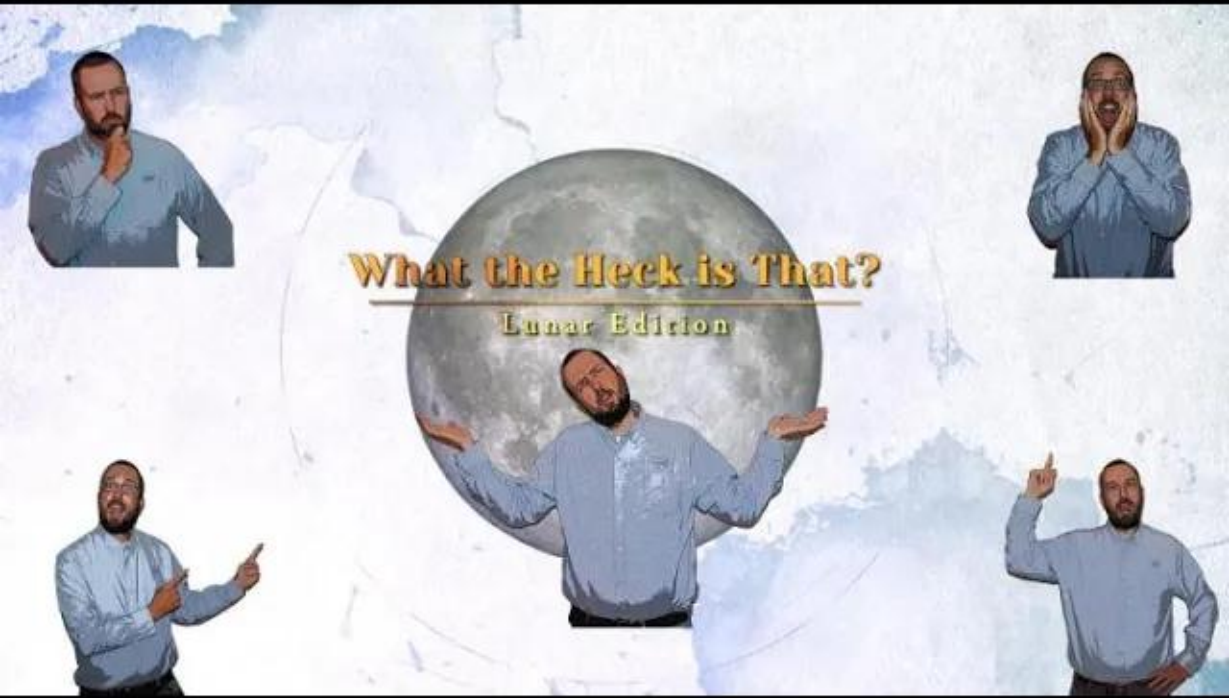
What the Heck is That?
Lunar Edition

1
00:00:00,433 --> 00:00:06,800
[Music]

2
00:00:06,800 --> 00:00:08,833
■ What the heck is that? ■■

3
00:00:08,833 --> 00:00:11,766
[Music fades]

4
00:00:12,700 --> 00:00:14,533
Hi everyone – I'm Noah Petro,

5
00:00:14,533 --> 00:00:17,833
the Project Scientist of NASA's Lunar Reconnaissance Orbiter Spacecraft

6
00:00:17,833 --> 00:00:19,633
which has been at the Moon for over a decade now,

7
00:00:19,633 --> 00:00:23,833
sending back a treasure-trove of data, including some spectacular images.

8
00:00:25,366 --> 00:00:27,900
Inevitably, whenever NASA publishes a photo

9
00:00:27,900 --> 00:00:30,600
or releases a video of ours showing the lunar landscape,

10
00:00:30,600 --> 00:00:33,066
we get emails, tweets, and online posts from viewers

11
00:00:33,066 --> 00:00:37,666
asking for us to further explain some of the weird looking visuals they are seeing.

12
00:00:39,366 --> 00:00:42,933
So today, we're going to look at these strange and mysterious looking features on the Moon

13
00:00:42,933 --> 00:00:46,066

to answer the question: What the heck is that?

14
00:00:46,066 --> 00:00:47,500
So let's launch into this!

15
00:00:49,833 --> 00:00:52,533
In our video "Apollo 13 Views of the Moon" –

16
00:00:52,533 --> 00:00:55,566
many viewers wondered about this strange looking circle with dark lines.

17
00:00:55,566 --> 00:00:57,666
So what the heck is that?

18
00:00:57,666 --> 00:01:00,400
Well, for starters, this is not the remnants of an ancient lake,

19
00:01:00,400 --> 00:01:02,033
and apologies to the sci-fi crowd,

20
00:01:02,033 --> 00:01:05,033
it’s not a secret Moon base with runways for spacecraft.

21
00:01:05,033 --> 00:01:08,233
This is a geological feature known as Komarov Crater.

22
00:01:08,233 --> 00:01:10,666
It’s 80 kilometers wide, and it’s on the far side of the Moon,

23
00:01:10,666 --> 00:01:12,966
on the edge of Mare Moscoviense.

24
00:01:12,966 --> 00:01:17,033
The floor is covered with a network of rilles that make it look like Sun-dried mud.

25
00:01:17,033 --> 00:01:21,266
And it’s a great example of a floor-fractured crater, or FFC.

26
00:01:21,266 --> 00:01:23,400
So what made Komarov look like that?

27
00:01:23,400 --> 00:01:26,266
The leading idea among scientists is that FFCs are like

28
00:01:26,266 --> 00:01:28,800
volcanoes that didn't quite reach the surface.

29
00:01:28,800 --> 00:01:31,666
An impactor hits the Moon, forming the crater.

30
00:01:31,666 --> 00:01:35,133
And underneath the crater floor, the impact creates a zone of broken rock,

31
00:01:35,133 --> 00:01:36,633
called a breccia lens.

32
00:01:36,633 --> 00:01:39,833
Magma from deeper inside the Moon rises into the cracks in the breccia lens,

33
00:01:39,833 --> 00:01:43,200
but something stops it from getting all the way to the surface.

34
00:01:43,200 --> 00:01:47,333
So, it spreads out under the crater floor, forming what’s called a sill.

35
00:01:47,333 --> 00:01:50,666
The magma and hot gasses in the sill push on the crater floor from below,

36
00:01:50,666 --> 00:01:54,800
causing it to bulge and fracture like the top of a cake in the oven.

37
00:01:54,800 --> 00:01:56,566
The cracks you see are known as graben.

38
00:01:56,566 --> 00:01:57,966

[Release the graben!]

39
00:01:57,966 --> 00:02:00,533
Using data from Lunar Reconnaissance Orbiter,

40
00:02:00,533 --> 00:02:04,566
scientists have cataloged over a hundred floor-fractured craters just like Komarov.

41
00:02:04,566 --> 00:02:07,966
They are fascinating works of nature from billions of years ago.

42
00:02:07,966 --> 00:02:08,966
[Billions!]

43
00:02:09,633 --> 00:02:13,500
An image from the Apollo 11 mission has gotten a lot of attention over the years.

44
00:02:13,500 --> 00:02:17,100
Here you see a pair of craters known as Messier and Messier A.

45
00:02:17,100 --> 00:02:20,300
But they don’t look like the more typical round craters you see on the Moon.

46
00:02:20,300 --> 00:02:25,766
LRO has taken even more high definition shots of these two sights, showing us incredible detail.

47
00:02:25,766 --> 00:02:30,200
These oval shapes and areas of ejected rock do look like they could belong in Star Wars

48
00:02:30,200 --> 00:02:32,266
as the crash site of the Millennium Falcon.

49
00:02:32,266 --> 00:02:34,500
And actually, the way you might imagine a scene like that happening,

50
00:02:34,500 --> 00:02:37,666
with an object slamming and then skipping across the surface

51
00:02:37,666 --> 00:02:40,733
is what took place here - except with an asteroid.

52
00:02:40,733 --> 00:02:45,033
You see, at very low angels, an incoming asteroid can actually become decapitated,

53
00:02:45,033 --> 00:02:47,566
with the top part splitting off at impact

54
00:02:47,566 --> 00:02:51,733
and either escaping back into space or skipping to form a second crater.

55
00:02:51,733 --> 00:02:54,300
Think of it like skipping a stone across the water.

56
00:02:54,300 --> 00:02:57,133
Both laboratory impact experiments and computer modeling

57
00:02:57,133 --> 00:03:00,000
have demonstrated the physical affects of the oblique impact

58
00:03:00,000 --> 00:03:03,300
of a large asteroid on the Moon. And LRO's data helps prove

59
00:03:03,300 --> 00:03:05,466
the formation of these unusual features.

60
00:03:06,600 --> 00:03:07,966
[LRO!]

61
00:03:07,966 --> 00:03:11,466
Scattered across the lunar surface are these long winding features –

62
00:03:11,466 --> 00:03:14,133
which many viewers have correctly assumed are channels.

63
00:03:14,133 --> 00:03:16,433

On the Moon, these are called rilles.

64
00:03:16,433 --> 00:03:18,933
There is a prominent one here on the Aristarchus plateau.

65
00:03:18,933 --> 00:03:21,033
And if you were comparing to visuals on the Earth –

66
00:03:21,033 --> 00:03:23,500
you might be tempted to think about long river canyons,

67
00:03:23,500 --> 00:03:25,766
flowing in long, sweeping meanders –

68
00:03:25,766 --> 00:03:28,900
like the mighty Mississippi pouring out into the Gulf of Mexico.

69
00:03:28,900 --> 00:03:30,833
And if that's what you're thinking –

70
00:03:30,833 --> 00:03:32,800
erase it from your memory, because it's wrong.

71
00:03:34,933 --> 00:03:38,200
Now to be fair, when these channels were observed on the Moon for the first time,

72
00:03:38,200 --> 00:03:42,000
there was an immediate thought that water may have carved these features.

73
00:03:42,000 --> 00:03:44,033
But, once we got actual samples from the Moon,

74
00:03:44,033 --> 00:03:47,333
combined with additional spacecraft data and studies over the years,

75
00:03:47,333 --> 00:03:50,666
we've come to understand that there was never flowing water on the Moon.

76
00:03:50,666 --> 00:03:53,500
So what could carve these sweeping features?

77
00:03:53,500 --> 00:03:58,166
If you said flowing liquid hot magma after it erupted onto the Moon's surface -

78
00:03:58,166 --> 00:03:59,100
you'd be correct!

79
00:03:59,100 --> 00:04:00,200
[Winner!]

80
00:04:00,200 --> 00:04:03,366
When lava flows across the surface, it erodes the crust,

81
00:04:03,366 --> 00:04:08,133
and slowly flows as it bends and turns, forming these beautiful channels.

82
00:04:08,133 --> 00:04:11,566
We have a great view of this in our Rima Prinz visualization.

83
00:04:11,566 --> 00:04:14,100
Here you see a long channel where lava once flowed

84
00:04:14,100 --> 00:04:16,300
from the Vera volcanic depression.

85
00:04:16,300 --> 00:04:20,166
Eruptions of lava fountains formed a lake of lava 300 meters deep

86
00:04:20,166 --> 00:04:24,300
and carved a lava channel one-hundred times deeper than anything found on Earth.

87
00:04:24,300 --> 00:04:26,266
These types of feature were so compelling

88
00:04:26,266 --> 00:04:29,833

that the Apollo 15 mission went and explored one in 1971,

89
00:04:29,833 --> 00:04:31,600
known as the Hadley rille.

90
00:04:31,600 --> 00:04:35,533
Future explorers may visit others, but they should leave their fishing rods at home.

91
00:04:37,500 --> 00:04:41,633
This visual is one of our most popular. This is a picture of Tycho crater,

92
00:04:41,633 --> 00:04:45,633
and the famous central peak boulder, which is about 400 feet wide.

93
00:04:45,633 --> 00:04:47,400
That’s longer than a football field.

94
00:04:48,766 --> 00:04:50,533
How in the world did that wind up there?

95
00:04:50,533 --> 00:04:52,300
Well I have no idea!

96
00:04:53,300 --> 00:04:56,166
["Oh, daggum-it!"]

97
00:04:59,500 --> 00:05:03,566
We’re going to fly now into a spot on the near side to look at this weird feature,

98
00:05:03,566 --> 00:05:06,333
which has long defied an easy explanation.

99
00:05:06,333 --> 00:05:07,833
It’s known as Reiner Gamma.

100
00:05:07,833 --> 00:05:11,166
Those squiggles and swirls sure are bizarre.

101
00:05:11,166 --> 00:05:13,433
A combination of computer modeling and data gathered

102
00:05:13,433 --> 00:05:17,300
from numerous recent lunar missions, including Lunar Reconnaissance Orbiter,

103
00:05:17,300 --> 00:05:20,566
now sheds light on the origin of these unusual surface decorations –

104
00:05:20,566 --> 00:05:22,366
which we call lunar swirls.

105
00:05:22,366 --> 00:05:23,500
Now think of it this way -

106
00:05:23,500 --> 00:05:27,533
You've probably been told that when you go outside to put on your sunscreen.

107
00:05:27,533 --> 00:05:29,733
Well, these beautiful swirls are constant reminders

108
00:05:29,733 --> 00:05:31,733
that the Moon is no different from you and me.

109
00:05:31,733 --> 00:05:34,866
Except that it's a Moon, and we're humans.

110
00:05:34,866 --> 00:05:39,900
These swirls are examples of what happens when the Moon applies SPF three million.

111
00:05:39,900 --> 00:05:43,733
The Moon is constantly bombarded by radiation from the Sun and galaxy,

112
00:05:43,733 --> 00:05:47,233
as well as micro-meteorites that sand-blast the surface.

113
00:05:47,233 --> 00:05:49,066

These swirls, however, show what happens

114
00:05:49,066 --> 00:05:52,300
when the radiation is blocked from reaching the surface.

115
00:05:52,300 --> 00:05:56,500
Data suggests that small magnetic anomalies block radiation from reaching the surface,

116
00:05:56,500 --> 00:06:00,033
and therefore prevent the Moon from getting sunburned in these areas,

117
00:06:00,033 --> 00:06:02,200
which keep them as bright as they appear to be.

118
00:06:02,200 --> 00:06:05,033
So, the next time you put on sunblock to go lounge outside,

119
00:06:05,033 --> 00:06:08,033
think of the Moon and how it gets baked in the Sun just like you and me.

120
00:06:08,033 --> 00:06:10,233
[Aaaaaaah!]

121
00:06:10,633 --> 00:06:11,866
Thanks for watching today.

122
00:06:11,866 --> 00:06:13,866
Hopefully this video taught you more about the Moon,