1
00:00:17,590 --> 00:00:15,350
the james webb space telescope is a

2
00:00:19,349 --> 00:00:17,600
reflecting telescope which means it

3
00:00:22,630 --> 00:00:19,359
images the universe with the help of

4
00:00:25,349 --> 00:00:22,640
mirrors we are here at l3 ios tinsley in

5
00:00:28,390 --> 00:00:25,359
richmond california to find out just how

6
00:00:30,710 --> 00:00:28,400
the observatory will work

7
00:00:33,030 --> 00:00:30,720
so i'd like to first show you one of our

8
00:00:34,630 --> 00:00:33,040
primary mirror segments and before we

9
00:00:38,389 --> 00:00:34,640
get too close we'll want to put our mask

10
00:00:40,150 --> 00:00:38,399
on to protect the optical surface okay

11
00:00:41,350 --> 00:00:40,160
this is one of our 18 primary mirror

12
00:00:43,590 --> 00:00:41,360
segments once they're all complete

13
00:00:45,110 --> 00:00:43,600

they'll combine to make one large

14
00:00:46,549 --> 00:00:45,120
primary mirror

15
00:00:49,029 --> 00:00:46,559
you can see the front side surface is

16
00:00:50,869 --> 00:00:49,039
highly polished and as we rotate to the

17
00:00:53,350 --> 00:00:50,879
backside surface you'll see that there

18
00:00:55,029 --> 00:00:53,360
is a honeycomb light waiting

19
00:00:57,430 --> 00:00:55,039
so it reduces the payload when it goes

20
00:00:58,869 --> 00:00:57,440
up into space and yet it's very stiff

21
00:01:01,750 --> 00:00:58,879
looks like you can attach things to it

22
00:01:04,469 --> 00:01:01,760
too yes they bond more hardware on the

23
00:01:06,310 --> 00:01:04,479
backside surface which makes it an even

24
00:01:08,230 --> 00:01:06,320
stronger structure and that's the way

25
00:01:09,350 --> 00:01:08,240
it'll go up in the space

26
00:01:10,950 --> 00:01:09,360
there are several other mirrors that

27
00:01:13,190 --> 00:01:10,960
we're doing here for james webb space

28
00:01:15,109 --> 00:01:13,200
telescope we have a

29
00:01:16,630 --> 00:01:15,119
secondary mirror element we have a

30
00:01:18,550 --> 00:01:16,640
tertiary mirror element and we're also

31
00:01:20,149 --> 00:01:18,560
doing the fine steering mirror that's

32
00:01:22,390 --> 00:01:20,159
for those of us who don't understand how

33
00:01:23,510 --> 00:01:22,400
a telescope works why do you have so

34
00:01:24,870 --> 00:01:23,520
many mirrors

35
00:01:26,550 --> 00:01:24,880
the light that comes from space is

36
00:01:29,190 --> 00:01:26,560
collected into the primary mirrors

37
00:01:30,789 --> 00:01:29,200
primary mirrors then take that light and

38
00:01:32,469 --> 00:01:30,799

image and bring it to the secondary

39
00:01:34,630 --> 00:01:32,479
mirror which

40
00:01:36,469 --> 00:01:34,640
projects it to the tertiary mirror and

41
00:01:37,590 --> 00:01:36,479
then that goes to the fine steering

42
00:01:39,590 --> 00:01:37,600
mirror and then with fine steering

43
00:01:41,590 --> 00:01:39,600
mirror they're able to adjust it move it

44
00:01:44,149 --> 00:01:41,600
around and get the images that they're

45
00:01:46,630 --> 00:01:44,159
looking for why all the bouncing around

46
00:01:49,429 --> 00:01:46,640
well the mirrors work together to

47
00:01:51,109 --> 00:01:49,439
reduce the aperture size to a format

48
00:01:52,630 --> 00:01:51,119
that can fit on a camera that we can

49
00:01:53,590 --> 00:01:52,640
image now that we've seen the primary

50
00:01:55,830 --> 00:01:53,600
mirror i'd love to show you the

51
00:01:57,749 --> 00:01:55,840
secondary mirror

52
00:02:00,389 --> 00:01:57,759
so andrea what's going on here

53
00:02:02,069 --> 00:02:00,399
we are performing a microscope

54
00:02:03,670 --> 00:02:02,079
inspection of the surface what he's

55
00:02:05,670 --> 00:02:03,680
doing here is he's getting very close to

56
00:02:06,789 --> 00:02:05,680
the optical surface so that he can

57
00:02:08,389 --> 00:02:06,799
capture

58
00:02:10,550 --> 00:02:08,399
surface data and then we can look at

59
00:02:12,790 --> 00:02:10,560
that later on and you can see this one

60
00:02:14,949 --> 00:02:12,800
is unique compared to the other mirrors

61
00:02:16,790 --> 00:02:14,959
this one is a convex hyperbola whereas

62
00:02:19,430 --> 00:02:16,800
the primary mirror and the tertiary

63
00:02:21,190 --> 00:02:19,440

mirror all concave

64
00:02:23,190 --> 00:02:21,200
and there's only one of these

65
00:02:25,110 --> 00:02:23,200
there's only one of these

66
00:02:26,949 --> 00:02:25,120
so on the telescope the

67
00:02:28,790 --> 00:02:26,959
light captured from the primary bounces

68
00:02:30,550 --> 00:02:28,800
onto this next right yep that's why they

69
00:02:33,190 --> 00:02:30,560
called the secondary element

70
00:02:34,949 --> 00:02:33,200
two switches i could pick two

71
00:02:37,190 --> 00:02:34,959
we also have the tertiary mirror which

72
00:02:38,710 --> 00:02:37,200
is a concave ellipse

73
00:02:40,309 --> 00:02:38,720
this is a onesie mirror just like the

74
00:02:43,110 --> 00:02:40,319
secondary in the fine steering mirror

75
00:02:45,030 --> 00:02:43,120
it's a one of a kind in a telescope

76
00:02:47,030 --> 00:02:45,040
and with this mirror we run through the

77
00:02:49,190 --> 00:02:47,040
same sort of rigorous testing that we do

78
00:02:50,470 --> 00:02:49,200
for the primary in the secondary mirror

79
00:02:52,309 --> 00:02:50,480
and we get down to those tight

80
00:02:54,710 --> 00:02:52,319
specifications that are required to

81
00:02:56,150 --> 00:02:54,720
maximize the image resolution thanks a

82
00:02:57,990 --> 00:02:56,160
lot for your time andrew and showing us

83
00:03:00,309 --> 00:02:58,000
your mirrors welcome

84
00:03:02,869 --> 00:03:00,319
andrea showed us a segment of the

85
00:03:04,949 --> 00:03:02,879
primary mirror the secondary mirror and

86
00:03:07,190 --> 00:03:04,959
the tertiary mirror she wasn't able to

87
00:03:09,589 --> 00:03:07,200
show us the fine steering mirror that's

88
00:03:11,750 --> 00:03:09,599

the mirror that keeps the beam of light

89
00:03:13,910 --> 00:03:11,760
collected by the telescope centered and

90
00:03:16,070 --> 00:03:13,920
stabilized that's because that fine

91
00:03:18,070 --> 00:03:16,080
steering mirror is inside this thermal

92
00:03:19,910 --> 00:03:18,080
chamber going through some extreme

93
00:03:21,509 --> 00:03:19,920
temperature changes to simulate the

94
00:03:23,030 --> 00:03:21,519
conditions of space