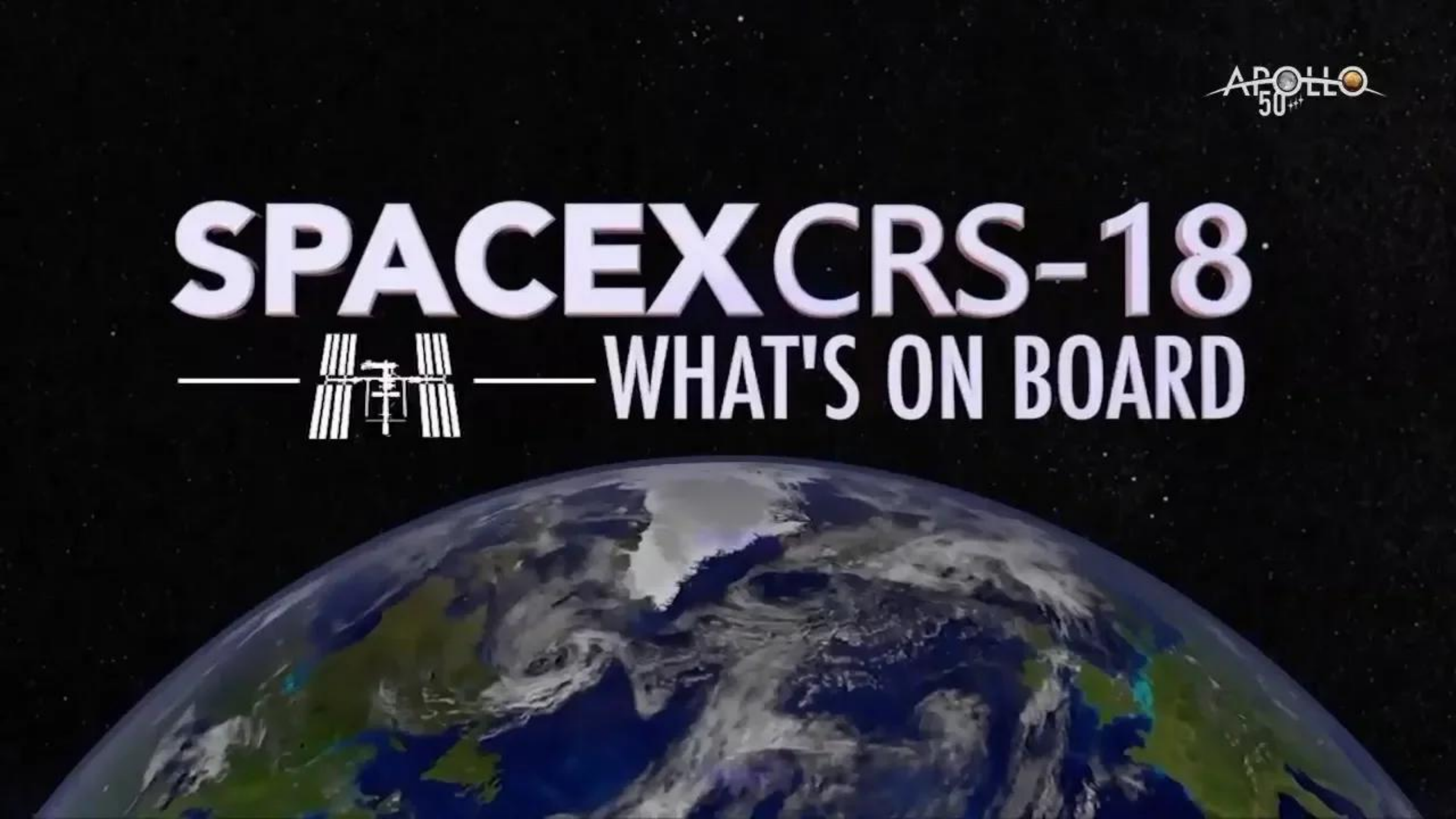
APOLLO 50
SPACEX CRS-18
WHAT'S ON BOARD

1
00:00:20,890 --> 00:00:25,050
More than a hundred thousand people are on a waiting
list right now for an organ transplant, and

2
00:00:25,050 --> 00:00:27,680
unfortunately that usually a one-to-one process.

3
00:00:27,680 --> 00:00:31,120
You get a organ when somebody else loses an
organ.

4
00:00:31,120 --> 00:00:36,149
What if one day you could print your own organ,
maybe from your own cells?

5
00:00:36,149 --> 00:00:39,480
Our goal is is that we're going to print a
tissue that's more than a centimeter thick

6
00:00:39,480 --> 00:00:42,260
And you think a centimeter, that's not really
that impressive.

7
00:00:42,260 --> 00:00:46,400
Well, that's more than 10 times what we can
print on the ground, and we think that microgravity

8
00:00:46,400 --> 00:00:47,620
is going to be the key.

9
00:00:47,620 --> 00:00:51,150
This big L is actually the bioprinter, so
this is the BFF.

10
00:00:51,150 --> 00:00:53,180
This actually legacy hardware.

11
00:00:53,180 --> 00:00:57,070
This is our ADSEP, or Advanced Space Experiment

Processor.

12
00:00:57,070 --> 00:01:00,079
That's where we will put the tissue after
it's printed.

13
00:01:00,079 --> 00:01:02,230
Basically, it's the maturation process.

14
00:01:02,230 --> 00:01:05,860
It's what turns a construct into a tissue
because we're just putting building blocks

15
00:01:05,860 --> 00:01:09,110
down and then can step back and let biology
do it biology does.

16
00:01:09,110 --> 00:01:12,630
As smart as we think we are biology will always
be smarter.

17
00:01:12,630 --> 00:01:14,030
We're not just bringing back tissue.

18
00:01:14,030 --> 00:01:17,530
We're bringing back tissue that's cardiac
tissue and it's going to beat just like a

19
00:01:17,530 --> 00:01:18,530
heart.

20
00:01:18,530 --> 00:01:19,810
That is cool as anything.

21
00:01:19,810 --> 00:01:24,540
So what happens if we build the next thing,
and the next thing and the next thing eventually

22
00:01:24,540 --> 00:01:26,710

yeah, we're going to print a heart.

23
00:01:26,710 --> 00:01:28,409
That's really where we're going.

24
00:01:28,409 --> 00:01:34,840
Biorock is an experiment to study how microbes,
bacteria interact with rocks in microgravity

25
00:01:34,840 --> 00:01:36,350
and simulated Martian gravity.

26
00:01:36,350 --> 00:01:40,960
And you might think why would we be interested
in what microbes do in rocks?

27
00:01:40,960 --> 00:01:45,810
Well microbes on the Earth are used to break
down rocks to release economically important

28
00:01:45,810 --> 00:01:46,810
elements.

29
00:01:46,810 --> 00:01:51,829
About 60% of the world's copper and gold is
today extracted in Biomining.

30
00:01:51,829 --> 00:01:55,860
So the long-term future exploration of the
Moon and Mars we might want to use microbes

31
00:01:55,860 --> 00:01:58,540
to help us break down rocks to do industry.

32
00:01:58,540 --> 00:02:03,250
That's a very long-term view in the shorter
term view microbes break down rocks, turn

33
00:02:03,250 --> 00:02:04,399

them into soils.

34
00:02:04,399 --> 00:02:10,130
If we want to transform our lunar and Martian
basalt into material that is more useful for

35
00:02:10,130 --> 00:02:13,980
agriculture for growing crops rather than
having to take things with us we might use

36
00:02:13,980 --> 00:02:15,350
bacteria to do that.

37
00:02:15,350 --> 00:02:20,700
And then finally, of course we could use extraterrestrial
materials to supply nutrients and life support

38
00:02:20,700 --> 00:02:21,700
systems.

39
00:02:21,700 --> 00:02:25,480
Why ship nutrients to the moon and Mars with
all that mass and energy cost when you can

40
00:02:25,480 --> 00:02:30,150
just shovel in some lunar and Martian regolith
into your life support system and provide

41
00:02:30,150 --> 00:02:32,340
the nutrients from that.

42
00:02:32,340 --> 00:02:37,360
Five to ten percent of fractures will not
heal without extra help or intervention by

43
00:02:37,360 --> 00:02:39,099
the orthopedic surgeon.

44
00:02:39,099 --> 00:02:44,150

And what they use is a drug called bone morphogenetic protein and this helps to heal the bone.

45
00:02:44,150 --> 00:02:48,320
However, there is a risk of developing cancer with the use of these proteins.

46
00:02:48,320 --> 00:02:53,019
So identifying new bone-healing agents is really important and that's what we're testing

47
00:02:53,019 --> 00:02:54,019
here.

48
00:02:54,019 --> 00:02:55,880
So you may say well, why do we need to do that in spaceflight?

49
00:02:55,880 --> 00:02:58,360
Why can't we just do it here on Earth?

50
00:02:58,360 --> 00:03:02,660
Animals will walk immediately after you do a bone surgery.

51
00:03:02,660 --> 00:03:04,070
Humans, we don't.

52
00:03:04,070 --> 00:03:10,050
We use crutches, we may be bedridden, but in spaceflight the animals can't see that

53
00:03:10,050 --> 00:03:15,070
gravity and bone healing is helped when you walk, when you bear weight.

54
00:03:15,070 --> 00:03:20,180
And the drugs that we currently have work through that mechanism the drug we have patented

55
00:03:20,180 --> 00:03:24,401
does not, and so we think it will be better
for bone healing and spaceflight if we go

56
00:03:24,401 --> 00:03:31,349
to Mars and have a fracture or here on Earth
for the military personnel, for bad auto accidents

57
00:03:31,349 --> 00:03:36,440
and even for people with osteoporosis that
have a fracture and it has impaired healing.

58
00:03:36,440 --> 00:03:40,620
This video here is showing the bioculture
where the bioreactors will be residing and

59
00:03:40,620 --> 00:03:42,230
this has two compartments.

60
00:03:42,230 --> 00:03:47,700
One of them is a warm compartment at 37 degrees
that's where the cells will grow and then

61
00:03:47,700 --> 00:03:52,739
the second compartment next to it is a cold
compartment and that's where all the nutrients

62
00:03:52,739 --> 00:03:54,159
and the media will be in.

63
00:03:54,159 --> 00:03:58,799
And what happens is that crew member will
inject the media at certain time points to

64
00:03:58,799 --> 00:04:02,230
feed these cells and then add the fixative
at the end.

65
00:04:02,230 --> 00:04:07,909

The cells will come in back to the Earth and
on Earth what we're going to do is isolate

66
00:04:07,909 --> 00:04:13,470
RNA and DNA and proteins from these cells
and do whole genome analysis whole proteome

67
00:04:13,470 --> 00:04:18,609
and how metabolome analysis and this will
help us understand the whole picture.

68
00:04:18,609 --> 00:04:24,130
We are taking advantage of a groundbreaking
discovery that was made the almost a decade

69
00:04:24,130 --> 00:04:27,240
ago, which is the induced pluripotent stem
cell technologies.

70
00:04:27,240 --> 00:04:33,900
So basically what it means is that we are
now able to make in a laboratory stem cells

71
00:04:33,900 --> 00:04:40,100
starting from a little fill a little drop
of blood from any of us or a little tiny piece

72
00:04:40,100 --> 00:04:46,289
of skin and we convert these cells into what
we call induced pluripotent stem cells.

73
00:04:46,289 --> 00:04:49,700
We use them to generate any cell type that
we want.

74
00:04:49,700 --> 00:04:53,979
So in our case that we're studying neurodegenerative
diseases, we really want to make the brain

75
00:04:53,979 --> 00:04:55,469

cells and study them.

76
00:04:55,469 --> 00:04:59,719
Well have a cell line from a Parkinson's patient
and also an age-matched control and these

77
00:04:59,719 --> 00:05:03,190
will be making dopaminergic neurons and these
are the neurons that are lost in Parkinson's

78
00:05:03,190 --> 00:05:04,190
disease.

79
00:05:04,190 --> 00:05:10,250
And we will also have a cell line from a multiple
sclerosis patient and these will be made into

80
00:05:10,250 --> 00:05:15,510
cortical neurons and microglia will be added
to those and also in age-matched control.

81
00:05:15,510 --> 00:05:17,530
So we're interested to see what happens in
space.

82
00:05:17,530 --> 00:05:20,390
Can we get more mature maturation of these
cells?

83
00:05:20,390 --> 00:05:23,130
Can we make a better model for Parkinson's
Disease and multiple sclerosis?

84
00:05:23,130 --> 00:05:29,890
So I think it has a lot of implications for
the health of brain cells of astronauts who

85
00:05:29,890 --> 00:05:33,710
spend a lot of time in space, and we're also
hoping to learn more about these two diseases