1
00:00:00,367 --> 00:00:03,237
[upbeat dramatic music]

2
00:00:06,306 --> 00:00:08,041
>> We've all seen the Martian,

3
00:00:08,041 --> 00:00:11,245
and we know we need breathable
oxygen to survive on Mars.

4
00:00:11,245 --> 00:00:12,179
What's up Watney?

5
00:00:13,213 --> 00:00:14,448
It turns out it's a lot better

6
00:00:14,448 --> 00:00:17,017
to be able to extract it
from the atmosphere of Mars,

7
00:00:17,017 --> 00:00:18,352
than bring it with
you on the trip over,

8
00:00:18,352 --> 00:00:20,120
if you have the technology.

9
00:00:20,120 --> 00:00:22,222
Let's see how close
we are on this episode

10
00:00:22,222 --> 00:00:24,157
of Crazy Engineering.

11
00:00:24,157 --> 00:00:26,460
[upbeat music]

12
00:00:29,329 --> 00:00:31,632

[Crazy Engineering
MOXIE]

13
00:00:33,333 --> 00:00:34,468
I'm here with Jim.

14
00:00:34,468 --> 00:00:36,069
He's gonna teach us
how to get oxygen

15
00:00:36,069 --> 00:00:37,371
on the surface of Mars.

16
00:00:37,371 --> 00:00:39,306
Jim, can you tell us
where we are right now?

17
00:00:39,306 --> 00:00:40,207
>> Absolutely.

18
00:00:40,207 --> 00:00:41,441
This is the JPL

19
00:00:41,441 --> 00:00:45,279
Mars Oxygen In-Situ Resource
Utilization Laboratory.

20
00:00:45,279 --> 00:00:48,048
We call this the
MOXIE lab for short.

21
00:00:48,048 --> 00:00:50,284
The MOXIE instrument is
a demonstration mission,

22
00:00:50,284 --> 00:00:53,320
designed to prove that we
can produce pure oxygen

23

00:00:53,320 --> 00:00:55,088
on the surface of Mars.

24
00:00:55,088 --> 00:00:58,425
If it's successful, NASA may
opt to send a dedicated mission

25
00:00:58,425 --> 00:01:02,062
to produce oxygen for
humans to use in the future.

26
00:01:02,062 --> 00:01:04,364
>> So how do we make oxygen
on the surface of Mars?

27
00:01:04,364 --> 00:01:07,000
>> It's actually a
fairly easy process.

28
00:01:07,000 --> 00:01:09,269
Basically what we do is
we take Mars atmosphere,

29
00:01:09,269 --> 00:01:11,104
we run it into a unit called

30
00:01:11,104 --> 00:01:13,407
a solid oxide electrolysis unit,

31
00:01:13,407 --> 00:01:16,343
which is basically a
fuel cell in reverse.

32
00:01:16,343 --> 00:01:17,244
[disc scratching]

33
00:01:17,244 --> 00:01:18,211
>> Wait a second.

34

00:01:18,211 --> 00:01:19,479
Reverse fuel cell?!?

35
00:01:19,479 --> 00:01:21,315
How does that work?

36
00:01:21,315 --> 00:01:24,051
>> So, this is a solid
oxide electrolysis unit,

37
00:01:24,051 --> 00:01:28,155
what happens is we have Mars
atmosphere enter in this line,

38
00:01:28,155 --> 00:01:30,123
goes into the SOXE unit.

39
00:01:30,123 --> 00:01:33,160
It's then heated up to
800 degrees Celsius.

40
00:01:33,160 --> 00:01:36,296
We inject energy into
the cathode and anode,

41
00:01:36,296 --> 00:01:40,434
and then what happens is oxygen
is separated from the CO2

42
00:01:40,434 --> 00:01:43,370
and comes out this
line over here.

43
00:01:43,370 --> 00:01:47,107
This line here is the
waste gases, that's leftover

44
00:01:47,107 --> 00:01:48,775
from the catalyst process.

45
00:01:49,176 --> 00:01:50,377
>> To test this technology,

46
00:01:50,377 --> 00:01:52,179
you're gonna need some
Martian atmosphere.

47
00:01:52,179 --> 00:01:54,147
Where on Earth are
you gonna find that?

48
00:01:54,147 --> 00:01:56,483
>> We know the composition
of Martian atmosphere.

49
00:01:56,483 --> 00:02:00,253
It's 95% CO_2 with
some trace gases,

50
00:02:00,253 --> 00:02:02,222
and there are companies
here, on Earth,

51
00:02:02,222 --> 00:02:03,991
that will mix that gas for us.

52
00:02:03,991 --> 00:02:05,359
We call it "Mars mixed gas,"

53
00:02:05,359 --> 00:02:07,995
and we use it for
most of our testing.

54
00:02:07,995 --> 00:02:09,730
>> Well, what if we land
on top of a mountain

55
00:02:09,730 --> 00:02:11,331
or down in a valley?

56
00:02:11,331 --> 00:02:14,134
The conditions for extracting
oxygen are totally different.

57
00:02:14,134 --> 00:02:15,369
We gotta test for all of that.

58
00:02:15,369 --> 00:02:17,037
>> So, the way we test for it

59
00:02:17,037 --> 00:02:19,206
is we designed an
instrumentation system

60
00:02:19,206 --> 00:02:21,408
that covers all of the
conditions of the instrument:

61
00:02:21,408 --> 00:02:25,045
lower pressures, higher
pressures, clogging filters,

62
00:02:25,045 --> 00:02:27,180
oxygen purity,
all of that stuff.

63
00:02:27,180 --> 00:02:29,016
>> Why don't we just
bring the oxygen with us

64
00:02:29,016 --> 00:02:30,117
when we go to Mars?

65
00:02:30,117 --> 00:02:32,085
>> It's very difficult
to bring something

66
00:02:32,085 --> 00:02:34,321

from the surface of the
earth to the surface of Mars,

67
00:02:34,321 --> 00:02:37,024
and it costs millions
and millions of dollars.

68
00:02:37,024 --> 00:02:39,059
So, it's much easier
and better for us,

69
00:02:39,059 --> 00:02:41,461
if we try to get that
resource from the planet.

70
00:02:43,030 --> 00:02:44,331
>> Well it's obviously
a huge challenge,

71
00:02:44,331 --> 00:02:46,299
but we're both really
optimistic up here.

72
00:02:46,299 --> 00:02:49,036
We're excited to see it
on the Mars 2020 mission,

73
00:02:49,036 --> 00:02:51,104
check back soon for some
more Crazy Engineering.

74
00:02:52,105 --> 00:02:53,240
Heads up Watney.

75
00:02:53,240 --> 00:02:55,509
[upbeat music]

76
00:02:58,578 --> 00:02:59,446
[Crazy Engineering]