433 --> 00:13:55,066
It’s an incredible milestone, and this next set of videos will help us see how that history connects with our curre

191
00:13:55,066 --> 00:13:58,233
of the Moon, and what is coming in the future.

192
00:13:58,233 --> 00:13:59,366
Take a look!

193
00:14:00,366 --> 00:14:03,766
Later this year, Apollo 17
astronaut and geologist Jack

194
00:14:03,766 --> 00:14:06,433
Schmitt will mark fifty
years since his first steps on

195
00:14:06,433 --> 00:14:10,700
the Moon in December 1972. Those
footprints left an impression on

196
00:14:10,700 --> 00:14:12,700
both the Moon and on Schmitt.

197
00:14:16,433 --> 00:14:17,833
“No matter how much preparation

198

00:14:17,833 --> 00:14:24,233
you have for experiences like
stepping on the Moon, it’s going

199
00:14:24,233 --> 00:14:26,633
to be more than you ever
anticipated.” Schmitt was the

200
00:14:26,633 --> 00:14:29,433
first trained field geologist to
observe the Moon up close and

201
00:14:29,433 --> 00:14:32,466
personal, and he found himself
discovering unexpected things

202
00:14:32,466 --> 00:14:35,933
with every step. “Every rock
that we examined had something

203
00:14:35,933 --> 00:14:40,166
new that I didn’t expect. And
surprises are what geologists

204
00:14:40,166 --> 00:14:43,500
like. That’s why you’re
exploring – to see the things

205
00:14:43,500 --> 00:14:45,800
that no one has ever seen
before.” Schmitt spent a

206
00:14:45,800 --> 00:14:48,600
combined twenty-two hours
outside of the spacecraft during

207
00:14:48,600 --> 00:14:51,600
his three excursions on the
Moon. Before his own trip,

208

00:14:51,600 --> 00:14:54,666
Schmitt trained other Apollo
astronauts. Sharing with them

209
00:14:54,666 --> 00:14:57,600
his in-depth knowledge of field
work. “The main thing was to

210
00:14:57,600 --> 00:15:02,233
expose them to as many different
geological experiences as we

211
00:15:02,233 --> 00:15:05,133
possibly could. Get them out in
the field – don’t let them sit

212
00:15:05,133 --> 00:15:08,033
in the classroom.” He treated
training scenarios on Earth the

213
00:15:08,033 --> 00:15:11,200
same way he would if they were
on the moon. Including simulated

214
00:15:11,200 --> 00:15:13,966
equipment, backpacks and cameras
strapped to the front of

215
00:15:13,966 --> 00:15:17,266
spacesuits. Astronauts could
then focus on what differences

216
00:15:17,266 --> 00:15:19,833
in the rocks they were seeing,
and what rock samples were best

217
00:15:19,833 --> 00:15:22,733
to collect. Essentially giving
them the fundamental field

218

00:15:22,733 --> 00:15:26,133
geological experiences that they needed to succeed. The four or

219
00:15:26,133 --> 00:15:28,866
five days per month Schmitt spent training astronauts in the

220
00:15:28,866 --> 00:15:31,933
field really did made a difference. “The quality and

221
00:15:31,933 --> 00:15:36,100
diversity of the Apollo sample collection, independent of

222
00:15:36,100 --> 00:15:39,733
Apollo 17 where you had an experienced geologist, the

223
00:15:39,733 --> 00:15:42,433
quality and diversity of that sample collection is just

224
00:15:42,433 --> 00:15:44,300
remarkable.”
Fortunately, the current

225
00:15:44,300 --> 00:15:47,200
Lunar Reconnaissance Orbiter mission, or LRO, is changing

226
00:15:47,200 --> 00:15:50,266
the game; bringing back high-quality photography of the Moon

227
00:15:50,266 --> 00:15:53,266
that Schmitt only wished he’d seen before his own trip. “The

228

00:15:53,266 --> 00:15:57,333
Lunar Reconnaissance Orbiter
program now has provided us with

229
00:15:57,333 --> 00:16:01,133
a much, much higher resolution
suite of photographs for any

230
00:16:01,133 --> 00:16:03,633
future astronauts." What we
learned from the Apollo missions

231
00:16:03,633 --> 00:16:06,700
helped lay the groundwork for
LRO, and LRO will help guide

232
00:16:06,700 --> 00:16:11,200
future explorers. "Every new
environment in which a geologist

233
00:16:11,200 --> 00:16:15,000
works is usually very different
than the last, but you have

234
00:16:15,000 --> 00:16:18,266
learned things from your
previous experiences that do in

235
00:16:18,266 --> 00:16:23,700
fact enable you to maximize the
value of your new experience."

236
00:16:23,700 --> 00:16:26,866
Schmitt has his fingers crossed
for future Moon exploration, a

237
00:16:26,866 --> 00:16:29,800
landscape he considers holds
answers to many questions about

238

00:16:29,800 --> 00:16:33,066
the early solar system. “You can
hear people talk about it, but

239
00:16:33,066 --> 00:16:35,800
you can’t absorb it until you’re
there.”

240
00:16:35,800 --> 00:16:41,166
[Music and beeping]

241
00:16:42,800 --> 00:16:59,166
[Music]

242
00:16:59,166 --> 00:17:04,533
Apollo 17, the final Apollo mission to land on the Moon,

243
00:17:04,533 --> 00:17:09,066
visited the spectacular Taurus-Littrow valley,

244
00:17:09,066 --> 00:17:12,033
deeper than Earth’s Grand Canyon.

245
00:17:12,033 --> 00:17:18,600
In December 1972, astronauts Gene Cernan and Jack Schmitt

246
00:17:18,600 --> 00:17:24,266
explored an active fault scarp, a gigantic landslide deposit,

247
00:17:24,266 --> 00:17:29,100
and brought back samples including beads of volcanic glass

248
00:17:29,100 --> 00:17:33,366
erupted in an ancient lunar fire fountain.

249
00:17:33,366 --> 00:17:38,000
Schmitt was the first professional geologist on the Moon.

250

00:17:38,000 --> 00:17:51,166
[Music fades]

251
00:17:54,300 --> 00:18:01,400
[Music]

252
00:18:01,400 --> 00:18:04,033
So we received samples from the Apollo
17 mission

253
00:18:05,633 --> 00:18:08,566
which were returned to Earth
in December of 1972.

254
00:18:08,566 --> 00:18:10,866
So nearly 50 years ago.

255
00:18:10,866 --> 00:18:13,700
Basically we collected on the moon
and brought back,

256
00:18:13,700 --> 00:18:16,933
then they were frozen within
about a month of being returned.

257
00:18:16,933 --> 00:18:19,233
So no one's ever looked at them since.

258
00:18:19,233 --> 00:18:20,900
It's very exciting.

259
00:18:28,933 --> 00:18:31,500
Curation facility at NASA's
Johnson Space Center

260
00:18:31,500 --> 00:18:35,300
sent us the samples and they did have to
do some special efforts to keep them cold

261

00:18:35,300 --> 00:18:36,666
because we wanted them to stay frozen.

262
00:18:36,666 --> 00:18:39,466
So they had a special cold shipping box
with panels

263
00:18:39,466 --> 00:18:42,566
that were frozen in a very cold freezer
and a chunk of dry ice.

264
00:18:44,266 --> 00:18:46,633
We picked it up from the receiving office
here at Goddard

265
00:18:48,666 --> 00:18:51,533
opened it up, pulled the samples out
and stuck them straight in our freezer

266
00:18:51,533 --> 00:18:52,633
and locked them up safely.

267
00:18:54,733 --> 00:18:55,633
So these

268
00:18:55,633 --> 00:18:58,566
frozen samples were actually collected
from a region on the moon

269
00:18:58,566 --> 00:19:00,600
that was in shadow from the sun.

270
00:19:00,600 --> 00:19:02,900
So it was basically a large boulder.

271
00:19:02,900 --> 00:19:04,666
In the near future,
we're going back to the moon

272

00:19:04,666 --> 00:19:06,466
and hopefully going to the polar
regions of the moon

273
00:19:06,466 --> 00:19:08,800
where some of these regions
are in permanent shadow

274
00:19:08,800 --> 00:19:11,533
and they don't see the sun, you know,
they're cold.

275
00:19:11,533 --> 00:19:15,366
These particular samples are really great
analogs for what we might expect

276
00:19:15,366 --> 00:19:17,666
to see in the polar regions
when we go back.

277
00:19:18,833 --> 00:19:21,466
So we actually started last week
to process the samples.

278
00:19:21,466 --> 00:19:26,266
So the samples we got are basically dirt,
lunar dirt, and we basically made "Moon

279
00:19:26,266 --> 00:19:27,166
tea" out of them.

280
00:19:27,166 --> 00:19:27,966
So "Moon tea"

281
00:19:27,966 --> 00:19:31,833
is what we call it when we pull out
the soluble compounds from the soil.

282
00:19:32,066 --> 00:19:35,833
And so we basically take the lunar sample,

seal it up with a torch in a little

283
00:19:35,833 --> 00:19:39,733
glass test tube full of water,
stick it in an oven overnight and boil it.

284
00:19:39,733 --> 00:19:42,600
And we're just pulling out
those soluble compounds that we care about

285
00:19:42,866 --> 00:19:44,800
the same way
you'd make tea with boiling water at home.

286
00:19:46,933 --> 00:19:49,333
What we're
trying to do is answer some questions

287
00:19:49,333 --> 00:19:53,500
about the history this sample experienced
at the surface of the Moon.

288
00:19:53,500 --> 00:19:56,133
The surface of the Moon
is a really hostile environment.

289
00:19:56,133 --> 00:19:58,800
You know, it's not like here on Earth
where we have this

290
00:19:58,800 --> 00:20:02,800
beautiful atmosphere that protects us
from the nasties of space.

291
00:20:02,800 --> 00:20:06,666
So we have particles from the sun
that are continuously hitting the

292
00:20:06,666 --> 00:20:07,533
surface of the Moon.

293
00:20:07,533 --> 00:20:09,033
And we've got galactic

294
00:20:09,033 --> 00:20:12,800
cosmic rays that are coming in
and penetrating into the surface as well.

295
00:20:12,800 --> 00:20:16,833
They actually create noble gases
in these particles.

296
00:20:16,833 --> 00:20:19,466
So you can imagine that
there's none to begin with.

297
00:20:19,466 --> 00:20:23,066
And then as they get exposed
to this space environment,

298
00:20:23,066 --> 00:20:26,966
they kind of get more
and more buildup of noble gases.

299
00:20:26,966 --> 00:20:31,466
And our technique is to actually unlock
those noble gases from the sample,

300
00:20:31,466 --> 00:20:36,166
a measure of them, so we can come up with
what we call a cosmic ray exposure age.

301
00:20:36,166 --> 00:20:40,733
So it's basically how long this sample
has been sat at the surface being exposed.

302
00:20:40,733 --> 00:20:42,500
It's basically getting a "space tan."

303

00:20:43,866 --> 00:20:45,133
Say, 50 years ago,

304
00:20:45,133 --> 00:20:48,266
this same technique, which is called
the Noble Gas Mass Spectrometry

305
00:20:48,266 --> 00:20:52,733
would probably need anywhere,
you know, tens to hundreds of milligrams

306
00:20:52,733 --> 00:20:56,333
to do the same thing that we now
do with a couple of milligrams.

307
00:20:57,100 --> 00:20:59,700
It's really special
to be part of this, and particularly

308
00:20:59,700 --> 00:21:05,066
because I can look back at the papers
and the processes that the curation office

309
00:21:05,066 --> 00:21:08,800
and the scientists in the 1970s
thought about and they put so much care

310
00:21:08,800 --> 00:21:11,466
into preserving these samples
for future science

311
00:21:11,466 --> 00:21:13,666
to making sure
that they were going to be at their,

312
00:21:13,666 --> 00:21:16,733
you know, the best conditions
so that as we develop new techniques,

313
00:21:16,733 --> 00:21:20,433

we're able to go and look at these samples
and get new answers

314
00:21:20,433 --> 00:21:22,533
to the science questions
that were being asked.

315
00:21:22,533 --> 00:21:26,033
You know, I'm still studying these samples
50 years later

316
00:21:26,033 --> 00:21:28,966
for the from the Apollo mission,
the original Apollo missions

317
00:21:28,966 --> 00:21:32,033
and you know, you don't know
what's going to be in another 50 years,

318
00:21:32,033 --> 00:21:35,866
but I'm still a part of the Apollo dream
of going to the Moon

319
00:21:35,866 --> 00:21:37,233
and bringing samples back.

320
00:21:37,233 --> 00:21:40,700
So the fact that we have Artemis
now is amazing.

321
00:21:40,700 --> 00:21:43,466
Like having our own Artemis
generation is really exciting.

322
00:21:43,466 --> 00:21:46,800
I just can't wait to see
people go back to the Moon.

323
00:21:46,800 --> 00:21:52,000
[Music fades]

324
00:21:54,433 --> 00:21:57,433
NASA's Astro Materials Research
and Exploration Science

325
00:21:57,433 --> 00:22:01,133
or ARES team at the Johnson Space Center
in Houston, Texas,

326
00:22:01,133 --> 00:22:05,333
is responsible for curating the agency's
Apollo lunar samples.

327
00:22:05,333 --> 00:22:09,233
Studies that these moon rocks continue
to unveil discoveries about the Moon

328
00:22:09,266 --> 00:22:13,333
and our solar system, but also help
prepare for the return of samples

329
00:22:13,333 --> 00:22:15,733
collected during future Artemis missions.

330
00:22:16,766 --> 00:22:18,833
Recent work by our team on samples

331
00:22:18,833 --> 00:22:23,000
such as the Apollo 17 core seen here
supports the Apollo

332
00:22:23,000 --> 00:22:26,700
Next Generation
Sample Analysis or ANGSA initiative.

333
00:22:27,433 --> 00:22:30,866
This initiative has enabled
a new generation of explorers

334

00:22:31,000 --> 00:22:35,100
equipped with new and improved
technologies to study Apollo samples.

335
00:22:36,066 --> 00:22:39,233
ANGSA helps link
generations of lunar explorers

336
00:22:39,233 --> 00:22:43,166
and has also enabled our team
to capture valuable lessons learned

337
00:22:43,433 --> 00:22:46,166
that can be applied to collecting
and curating moon rocks

338
00:22:46,433 --> 00:22:51,800
from Apollo to Artemis. Let's take a look
at how NASA's got samples from the Moon.

339
00:22:51,800 --> 00:22:55,366
[Music]

340
00:22:55,366 --> 00:23:00,233
“Liftoff . . . all engines running . . . liftoff . . . We have liftoff!”

341
00:23:03,466 --> 00:23:07,966
”Tranquility base here. The Eagle has landed!”

342
00:23:09,933 --> 00:23:16,233
“Oh, man, look at that rock out there! Absolutely incredible.”

343
00:23:16,233 --> 00:23:33,333
[Music]

344
00:23:35,033 --> 00:23:38,266
Apollo samples
may have been collected 50 years ago,

345

00:23:38,266 --> 00:23:40,933
but new and exciting research is ongoing.

346
00:23:41,466 --> 00:23:44,366
Seen here is the Apollo 17 core sample

347
00:23:44,500 --> 00:23:48,466
that was vacuum sealed on the Moon. Earlier
this year,

348
00:23:48,500 --> 00:23:52,266
almost 50 years later,
the team members seen here were involved

349
00:23:52,266 --> 00:23:56,966
in the successful extraction of gases
from the core sample vacuum container.

350
00:23:57,633 --> 00:23:58,966
The many lessons learned from

351
00:23:58,966 --> 00:24:02,566
this process will be applied
to the future collection of volatiles,

352
00:24:02,766 --> 00:24:08,033
which you can think of as gases from water
or hydrogen or carbon dioxide or others

353
00:24:08,300 --> 00:24:10,766
that we hope to collect during Artemis
missions.

354
00:24:12,166 --> 00:24:16,733
The team also carefully processed
lunar material collected in the Apollo 17

355
00:24:16,733 --> 00:24:21,600
core from below the lunar surface,
carefully separating out individual pieces

356
00:24:21,600 --> 00:24:26,066
of various sizes and documenting
every step taken throughout the process.

357
00:24:27,633 --> 00:24:29,200
Utilizing technologies

358
00:24:29,200 --> 00:24:33,000
such as X-ray computed
tomography or XCT scans,

359
00:24:33,166 --> 00:24:37,766
which you can think of or think about,
like scans a doctor may take of your brain

360
00:24:37,766 --> 00:24:42,333
or another part of your body to see
what it looks like without doing surgery - well-

361
00:24:42,333 --> 00:24:46,433
these types of scans provide
exciting data valuable for research,

362
00:24:46,766 --> 00:24:51,866
but scans of the vacuum sealed Apollo 17
core proved to be extremely valuable

363
00:24:52,033 --> 00:24:55,000
in the successful gas extraction
and processing.

364
00:24:55,633 --> 00:24:58,700
These lessons learned,
again, will be applied to the collection

365
00:24:58,700 --> 00:25:01,033
and curation of future samples.

366

00:25:02,433 --> 00:25:05,166
Lunar exploration
and investigating moon rocks

367
00:25:05,166 --> 00:25:08,766
is exciting, and individuals of all ages
can get involved.

368
00:25:09,200 --> 00:25:13,366
One way is to check out our Astromaterials 3D Lunar Collection.

369
00:25:14,366 --> 00:25:17,333
Astromaterials 3D allows an individual

370
00:25:17,333 --> 00:25:21,866
to explore a subset of samples collected
from the six Apollo surface missions.

371
00:25:22,266 --> 00:25:25,633
You can select the mission,
find a sample of interest to you,

372
00:25:25,866 --> 00:25:28,533
and then open that
sample and explore it further.

373
00:25:29,866 --> 00:25:31,766
As you further explore the sample,

374
00:25:31,766 --> 00:25:36,266
you can interact with the sample or
you may decide to explore it even further,

375
00:25:36,266 --> 00:25:41,433
using our Explorer tool. The Astromaterials, 3D Explorer allows you

376
00:25:41,433 --> 00:25:45,433
to interact with the sample looking at it
in different lighting conditions,

377
00:25:46,266 --> 00:25:48,900
or even allowing you to view it in 3D.

378
00:25:49,500 --> 00:25:52,800
Now, as you wear 3D glasses and explore
this sample.

379
00:25:52,900 --> 00:25:57,000
It's as though the sample is jumping
out of the screen and into your hands.

380
00:25:58,266 --> 00:26:01,733
Now, thanks to XCT scans of each sample,

381
00:26:01,766 --> 00:26:05,166
again, think about a doctor
taking a scan of a part of your body -

382
00:26:05,733 --> 00:26:08,933
you can actually explore
the interior of a sample,

383
00:26:08,933 --> 00:26:12,900
in a sense, slicing into it
and finding interesting features.

384
00:26:15,066 --> 00:26:17,766
There are lots of other details
available on the site,

385
00:26:17,766 --> 00:26:21,433
but one additional aspect to point out
is that you can even download

386
00:26:21,433 --> 00:26:24,733
and print your own 3D
model, which can also be fun.

387
00:26:26,000 --> 00:26:28,466

Now additional resources we have available

388
00:26:28,500 --> 00:26:30,866
are our classifying moon rock interactive.

389
00:26:33,233 --> 00:26:41,600
“That’s one small step for man . . . one giant leap for mankind.”

390
00:26:43,900 --> 00:26:46,066
This online interactive allows

391
00:26:46,166 --> 00:26:49,800
learners of various ages
to get introduced to our lunar lab,

392
00:26:50,366 --> 00:26:53,166
build background
as well as skills, enabling

393
00:26:53,166 --> 00:26:55,966
a user to learn how to classify moon rocks
as well.

394
00:26:56,966 --> 00:27:01,633
Users can also learn fun facts
about the samples, as well as fun facts

395
00:27:01,633 --> 00:27:04,966
about each of the Apollo missions
and so much more.

396
00:27:05,966 --> 00:27:10,500
The interactive encourages users
to continue their journey of exploration

397
00:27:10,500 --> 00:27:13,166
with connection to views of landing sites,

398
00:27:13,600 --> 00:27:16,900

as well as Astromaterials 3D and more.

399
00:27:17,800 --> 00:27:20,800
We encourage you to take advantage
of the many ways

400
00:27:20,800 --> 00:27:24,400
to explore the Moon,
including looking up at the night sky,

401
00:27:24,766 --> 00:27:28,700
but also exploring and interacting
with the moon rocks in our collection

402
00:27:28,900 --> 00:27:32,066
using resources
we have available on our website.

403
00:27:33,066 --> 00:27:33,700
We hope

404
00:27:33,700 --> 00:27:37,766
you, as we are, are excited about the journey
back to the Moon

405
00:27:37,966 --> 00:27:41,500
as we continue to learn from Apollo
and look to the future

406
00:27:41,500 --> 00:27:45,966
with Artemis and the future collection
and curation of moon rocks.

407
00:27:50,066 --> 00:27:57,966
I’m focusing on the Moon because humans will be expanding the area of activity in the near future.

408
00:27:57,966 --> 00:28:04,800
I’ve been supporting it from the aspect of landing site analysis using observation data.

409

00:28:04,800 --> 00:28:10,033
Let’s look up at the Moon and imagine humans walking there again!

410
00:28:10,200 --> 00:28:14,233
My name is Kinga Gruszecka, let's observe the Moon together!

411
00:28:15,900 --> 00:28:22,366
We are like the Moon. Each phase is a change, to reach our fullness.

412
00:28:23,800 --> 00:28:26,833
Hooray for Observe the Moon Night!

413
00:28:26,900 --> 00:28:30,666
Hey, we're the 2022 winter over crew
at the bottom of the world, observing

414
00:28:30,666 --> 00:28:32,600
from the National Science Foundation

415
00:28:32,600 --> 00:28:35,166
Amundsen–Scott South Pole Station here in Antarctica.

416
00:28:35,166 --> 00:28:37,300
In Spanish, we say  “observa la luna.”

417
00:28:37,833 --> 00:28:40,000
In French, we say “observe la lune.”

418
00:28:40,266 --> 00:28:43,066
South Pole station’s looking forward to Artemis one launch,

419
00:28:43,066 --> 00:28:45,800
and NASA going back to the Moon!

420
00:28:46,100 --> 00:28:50,200
If I go to the Moon, I'd bring some crackers just in case it's made of cheese! [laughing]

421
00:28:51,966 --> 00:28:56,766

Hello again, I hope you're enjoying this International Observe the Moon Night broadcast.

422
00:28:56,766 --> 00:29:01,633
As a reminder, you can visit our website: moon.nasa.gov/observe

423
00:29:01,633 --> 00:29:06,133
where you can find resources, activities, viewing guides, and more -

424
00:29:06,133 --> 00:29:09,066
lots of things to help you learn more about the Moon

425
00:29:09,066 --> 00:29:13,500
and enhance your experience participating in International Observe the Moon Night.

426
00:29:13,500 --> 00:29:19,333
Now, the Moon has been an important marker of time for humans for tens of thousands of years.

427
00:29:19,333 --> 00:29:23,466
It's an important part of creation stories in cultures around the world.

428
00:29:23,466 --> 00:29:26,666
It's woven into our language and our art.

429
00:29:26,666 --> 00:29:30,833
Today, the Moon continues to inspire poets and painters,

430
00:29:30,833 --> 00:29:34,900
artists and dreamers, scientists and explorers.

431
00:29:34,900 --> 00:29:37,800
Next - we present some Moon poetry and also some

432
00:29:37,800 --> 00:29:42,133
beautiful views of the lunar terrain that we hope will inspire you.

433
00:29:43,700 --> 00:29:47,433
A brief history of the Moon.

434
00:29:47,433 --> 00:29:50,900
When the Moon rises, it’s where you are.

435
00:29:50,900 --> 00:29:55,100
Light reflected from the Sun shines in your eyes.

436
00:29:55,100 --> 00:30:01,333
Your skin beneath the Moon is a long skein of stories too many here to tell.

437
00:30:01,333 --> 00:30:06,066
Ah, but there is a man stooped fishing beneath a banyan tree,

438
00:30:06,066 --> 00:30:12,833
there, and a precious elixir somewhere in, perhaps, the snow-white south.

439
00:30:12,833 --> 00:30:21,400
They’ve said all that’s lost on Earth gathers heaped up there, on what they’ve also said was our mirror.

440
00:30:21,400 --> 00:30:30,033
Inanna rotting monthly on a hook, global goddess, arrowed, lonely, dark, full,

441
00:30:30,033 --> 00:30:35,200
and the children are singing:  “Guard me till you die.”

442
00:30:35,200 --> 00:30:40,600
Your heart brims with Moonlight because you love and are loved,

443
00:30:40,600 --> 00:30:43,700
changing moods like shapes that cross the sky,

444
00:30:43,700 --> 00:30:50,166
and someone in a cave once etched phases on antler to keep time.

445
00:30:50,166 --> 00:30:56,366
We had to know. Silver falling through clear or clouds ringed like caution against the thief,

446
00:30:56,366 --> 00:31:04,033

night-road, Moon-road, a destination reached: a village or, metaphorically, say,

447
00:31:04,033 --> 00:31:12,466
the Moon itself drawn down from Heaven by the telescope, not spirit-smooth but rock.

448
00:31:12,466 --> 00:31:18,400
You, tonight’s Galileo, can see time: collision-born! Craters!

449
00:31:18,400 --> 00:31:23,733
Mountains shocked up to snare sunlight on the night’s ragged edge,

450
00:31:23,733 --> 00:31:28,066
valleys of dust and boulders radiating from maria.

451
00:31:28,066 --> 00:31:37,400
Just by looking, the Moon is yours where you are, living magnified by this lunar span.

452
00:31:39,400 --> 00:31:41,866
I’m Julie Swardstad Johnson.

453
00:31:41,866 --> 00:31:44,866
Nocturne with Freeway

454
00:31:45,566 --> 00:31:53,500
The day having taken itself off, unruly as the mass of feral cats who have lately made my yard their own,

455
00:31:53,500 --> 00:32:00,000
the Moon lifts up from behind Redington Pass, from behind domed mountains,

456
00:32:00,000 --> 00:32:04,400
behind the overpass, the mound of asphalt massed up

457
00:32:04,400 --> 00:32:09,600
so Broadway can be widened after years
of debate and alternate proposals

458
00:32:09,600 --> 00:32:13,500
and whatever it is that keeps us from choosing well together.

459
00:32:13,500 --> 00:32:19,833
the Moon rules over all this. I don’t know if it’s full or a day past,

460
00:32:19,833 --> 00:32:24,700
maybe one to go, my mind eager to fill in what’s missing.

461
00:32:24,700 --> 00:32:32,166
It matters to me, here in all I lament and praise, the city’s million dreams surrounding me.

462
00:32:32,166 --> 00:32:38,833
I want the precise name for this moment’s shine, a measure of all that does not pass through me.

463
00:32:39,633 --> 00:37:26,300
[Music]

464
00:37:28,133 --> 00:37:33,366
The future of lunar exploration is as bright as the Moon in our night sky.

465
00:37:33,366 --> 00:37:38,600
NASA is gearing up to return humans back to the lunar surface with the Artemis missions.

466
00:37:38,600 --> 00:37:43,366
We’ll be exploring the Moon’s South Pole, looking for water ice with the VIPER rover,

467
00:37:43,366 --> 00:37:47,200
and with VERTEX will explore a feature known as Reiner Gamma,

468
00:37:47,200 --> 00:37:53,666
an area that has beautiful white swirls and a very strong and mysterious magnetic field.

469
00:37:53,666 --> 00:37:58,000
The women and men serving as the scientists, engineers and astronauts for these missions

470
00:37:58,000 --> 00:38:05,300
are all helping us take the next giant leap forward in exploring and better understanding our Moon, and our univ

471

00:38:05,300 --> 00:38:08,633
There’s a lot on the horizon, as you’ll see in these next videos.

472
00:38:10,366 --> 00:38:15,666
Artemis I is paving the way for us to\h
explore deeper and deeper into space.

473
00:38:15,666 --> 00:38:19,433
I think Artemis I is significant on so many levels.

474
00:38:19,433 --> 00:38:22,900
It is a new frontier to do science.

475
00:38:22,900 --> 00:38:27,833
So the primary objective is to test the Orion spacecraft integrated with the Space Launch System.

476
00:38:27,833 --> 00:38:33,100
And it is designed to carry out the boldest of the bold missions.

477
00:38:33,100 --> 00:38:35,666
But it's more than just learning how to travel in space.

478
00:38:35,666 --> 00:38:39,833
We're taking a lot of cool science along with us on this first mission to the Moon.

479
00:38:39,833 --> 00:38:44,600
So as NASA plans to go back to the surface of the Moon and then on to Mars,

480
00:38:44,600 --> 00:38:47,666
we want to spend more time there and that's riskier business.

481
00:38:47,666 --> 00:38:53,700
So the more we learn about the Moon itself and the environment where we'll be operating, the better we can pr

482
00:38:53,700 --> 00:38:59,766
We have 10 CubeSats, we call secondary payloads, which are small scientific spacecraft of their own,

483
00:38:59,766 --> 00:39:02,500

that will each be conducting their own scientific mission.

484
00:39:02,500 --> 00:39:07,633
All of these payloads, in some form or fashion, will help us going forward.

485
00:39:07,633 --> 00:39:10,066
They are going to be studying the Moon.

486
00:39:10,066 --> 00:39:12,800
And they're going to help us understand, what is the Moon made out of?

487
00:39:12,800 --> 00:39:16,700
What types of rocks? What types of regolith? What types of ice?

488
00:39:16,700 --> 00:39:18,833
What's mixed in with water that might be present?

489
00:39:18,833 --> 00:39:23,733
One of them is actually going to attempt to land on the Moon. They're going to be studying the Sun.

490
00:39:23,733 --> 00:39:27,600
Understanding and studying the space environment or the space weather.

491
00:39:27,600 --> 00:39:30,033
Some different propulsion systems.

492
00:39:30,033 --> 00:39:36,966
These novel ideas will ultimately turn into the technology and the systems that we want to use going forward.

493
00:39:36,966 --> 00:39:41,966
There's a lot of cool things going on between all these CubeSats that make up our secondary payloads.

494
00:39:41,966 --> 00:39:47,000
Additionally, inside the Orion we'll be flying an experiment to study space biology.

495
00:39:47,000 --> 00:39:57,833
Space biology is where we study the underlying changes that Earth-based biological systems undergo when th

496
00:39:57,833 --> 00:40:01,166
Or basically how does life respond to the space environment?

497
00:40:01,166 --> 00:40:05,866
The level of ionizing radiation that you experience when you go beyond the Van Allen belt,

498
00:40:05,866 --> 00:40:10,800
so you go beyond the protective magnetic sphere that we have around us,

499
00:40:10,800 --> 00:40:15,266
you then get exposed to higher levels of ionizing radiation.

500
00:40:15,266 --> 00:40:18,833
So we are flying several space biology experiments.

501
00:40:18,833 --> 00:40:21,200
We'll take a series of materials —

502
00:40:21,200 --> 00:40:21,833
plant seeds,

503
00:40:21,833 --> 00:40:22,400
fungi,

504
00:40:22,500 --> 00:40:23,833
the yeast cell,

505
00:40:23,833 --> 00:40:24,333
algae,

506
00:40:24,333 --> 00:40:30,966
and ride along the trip. And then when it comes home we can analyze how they responded to that environment

507
00:40:30,966 --> 00:40:37,900
This research will help us thrive in space. It will help us to go further and stay there longer.

508
00:40:37,900 --> 00:40:44,333

In addition to space biology, we'll be learning about how to make astronauts more effective in the Orion in the f

509
00:40:44,333 --> 00:40:48,633
An example of that is something called the Callisto technology demonstration.

510
00:40:48,633 --> 00:40:51,466
Lockheed Martin built the Orion spacecraft for NASA.

511
00:40:51,466 --> 00:40:55,900
And we'll be flying a secondary payload that's a demonstration payload called Callisto.

512
00:40:55,900 --> 00:41:01,566
So we took the technology from Amazon for Alexa and the WebEx technology from Cisco

513
00:41:01,566 --> 00:41:06,900
and so we built a digital assistant, if you will, a custom space-qualified Alexa.

514
00:41:06,900 --> 00:41:10,433
Alexa, how does the life support system work?

515
00:41:10,433 --> 00:41:15,633
Orion's life support system is the Environmental Control and Life Support System, or ECLS.

516
00:41:15,633 --> 00:41:20,500
And so this payload is the demonstration mission to show how astronauts in the future

517
00:41:20,500 --> 00:41:24,333
could use this technology as an innovative user interface.

518
00:41:24,333 --> 00:41:28,100
So there you have it. I hope you agree with me, this is exciting.

519
00:41:28,100 --> 00:41:29,900
I am just over the Moon excited for the Artemis I launch.

520
00:41:30,200 --> 00:41:34,166
The science we'll conduct on Artemis I lays the groundwork

521
00:41:34,166 --> 00:41:39,800
to ensure that we can safely conduct scientific activities at the Moon with our astronauts going forward.

522
00:41:39,866 --> 00:41:45,166
This really is the stepping stone for us as we take that next giant leap in space exploration.

523
00:41:51,400 --> 00:41:52,433
[Music]

524
00:41:52,433 --> 00:41:55,733
Artemis is our 21st century return to the Moon.

525
00:41:55,733 --> 00:41:59,000
Together, NASA, international space agencies,

526
00:41:59,000 --> 00:42:01,000
and a growing global space industry

527
00:42:01,000 --> 00:42:04,533
will explore Earth’s nearest neighbor with advanced robotics

528
00:42:04,533 --> 00:42:08,600
and our next generation of astronauts.

529
00:42:08,600 --> 00:42:11,300
But where will our astronauts explore?

530
00:42:11,300 --> 00:42:14,200
The Moon is a treasure trove of scientific discovery,

531
00:42:14,200 --> 00:42:17,300
and NASA has its sights set on the South Pole.

532
00:42:17,300 --> 00:42:19,933
This mysterious region features soaring mountains

533
00:42:19,933 --> 00:42:23,000

and deep craters, leading to unique locations

534
00:42:23,000 --> 00:42:25,700
that experience nearly continuous sunlight –

535
00:42:25,700 --> 00:42:30,000
in contrast to nearby depressions that never see the sun.

536
00:42:30,000 --> 00:42:33,200
Artemis III will mark humanity's return to the lunar surface

537
00:42:33,200 --> 00:42:36,400
for the first time since 1972.

538
00:42:36,400 --> 00:42:39,533
NASA has identified thirteen regions near the South Pole

539
00:42:39,533 --> 00:42:41,800
that meet safety requirements for landing

540
00:42:41,800 --> 00:42:46,433
and present opportunities to search for lunar resources.

541
00:42:46,433 --> 00:42:48,833
Each region can also help us learn more about

542
00:42:48,833 --> 00:42:50,400
the history of the Moon,

543
00:42:50,400 --> 00:42:54,500
and gain a better understanding of our place in the solar system.

544
00:42:56,233 --> 00:42:58,833
These thirteen candidate landing regions represent

545
00:42:58,833 --> 00:43:01,933
a diversity of features in the lunar South Pole,

546
00:43:01,933 --> 00:43:03,600
ranging from the summits of mountains

547
00:43:03,600 --> 00:43:06,033
rising miles above their surroundings,

548
00:43:06,033 --> 00:43:08,533
to the rims of large craters.

549
00:43:08,533 --> 00:43:12,133
These features together act to both expose and preserve

550
00:43:12,133 --> 00:43:15,133
billions of years of geologic history.

551
00:43:19,000 --> 00:43:21,600
Using robotic orbiters and rovers,

552
00:43:21,600 --> 00:43:23,700
NASA and the global science community

553
00:43:23,700 --> 00:43:25,600
will continue to study these regions

554
00:43:25,600 --> 00:43:28,733
before selecting the Artemis III landing site.

555
00:43:31,733 --> 00:43:34,533
The astronauts selected for this bold expedition

556
00:43:34,533 --> 00:43:36,900
will literally and figuratively shine a light

557
00:43:36,900 --> 00:43:40,400
on some of the deepest, darkest areas of the solar system,

558
00:43:40,400 --> 00:43:43,600

revealing ancient secrets of the universe.

559
00:43:43,600 --> 00:43:46,233
[Music fades]

560
00:43:56,733 --> 00:44:01,000
The goal of the test here at the slope
lab is to test the latest VIPER

561
00:44:01,000 --> 00:44:05,633
mobility prototype in this facility
in order to verify requirements.

562
00:44:06,333 --> 00:44:11,966
That means we want to check that
the system does what it is supposed to do once on the Moon.

563
00:44:11,966 --> 00:44:14,500
The VIPER test unit that is behind me

564
00:44:15,066 --> 00:44:18,500
is a light version
of the full VIPER rover.

565
00:44:18,966 --> 00:44:23,133
We stripped down the heavy components
to try to maintain the mass load

566
00:44:23,133 --> 00:44:27,133
so that we can drive on Earth,
which has a much higher gravity.

567
00:44:28,233 --> 00:44:30,833
And we need to do this because the system

568
00:44:30,833 --> 00:44:33,600
is designed to go to the Moon
where it will be a lot lighter.

569

00:44:34,366 --> 00:44:38,733
We have consulted NASA scientists
who have analyzed images and data

570
00:44:38,733 --> 00:44:43,300
from previous Apollo missions
to determine the distribution of rocks

571
00:44:43,300 --> 00:44:48,033
and craters of different sizes
over certain areas of the terrain and

572
00:44:48,266 --> 00:44:51,966
the shapes and characteristics of rocks
that we expect to see on the surface.

573
00:44:52,366 --> 00:44:55,300
So what we've done is use that information

574
00:44:55,666 --> 00:44:59,566
to recreate a Moon-like terrain for the rover.

575
00:45:00,266 --> 00:45:04,200
We're testing rover capabilities
when we go into an extreme

576
00:45:04,200 --> 00:45:05,966
sinkage environment.

577
00:45:05,966 --> 00:45:09,433
So in the Moon, when we're roving,
we might encounter areas

578
00:45:09,433 --> 00:45:13,066
with fluffier soil,
something similar to quicksand.

579
00:45:13,533 --> 00:45:16,500
And so our rover has a capability to

580
00:45:17,400 --> 00:45:20,500
still make forward progress
in these quicksands.

581
00:45:20,833 --> 00:45:25,200
We're also testing
the ability that the rover has to move in

582
00:45:25,200 --> 00:45:30,333
a very special way is similar
to a caterpillar inchworming motion.

583
00:45:30,866 --> 00:45:32,933
So the rover is able to

584
00:45:34,300 --> 00:45:36,300
change the distance between its wheels

585
00:45:36,566 --> 00:45:40,100
and apply power to the wheels
in a very coordinated manner.

586
00:45:40,300 --> 00:45:44,433
And that would allow the VIPER rover
to get unstuck of this quicksand.

587
00:45:44,900 --> 00:45:48,533
This is challenging for the rover,
but it's important to test

588
00:45:48,533 --> 00:45:53,266
because we need to better understand and
mitigate risks and hazards to the rover.

589
00:45:53,666 --> 00:45:57,766
And we have a great team of NASA engineers
here to address any risk that we might face.

590
00:47:29,566 --> 00:47:09,166

[Music]

591
00:47:29,566 --> 00:47:36,866
Lacus Mortis, the Lake of Death, is a lava plain about 160 kilometers across.

592
00:47:36,866 --> 00:47:39,133
It was chosen as the first landing site

593
00:47:39,133 --> 00:47:45,500
for NASA's Commercial Lunar Payload Services Program of robotic missions,

594
00:47:45,500 --> 00:47:50,666
Near its center is the crater Bürg, 40 kilometers in diameter.

595
00:47:50,666 --> 00:47:54,133
West of Bürg, Lacus Mortis's floor is broken

596
00:47:54,133 --> 00:48:00,733
by a fascinating network of fault scarps and fractures known as straight rilles.

597
00:48:00,733 --> 00:48:23,233
[Music fades]

598
00:48:24,700 --> 00:48:28,300
Welcome back! I hope you are enjoying the program,

599
00:48:28,300 --> 00:48:32,433
and I want to remind you that you can share your pictures and observations of the Moon,

600
00:48:32,433 --> 00:48:35,666
and find out what other people are doing to celebrate

601
00:48:35,666 --> 00:48:38,466
in our International Observe the Moon Night Flickr gallery

602
00:48:38,466 --> 00:48:42,600
and through the hashtag #ObserveTheMoon on social media.

603
00:48:42,600 --> 00:48:46,866
Each of us can observe the Moon and come away with a sense of wonder and awe.

604
00:48:46,866 --> 00:48:50,633
We asked some lunar scientists what excites them most about the Moon,

605
00:48:50,633 --> 00:48:52,366
and here's what they had to say . . .

606
00:48:53,133 --> 00:49:02,166
[Music]

607
00:49:02,600 --> 00:49:04,633
Hi! My name is Aisha Khatib.

608
00:49:04,633 --> 00:49:07,766
I'm a Ph.D. candidate at the University of Maryland.

609
00:49:07,766 --> 00:49:13,600
I study lunar seismology, and especially deep moonquakes.

610
00:49:13,600 --> 00:49:18,833
I'm really excited about the fact that we're going forward to the Moon

611
00:49:18,833 --> 00:49:25,133
and we are trying to answer some of these questions that we've had for the past 50 years.

612
00:49:25,133 --> 00:49:29,433
What people might not know about the Moon is that the Moon is seismically active.

613
00:49:29,433 --> 00:49:33,666
So there are a lot of seismic events that occur on the Moon.

614
00:49:33,666 --> 00:49:34,900
So just as the

615
00:49:34,900 --> 00:49:37,400

Earth has earthquakes,
the Moon also has moonquakes.

616
00:49:38,033 --> 00:49:41,300
And there are several
different kinds of moonquakes

617
00:49:41,300 --> 00:49:44,266
that we've been able to observe
from the Apollo seismic data.

618
00:49:44,900 --> 00:49:47,000
We have thermal moonquakes,
we have shallow moonquakes.

619
00:49:47,000 --> 00:49:50,866
And we also have something
that are really, really mysterious called

620
00:49:50,866 --> 00:49:55,433
deep moonquakes, which occur
really deep down in the lunar interior.

621
00:49:55,700 --> 00:50:00,233
And we think they are due
to tidal stresses,

622
00:50:00,500 --> 00:50:03,866
but we don't exactly know
what causes these moonquakes.

623
00:50:04,100 --> 00:50:06,966
And I'm really excited
about seeing new data finally,

624
00:50:06,966 --> 00:50:09,800
after only working with data
that's 50 years old.

625
00:50:10,200 --> 00:50:12,333

So that's what I'm excited about.

626
00:50:13,666 --> 00:50:16,733
Hello, I'm Greg Schmidt,
director of NASA's SSERVI,

627
00:50:16,733 --> 00:50:20,700
the Solar System Exploration
Research Virtual Institute.

628
00:50:21,000 --> 00:50:26,900
So - one of the things that excites
me so much is the discovery of volatiles.

629
00:50:26,900 --> 00:50:29,833
So what what do I mean about that?

630
00:50:29,833 --> 00:50:33,433
You know, what I mean
is that we have discovered things

631
00:50:33,800 --> 00:50:36,700
like water, you know, in the form of ice.

632
00:50:36,700 --> 00:50:39,433
Now, how it got there, we don't know yet.

633
00:50:39,466 --> 00:50:44,333
You know, a lot of people are still doing
some pretty exciting research on that.

634
00:50:44,666 --> 00:50:47,933
There are other kind of materials that are

635
00:50:48,200 --> 00:50:51,700
that are preserved
in these permanently shadowed

636
00:50:52,100 --> 00:50:56,366

regions on the Moon that have been there
for a really, really long time.

637
00:50:56,366 --> 00:50:58,800
I mean, we're talking billions of years.

638
00:50:59,233 --> 00:51:00,766
Why are they still there?

639
00:51:00,766 --> 00:51:03,933
Because it's so very, very cold.

640
00:51:03,933 --> 00:51:06,500
We're talking about
some of the coldest places

641
00:51:06,833 --> 00:51:11,866
in the solar system, this cold
or perhaps even colder than than Pluto.

642
00:51:11,866 --> 00:51:14,933
And and yet here they are on the Moon.

643
00:51:14,933 --> 00:51:19,366
And so what's happened is that gases,

644
00:51:19,666 --> 00:51:23,833
water, other things
have come into these shadowed regions

645
00:51:24,133 --> 00:51:28,366
and there's no sunlight
for a billion years, perhaps more.

646
00:51:28,766 --> 00:51:31,100
And they get trapped there.

647
00:51:31,100 --> 00:51:34,566
And so what form

they're in, how they're mixed in

648
00:51:34,566 --> 00:51:39,766
with the lunar regolith, as we call it,
which is basically the dirt on the Moon -

649
00:51:39,766 --> 00:51:41,633
how that's all mixed together -

650
00:51:41,633 --> 00:51:45,866
that's something that we need to find out.
But it just presents

651
00:51:45,866 --> 00:51:49,000
some really exciting research
opportunities.

652
00:51:49,900 --> 00:51:52,533
Hi, I'm Linden Wike
and I'm about to enter my third year

653
00:51:52,533 --> 00:51:56,666
as a graduate student at the University
of Maryland studying planetary geology.

654
00:51:57,000 --> 00:52:00,933
I'm very excited about the Moon right now
because it serves as our first step

655
00:52:00,933 --> 00:52:04,233
towards exploring more of the solar system
and the universe as a whole.

656
00:52:04,233 --> 00:52:08,633
But for the Artemis mission coming up, I'm
very keen on seeing astronauts get to go

657
00:52:08,633 --> 00:52:13,233
back to the Moon, forward to the Moon
for the first time in 50 years.

658
00:52:13,233 --> 00:52:17,700
So having astronauts go to
the Moon is also very important to me

659
00:52:17,700 --> 00:52:20,700
as it ties into my own research
where I've been looking into

660
00:52:20,700 --> 00:52:23,900
how to detect lava tubes
as a resource for the astronauts

661
00:52:23,900 --> 00:52:27,900
and their equipment to use as shelter.
When they get to the Moon, when they say

662
00:52:27,900 --> 00:52:31,700
we need something to take shelter -
and I'll be helping to find those.

663
00:52:31,700 --> 00:52:33,566
I'm Carlie Pieters.

664
00:52:33,566 --> 00:52:36,666
I'm a planetary geoscientist.

665
00:52:38,500 --> 00:52:39,533
I'm a

666
00:52:39,533 --> 00:52:42,500
semi-retired
professor from Brown University.

667
00:52:43,700 --> 00:52:46,500
But I've been working on lunar exploration

668
00:52:46,500 --> 00:52:49,133
and lunar science for decades,

and I love it.

669
00:52:49,733 --> 00:52:54,766
Remember the Earth and the Moon are related -

670
00:52:54,766 --> 00:52:58,533
more related
than any other planetary bodies.

671
00:52:58,533 --> 00:53:01,766
And the Moon affects us

672
00:53:01,766 --> 00:53:04,366
sometimes directly, sometimes

673
00:53:04,366 --> 00:53:06,700
just because we can go out on a moonlit

674
00:53:06,700 --> 00:53:09,700
night and smile.

675
00:53:09,700 --> 00:53:13,166
It's an old friend. It's not going away.

676
00:53:13,166 --> 00:53:16,133
It'll be there for much longer
than we are.

677
00:53:16,933 --> 00:53:19,166
And I love it.

678
00:53:27,533 --> 00:53:32,866
Today, we've shown you a number of ways that we study the Moon at NASA, and why we're doing it.

679
00:53:32,866 --> 00:53:37,766
There is so much that we're still learning from our past exploration, and so many things

680
00:53:37,766 --> 00:53:43,300

that are happening now as we prepare for the next phase of lunar exploration with Artemis.

681
00:53:43,300 --> 00:53:46,966
The Moon is the cornerstone for learning more about the solar system.

682
00:53:46,966 --> 00:53:50,766
It’s a stepping stone for reaching Mars and beyond.

683
00:53:50,766 --> 00:53:54,800
Our accomplishments at the Moon prove that nothing is beyond our reach.

684
00:53:54,800 --> 00:53:56,833
It’s a symbol in the sky.

685
00:53:56,833 --> 00:54:00,800
So remember - no matter who you are or where you’re from,

686
00:54:00,800 --> 00:54:05,000
you have the potential to dream big and reach for the stars.

687
00:54:05,000 --> 00:54:08,900
In that spirit, we bring you this next Moon-themed music video,

688
00:54:08,900 --> 00:54:12,100
featuring singers Javier Colon and Matt Cusson.

689
00:54:12,100 --> 00:54:13,733
I hope you enjoy it.

690
00:54:43,766 --> 00:54:26,366
[music]

691
00:54:44,400 --> 00:54:54,000
Have you ever wanted to fly
among the stars? To see up close

692
00:54:54,000 --> 00:55:01,400
what we could only see from

afar. Come on let’s go

693
00:55:01,400 --> 00:55:12,000
your dreams are possible. We can
fly far away from here. Defying

694
00:55:12,000 --> 00:55:21,000
gravity we’ll soar beyond the
atmosphere. We will see things

695
00:55:21,000 --> 00:55:29,400
we've never seen before. We’ll
open up a door to a new world

696
00:55:29,400 --> 00:55:38,400
and go explore the Moon and so
much more.

697
00:55:38,400 --> 00:55:42,766
[music]

698
00:55:42,766 --> 00:55:52,900
I remember dreaming that I could
take flight - to chase forever

699
00:55:52,900 --> 00:56:00,400
into the heart of the night.
Above it all,

700
00:56:00,400 --> 00:56:08,833
the world's so small. We can fly
far away from here.

701
00:56:08,833 --> 00:56:17,400
Defying gravity we'll soar
beyond the atmosphere.

702
00:56:17,400 --> 00:56:26,100
We will see things we've never
seen before - open up a door

703
00:56:26,100 --> 00:56:32,600
to a new world and go explore,
the Moon there's so much . . .

704
00:56:32,600 --> 00:56:40,400
more that we have yet to see,
much more to understand.

705
00:56:40,400 --> 00:56:51,400
But the time is here and now.
After all we're just

706
00:56:51,400 --> 00:57:01,366
one speck of sand in this
universe of ours.

707
00:57:01,366 --> 00:57:10,900
We can fly far away from here.
Defying gravity we'll soar

708
00:57:10,900 --> 00:57:15,400
beyond the atmosphere
( yyyeah ).

709
00:57:15,400 --> 00:57:22,100
We can see things we've never
seen before.

710
00:57:22,100 --> 00:57:29,033
We'll open up a door to a new
world and go explore -

711
00:57:29,033 --> 00:57:34,400
the Moon and so much more.

712
00:57:34,400 --> 00:57:44,900
[music]

713

00:57:57,766 --> 00:57:59,933
That concludes our program for this evening.

714
00:57:59,933 --> 00:58:04,533
I'd like to thank the Solar System Exploration Division at NASA's Goddard Space Flight Center

715
00:58:04,533 --> 00:58:09,366
and NASA's Lunar Reconnaissance Orbiter for sponsoring International Observe the Moon Night.

716
00:58:09,366 --> 00:58:12,866
I'd also like to thank our incredible supporters around the world,

717
00:58:12,866 --> 00:58:15,633
and each and every one of you for watching

718
00:58:15,633 --> 00:58:19,100
and for celebrating International Observe the Moon Night with us.

719
00:58:19,100 --> 00:58:24,966
You can keep up with lunar science and exploration throughout the year on moon.nasa.gov,

720
00:58:24,966 --> 00:58:27,733
and by following NASA Moon on social media,

721
00:58:27,733 --> 00:58:31,833
and by subscribing to our International Observe the Moon Night newsletter.

722
00:58:31,833 --> 00:58:35,933
You can sign up on moon.nasa.gov/observe

723
00:58:35,933 --> 00:58:39,933
and that's the same place you can find the Moon maps made special for today,

724
00:58:39,933 --> 00:58:46,300
activity recommendations, and find out where people are observing the Moon around the world right now.

725
00:58:46,300 --> 00:58:48,433
And add yourself to the map!

726
00:58:48,433 --> 00:58:50,033
Thanks so much for joining us.