



1

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

>> STEPHEN: How do you get a heavy-lift rocket like SLS into space?

2

00:00:03,000 --> 00:00:05,600

Well... you burn stuff.

3

00:00:05,700 --> 00:00:17,900

[Fast paced music]

4

00:00:18,000 --> 00:00:20,000

That's one small step for man...

5

00:00:21,100 --> 00:00:23,100

Traveling through space is hard.

6

00:00:23,500 --> 00:00:25,000

That's why NASA's Space Launch System

7

00:00:25,100 --> 00:00:27,500

will have to be the most powerful rocket in history.

8

00:00:27,600 --> 00:00:30,900

How is SLS able to meet the challenges of exploring deep space?

9

00:00:31,100 --> 00:00:33,900

Well, when it comes to our journey to Mars and beyond...

10

00:00:34,000 --> 00:00:37,500

There are NO small steps.

11

00:00:37,600 --> 00:00:39,500

Rockets are full of fuel.

12

00:00:39,600 --> 00:00:42,100

When that fuel burns, it creates hot, expanding gas

13

00:00:42,200 --> 00:00:45,000

that shoots out of the back of the rocket, pushing the rocket forward.

14

00:00:45,000 --> 00:00:48,900

Now, to burn, the fuel needs high temperatures and an oxidant, like oxygen-

15

00:00:49,000 --> 00:00:50,500

-Which is pretty available, here on Earth.

16

00:00:50,600 --> 00:00:54,500

But rockets have to travel in space, where oxygen is a little harder to come by.

17

00:00:54,600 --> 00:00:57,900

So, it has to carry its own oxidant along with its fuel.

18

00:00:58,000 --> 00:01:01,500

Rocket fuel comes in two forms: solid and liquid.

19

00:01:01,600 --> 00:01:04,100

For solid fuel, think of a firework.

20

00:01:04,200 --> 00:01:06,000

When the lit fuse reaches the fuel,

21

00:01:06,100 --> 00:01:08,800

- in this case, a gunpowder mix -

22

00:01:08,900 --> 00:01:11,000

then the heat and the oxygen combine to burn the fuel,

23

00:01:11,100 --> 00:01:13,900

creating the hot gas to send it shooting skywards.

24

00:01:14,000 --> 00:01:15,200

[firework blasts off]

25

00:01:15,500 --> 00:01:16,500

Once solid rocket fuel is lit,

26

00:01:16,600 --> 00:01:18,800

it's going to burn until it's done.

27

00:01:18,900 --> 00:01:21,400

There's no stopping it, or slowing it down!

28

00:01:21,500 --> 00:01:23,900

Solid rocket engines aren't very super fuel efficient,

29

00:01:24,000 --> 00:01:28,000

but they're very powerful and solid fuel is easier to store.

30

00:01:30,400 --> 00:01:33,100

Liquid fuel powers a rocket, like how gasoline powers your car.

31

00:01:33,200 --> 00:01:36,000

Instead of gasoline, rockets use liquid oxygen

32

00:01:36,100 --> 00:01:38,300

combined with either kerosene or liquid hydrogen.

33

00:01:38,500 --> 00:01:41,500

And like in your car, you can control how fast or slow you burn that fuel,

34

00:01:41,600 --> 00:01:43,000

making you go faster or slower.

35

00:01:43,100 --> 00:01:46,300

Liquid rocket engines are more fuel efficient than solid rocket ones,

36

00:01:46,400 --> 00:01:47,500

but they're less powerful.

37

00:01:47,600 --> 00:01:49,400

So which do you choose for SLS?

38

00:01:50,000 --> 00:01:51,000

Both.

39

00:01:51,000 --> 00:01:54,500

To get off of Earth, you need a tremendous amount of thrust to overcome gravity,

40

00:01:54,600 --> 00:01:56,000

so solid rocket engines are key.

41

00:01:56,100 --> 00:01:59,100

Once you're higher and need efficiency, liquid rocket engines are best.

42

00:01:59,600 --> 00:02:03,900

The Saturn V used liquid fuel, while the Shuttle used both liquid and solid.

43

00:02:04,000 --> 00:02:05,100

The SLS will use both, too.

44

00:02:05,200 --> 00:02:08,600

In the first flights, the Shuttle's solid rocket boosters, or SRBs,

45

00:02:08,700 --> 00:02:11,000

will be used to boost the SLS off the ground.

46

00:02:11,100 --> 00:02:13,500

Once the SRB's fuel is used up, they are jettisoned,

47

00:02:13,600 --> 00:02:16,900

leaving the center stage engines, which are liquid-fueled, to carry the load.

48

00:02:17,100 --> 00:02:21,000

The SLS's efficient use of fuel is key to getting it beyond low-Earth orbit,

49

00:02:21,100 --> 00:02:22,900

which is the first step to Mars.

50

00:02:23,000 --> 00:02:24,000

[cheers]

51

00:02:24,100 --> 00:02:26,500

[fast paced music]

52

00:02:26,600 --> 00:02:28,100

Thanks for watching No Small Steps!