NO SMALL STEPS

with **Stephen Granade**

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1
00:00:02,010 --> 00:00:03,500
>> STEPHEN: The thing that makes space travel difficult

2
00:00:03,750 --> 00:00:06,500
is that everything we use to do it is so massive.

3
00:00:06,750 --> 00:00:08,750
To get to orbit, let alone to the Moon or Mars,

4
00:00:09,000 --> 00:00:11,250
you have to lift a lot of very heavy stuff.

5
00:00:11,250 --> 00:00:12,750
So how do you do that?

6
00:00:13,000 --> 00:00:15,000
How do you escape gravity,

7
00:00:15,100 --> 00:00:16,100
the force that holds us to Earth...?

8
00:00:16,100 --> 00:00:18,900
Well, let’s talk.

9
00:00:19,000 --> 00:00:19,900
[Space Shot takes off]

10
00:00:20,000 --> 00:00:22,000
Woooo!

11
00:00:22,100 --> 00:00:22,700
[Fast paced music]

12
00:00:22,800 --> 00:00:24,100
That’s one small step for man…

13
00:00:25,600 --> 00:00:27,500

Traveling through space is hard.

14
00:00:28,000 --> 00:00:29,900
That’s why NASA’s Space Launch System

15
00:00:30,000 --> 00:00:31,900
will have to be the most powerful rocket in history.

16
00:00:32,000 --> 00:00:34,000
How is SLS able to meet the challenges

17
00:00:34,100 --> 00:00:35,100
of exploring deep space?

18
00:00:35,900 --> 00:00:38,100
Well, when it comes to our journey to Mars and beyond…

19
00:00:38,500 --> 00:00:40,500
There are NO small steps.

20
00:00:42,000 --> 00:00:44,500
Let’s talk about low-Earth orbit first, which,

21
00:00:44,900 --> 00:00:46,500
compared to Mars, is relatively close.

22
00:00:46,600 --> 00:00:50,000
The International Space Station is only 220 miles over our heads.

23
00:00:50,000 --> 00:00:52,500
For years, the Space Shuttle got us to low-Earth orbit.

24
00:00:52,900 --> 00:00:54,500
It weighed 4.4 million pounds and

25
00:00:54,501 --> 00:00:56,500
could carry around 54,000 pounds into orbit.

26
00:00:57,000 --> 00:00:59,900
That’s only about 18 family sedans worth of stuff,

27
00:01:00,000 --> 00:01:02,900
and that’s because, of that 4.4 million pounds of weight,

28
00:01:03,000 --> 00:01:04,500
3 million pounds was fuel.

29
00:01:04,600 --> 00:01:06,900
The Shuttle’s fuel weighed more than twice the shuttle,

30
00:01:07,000 --> 00:01:09,100
its external tank, and solid rocket boosters combined!

31
00:01:09,900 --> 00:01:13,000
It’s like driving a car that requires a 1,000 gallon gas tank.

32
00:01:14,000 --> 00:01:15,100
The Shuttle got us to low Earth orbit,

33
00:01:15,200 --> 00:01:16,100
But what about the Moon?

34
00:01:16,200 --> 00:01:19,100
The Moon is 240,000 miles away,

35
00:01:19,200 --> 00:01:21,500
which is 1,000 times farther than the Shuttle can take us.

36
00:01:21,600 --> 00:01:24,400
Thankfully, we don’t need 1,000 times as much fuel.

37
00:01:24,500 --> 00:01:26,400
The cool thing about space is that you can coast.

38
00:01:26,500 --> 00:01:28,500

We’ve just got to go fast enough to reach the Moon

39
00:01:28,600 --> 00:01:30,100
and let its gravity pull us into orbit.

40
00:01:31,500 --> 00:01:33,100
So you don’t need 1,000 times as much fuel,

41
00:01:33,200 --> 00:01:35,500
but you do need more. But the more fuel you have,

42
00:01:35,600 --> 00:01:36,900
the heavier your vehicle has to be,

43
00:01:37,000 --> 00:01:39,000
and the heavier your vehicle is, the more fuel you need.

44
00:01:39,100 --> 00:01:40,500
Tricky, huh?

45
00:01:40,900 --> 00:01:43,100
The Saturn V is the rocket that took us to the Moon.

46
00:01:43,100 --> 00:01:46,100
It could carry 260,000 pounds into orbit.

47
00:01:46,100 --> 00:01:48,500
That’s almost five times what the Shuttle could carry,

48
00:01:48,500 --> 00:01:50,900
and it could carry 100,000 pounds to the Moon.

49
00:01:51,000 --> 00:01:54,000
However, to do that, it weighed 6.5 million pounds,

50
00:01:54,000 --> 00:01:55,600
and 6 million pounds of that was fuel.

51
00:01:55,700 --> 00:01:57,100
That’s right… to get to the Moon

52
00:01:57,200 --> 00:02:00,000
we had to build a vehicle that was over 90% fuel.

53
00:02:01,000 --> 00:02:02,000
Now, what about Mars?

54
00:02:02,100 --> 00:02:05,000
When we go to Mars, it’ll be around 50 million miles away…

55
00:02:05,100 --> 00:02:06,900
[High-speed wind sound]

56
00:02:07,000 --> 00:02:08,900
…About 200 times further away than the Moon.

57
00:02:09,000 --> 00:02:10,100
The Space Shuttle won’t get us there,

58
00:02:10,200 --> 00:02:11,900
the Saturn V won’t get us there…

59
00:02:11,900 --> 00:02:13,500
and we’d kinda like to come back.

60
00:02:13,900 --> 00:02:15,900
So the family sedan isn’t going to get us there.

61
00:02:16,000 --> 00:02:16,900
We need something bigger.

62
00:02:17,100 --> 00:02:17,900
Maybe a van.

63
00:02:18,000 --> 00:02:18,900

Or a bus…

64
00:02:19,000 --> 00:02:21,500
or maybe the biggest rocket in the history of the world.

65
00:02:21,600 --> 00:02:23,100
We need SLS.

66
00:02:23,900 --> 00:02:25,900
The first version of SLS will get us to the Moon.

67
00:02:26,000 --> 00:02:28,500
The second version will be the tallest rocket in history,

68
00:02:28,600 --> 00:02:29,900
it'll produce the greatest thrust,

69
00:02:30,000 --> 00:02:31,800
and it'll get the most stuff into orbit.

70
00:02:32,000 --> 00:02:33,900
The second version of the SLS will have about

71
00:02:34,000 --> 00:02:35,100
the same fuel as a Saturn V,

72
00:02:35,200 --> 00:02:37,000
but where the Saturn V could only go to the moon,

73
00:02:37,100 --> 00:02:40,000
the SLS will go to Mars.

74
00:02:40,100 --> 00:02:42,900
Next time, we'll talk about how the SLS is so powerful,

75
00:02:43,000 --> 00:02:45,000
and how the Space Shuttle and the Saturn V

76
00:02:45,100 --> 00:02:46,500
paved the way to Mars.