5 THINGS

1
00:00:13,830 --> 00:00:11,589
[Music]

2
00:00:16,950 --> 00:00:13,840
servicing just means the ability to be

3
00:00:19,269 --> 00:00:16,960
able to fix or repair something in space

4
00:00:20,710 --> 00:00:19,279
so similarly to if your car breaks here

5
00:00:22,550 --> 00:00:20,720
on earth or there's a problem with your

6
00:00:24,310 --> 00:00:22,560
air conditioner at home you know you can

7
00:00:27,029 --> 00:00:24,320
fix those things and it's pretty easy to

8
00:00:28,310 --> 00:00:27,039
do on the ground

9
00:00:30,070 --> 00:00:28,320
in space it's a little bit more

10
00:00:32,950 --> 00:00:30,080
challenging so you need to kind of

11
00:00:34,790 --> 00:00:32,960
design that ability into the hardware to

12
00:00:36,549 --> 00:00:34,800
allow astronauts to be able to fix

13
00:00:39,760 --> 00:00:36,559

things in space while they're wearing

14
00:00:44,869 --> 00:00:42,310
[Music]

15
00:00:50,069 --> 00:00:44,879
the hubble space telescope was specially

16
00:00:52,709 --> 00:00:50,079
designed to enable it to live longer

17
00:00:55,270 --> 00:00:52,719
engineers on the ground designed it with

18
00:00:58,150 --> 00:00:55,280
interfaces or pieces of hardware that

19
00:01:03,670 --> 00:00:58,160
could easily be accessed by an astronaut

20
00:01:09,190 --> 00:01:07,429
when hubble launched in 1990

21
00:01:10,950 --> 00:01:09,200
unfortunately scientists discovered that

22
00:01:12,760 --> 00:01:10,960
when they received the first images they

23
00:01:14,870 --> 00:01:12,770
looked blurry

24
00:01:16,310 --> 00:01:14,880
[Music]

25
00:01:18,630 --> 00:01:16,320
with some amazing smart people on the

26
00:01:20,149 --> 00:01:18,640
ground they realized that that primary

27
00:01:21,270 --> 00:01:20,159
mirror that collects all the light from

28
00:01:23,510 --> 00:01:21,280
the stars

29
00:01:25,030 --> 00:01:23,520
was slightly misshapen by just a teeny

30
00:01:30,710 --> 00:01:25,040
amount and that's what made all the

31
00:01:35,510 --> 00:01:33,830
the first hubble servicing mission sm-1

32
00:01:38,390 --> 00:01:35,520
of which one of the primary objectives

33
00:01:40,069 --> 00:01:38,400
was to fix that misshapen mirror by

34
00:01:42,469 --> 00:01:40,079
launching a dedicated separate

35
00:01:44,389 --> 00:01:42,479
scientific instrument that has uh what

36
00:01:45,830 --> 00:01:44,399
you might hear eyeglasses on it or

37
00:01:47,749 --> 00:01:45,840
special lenses

38
00:01:49,910 --> 00:01:47,759

that could correct for this misshapen

39
00:01:51,510 --> 00:01:49,920
mirror and then sharpen up all the

40
00:01:53,220 --> 00:01:51,520
scientific images to make them look the

41
00:01:55,910 --> 00:01:53,230
way they're supposed to look

42
00:01:58,069 --> 00:01:55,920
[Music]

43
00:02:00,149 --> 00:01:58,079
hubble was unique in that the failures

44
00:02:02,310 --> 00:02:00,159
that we met with towards the end of the

45
00:02:03,590 --> 00:02:02,320
servicing missions forced us to design

46
00:02:05,670 --> 00:02:03,600
tools that had never been designed

47
00:02:07,510 --> 00:02:05,680
before so we ended up repairing parts of

48
00:02:11,110 --> 00:02:07,520
the telescope that were not planned on

49
00:02:17,030 --> 00:02:14,470
the analogy given is doing heart surgery

50
00:02:19,430 --> 00:02:17,040
in space

51
00:02:21,030 --> 00:02:19,440
with tiny tools tethers and techniques

52
00:02:22,470 --> 00:02:21,040
that were never initially designed to be

53
00:02:24,390 --> 00:02:22,480
used

54
00:02:25,830 --> 00:02:24,400
we learned a lot about how to do harder

55
00:02:30,309 --> 00:02:25,840
things you know harder things than

56
00:02:36,470 --> 00:02:32,070
there are lots of types of missions

57
00:02:41,270 --> 00:02:38,150
including hubble space telescope the

58
00:02:42,630 --> 00:02:41,280
international space station

59
00:02:45,589 --> 00:02:42,640
there'll be future you know lunar

60
00:02:46,949 --> 00:02:45,599
missions and martian missions

61
00:02:48,790 --> 00:02:46,959
so they're using some of the tools and

62
00:02:50,470 --> 00:02:48,800
techniques that were developed by some

63
00:02:52,150 --> 00:02:50,480

of our hubble engineers and then

64
00:02:54,390 --> 00:02:52,160
similarly a lot of those lessons learned

65
00:02:55,670 --> 00:02:54,400
will be applied to future lunar space

66
00:02:57,430 --> 00:02:55,680
walks and martian space walks because

67
00:02:59,830 --> 00:02:57,440
we're going to need to be doing more

68
00:03:01,270 --> 00:02:59,840
specific probably more hand intensive