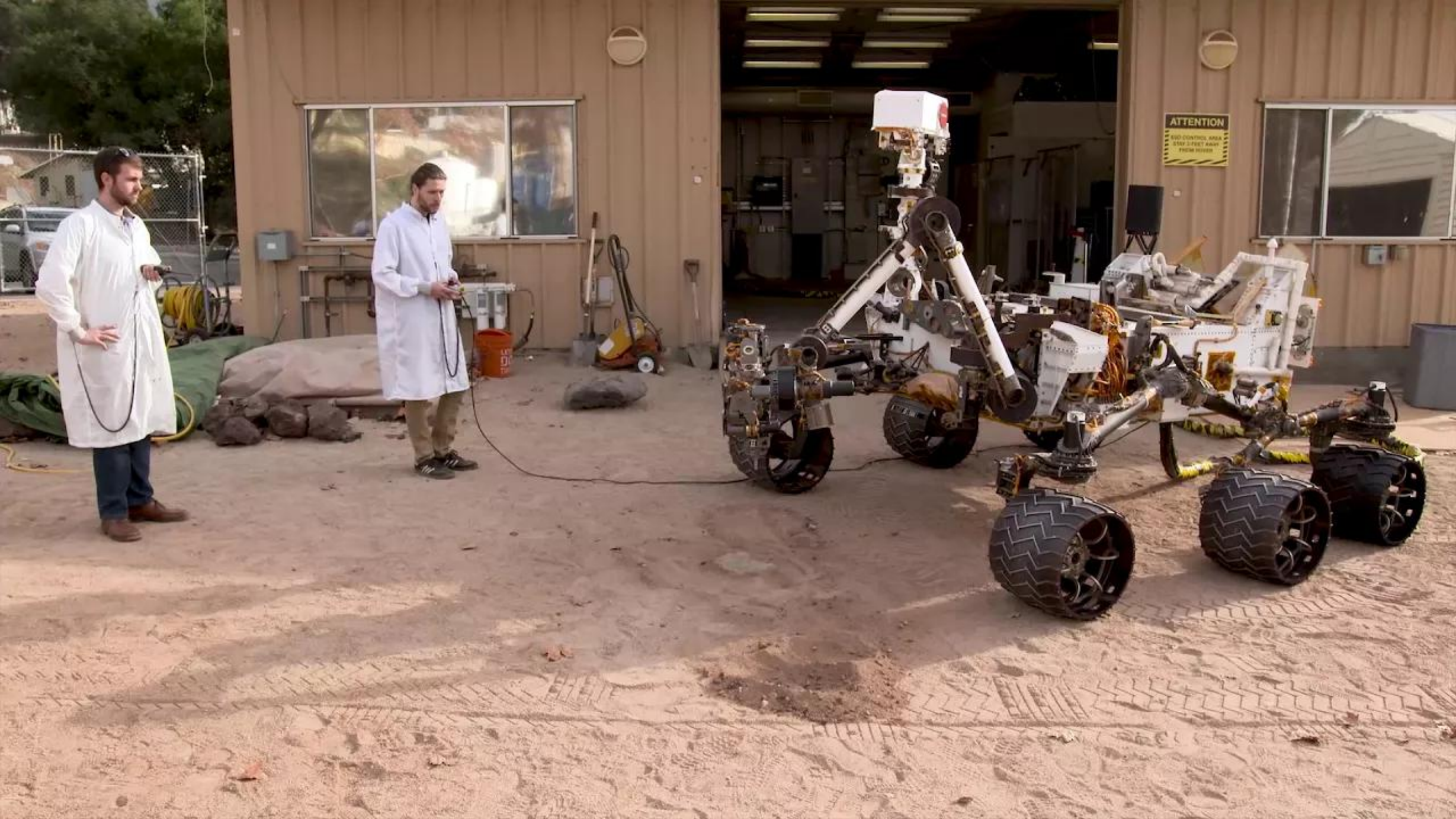
ATTENTION

1
00:00:04,403 --> 00:00:07,306
[Doug Klein] Since Curiosity
landed on Mars in 2012,

2
00:00:07,339 --> 00:00:09,075
it's used its drill
to acquire samples

3
00:00:09,108 --> 00:00:12,145
from Martian
rocks 15 times.

4
00:00:12,178 --> 00:00:14,781
But a little over a year ago
in December of 2016,

5
00:00:14,814 --> 00:00:17,784
Curiosity's drill started
giving it problems.

6
00:00:17,817 --> 00:00:20,019
The drill's feed mechanism,
which is responsible for

7
00:00:20,052 --> 00:00:22,755
moving Curiosity's drill bit
into and out of rocks,

8
00:00:22,788 --> 00:00:24,924
didn't move when commanded.

9
00:00:24,957 --> 00:00:27,293
When Curiosity drills into a
rock the way it was designed

10
00:00:27,326 --> 00:00:30,696
to, the drill's two stabilizer
posts touch the rock first to

11

00:00:30,729 --> 00:00:32,999
steady the arm while the
drill's feed mechanism moves

12
00:00:33,032 --> 00:00:35,301
the bit forward into the rock.

13
00:00:35,334 --> 00:00:36,936
Without the feed
mechanism working,

14
00:00:36,969 --> 00:00:39,072
we can't drill that way.

15
00:00:39,105 --> 00:00:41,040
To solve this problem, we do
what we always do.

16
00:00:41,073 --> 00:00:42,975
We worked it out in
the testbed using

17
00:00:43,008 --> 00:00:45,311
Curiosity's twin on Earth.

18
00:00:45,344 --> 00:00:47,480
Our team of engineers and
scientists have been working

19
00:00:47,513 --> 00:00:49,615
for months to figure out a way
to collect and deliver

20
00:00:49,648 --> 00:00:52,218
rock samples without using
the feed mechanism.

21
00:00:52,251 --> 00:00:54,153
Here's what we came up with.

22
00:00:54,186 --> 00:00:56,856
Using our new technique called
feed extended drilling,

23
00:00:56,889 --> 00:00:58,858
the stabilizers are not used.

24
00:00:58,891 --> 00:01:00,593
The bit is now in a
forward position

25
00:01:00,626 --> 00:01:02,495
extended past
the stabilizers.

26
00:01:02,528 --> 00:01:03,896
[Male on radio unintelligable]

27
00:01:03,929 --> 00:01:05,598
[Klein] Moving the drill
straight into a rock

28
00:01:05,631 --> 00:01:06,933
and retracting safely

29
00:01:06,966 --> 00:01:09,269
without the stabilizers
is challenging.

30
00:01:10,202 --> 00:01:13,005
We move the arm instead of the
feed mechanism to place the

31
00:01:13,038 --> 00:01:15,942
bit onto the rock and press it
forward as it drills.

32
00:01:16,509 --> 00:01:18,444
[Man on radio] [Unintelligble]

start hole's beginning, over.

33
00:01:18,477 --> 00:01:20,613
[Klein] After making contact,
we apply a light preload

34
00:01:20,646 --> 00:01:22,448
and drill a shallow
pilot hole.

35
00:01:22,481 --> 00:01:24,317
We use a force sensor
in the robotic arm

36
00:01:24,350 --> 00:01:26,686
to give Curiosity
a sense of touch.

37
00:01:26,786 --> 00:01:27,987
[drilling]

38
00:01:28,020 --> 00:01:30,890
This lets Curiosity adjust its
arm motion and avoid getting

39
00:01:30,923 --> 00:01:33,626
stuck while drilling; kind of
like you might adjust your arm

40
00:01:33,659 --> 00:01:35,595
while drilling into
a wall at home.

41
00:01:36,228 --> 00:01:37,163
[knocking]

42
00:01:37,196 --> 00:01:38,531
After drilling, we use
a similar technique

43
00:01:38,564 --> 00:01:41,201
to retract from the hole
without getting stuck.

44
00:01:42,735 --> 00:01:45,371
We recently tried this method
using Curiosity on Mars

45
00:01:45,404 --> 00:01:47,740
and here's how it turned out.

46
00:01:47,773 --> 00:01:50,409
This picture shows the first
hole drilled on Mars ever

47
00:01:50,442 --> 00:01:52,378
with this new
drilling technique.

48
00:01:52,411 --> 00:01:54,380
Even though we can't see the
hole in this image,

49
00:01:54,413 --> 00:01:56,949
we know we drilled about
one centimeter deep.

50
00:01:56,982 --> 00:01:58,718
The hole itself is buried
under the powder

51
00:01:58,751 --> 00:02:01,287
generated during drilling.

52
00:02:01,320 --> 00:02:03,956
This is a good sign for the
new drilling method.

53
00:02:03,989 --> 00:02:06,759

Next, we have to drill a
deeper hole to collect sample

54
00:02:06,792 --> 00:02:08,928
and demonstrate our new
techniques for delivering the

55
00:02:08,961 --> 00:02:12,265
sample to Curiosity's
two onboard labs.

56
00:02:12,298 --> 00:02:13,933
That will come in
the days ahead.

57
00:02:13,966 --> 00:02:15,101
[LOGO: NASA / Jet
Propulsion Laboratory