



# HUBBLE

## TOOL TIME

### ASTRONAUT TRAINING

1  
00:00:02,550 --> 00:00:01,429  
as i mentioned as john mentioned earlier

2  
00:00:03,750 --> 00:00:02,560  
which we talked about not doing and i

3  
00:00:06,750 --> 00:00:03,760  
did anyway

4  
00:00:19,429 --> 00:00:06,760  
it's okay this is why we train okay

5  
00:00:22,390 --> 00:00:19,439  
[Music]

6  
00:00:24,470 --> 00:00:22,400  
hi i'm john grunsfeld nasa astronaut hi

7  
00:00:26,550 --> 00:00:24,480  
i'm christy hansen johnson space center

8  
00:00:29,189 --> 00:00:26,560  
eva task astronaut training lead and

9  
00:00:31,509 --> 00:00:29,199  
flight controller and eva means extra

10  
00:00:34,069 --> 00:00:31,519  
vehicular activity which is just another

11  
00:00:35,910 --> 00:00:34,079  
long way of saying space walk and i got

12  
00:00:37,430 --> 00:00:35,920  
to do eight space walks on the hubble

13  
00:00:38,950 --> 00:00:37,440

space telescope

14

00:00:41,590 --> 00:00:38,960

you might wonder

15

00:00:44,310 --> 00:00:41,600

how did we learn to do the complex tasks

16

00:00:46,549 --> 00:00:44,320

using all the cool tools that we used on

17

00:00:48,709 --> 00:00:46,559

the hubble space telescope christie how

18

00:00:51,350 --> 00:00:48,719

did we learn how to do all of that so as

19

00:00:52,869 --> 00:00:51,360

the eva task training lead one of my big

20

00:00:55,110 --> 00:00:52,879

duties was to work together with the

21

00:00:57,270 --> 00:00:55,120

astronauts for about two years as well

22

00:00:58,950 --> 00:00:57,280

as my goddard engineering colleagues to

23

00:01:00,790 --> 00:00:58,960

develop tools techniques and procedures

24

00:01:02,869 --> 00:01:00,800

to train crews but generically from

25

00:01:05,189 --> 00:01:02,879

johnson space center i had to train the

26  
00:01:07,910 --> 00:01:05,199  
crew on how to work on mockups that

27  
00:01:09,590 --> 00:01:07,920  
simulated flight like hardware on orbit

28  
00:01:10,550 --> 00:01:09,600  
and there are various venues that we did

29  
00:01:12,149 --> 00:01:10,560  
that so

30  
00:01:14,630 --> 00:01:12,159  
the neutral buoyancy tank is a giant

31  
00:01:17,030 --> 00:01:14,640  
swimming pool that's 40 feet deep 6.2

32  
00:01:19,190 --> 00:01:17,040  
million gallons of water and we can take

33  
00:01:21,109 --> 00:01:19,200  
mockups which are volumetric equivalents

34  
00:01:23,030 --> 00:01:21,119  
of space tools and science instruments

35  
00:01:24,789 --> 00:01:23,040  
on orbit take them down under the water

36  
00:01:27,429 --> 00:01:24,799  
and put them in flight like positions

37  
00:01:29,990 --> 00:01:27,439  
volumetrically similar meaning same size

38  
00:01:31,429 --> 00:01:30,000

screw positions are in the same location

39

00:01:32,310 --> 00:01:31,439

distances from point a to point b are

40

00:01:34,310 --> 00:01:32,320

the same as what you'll see on the

41

00:01:35,830 --> 00:01:34,320

telescope so in the neutral buoyancy

42

00:01:37,749 --> 00:01:35,840

tank we have a mock-up of the whole

43

00:01:39,429 --> 00:01:37,759

space telescope so it's built out of

44

00:01:40,469 --> 00:01:39,439

different materials with holes in it you

45

00:01:42,149 --> 00:01:40,479

know because you want a heavy metal

46

00:01:44,389 --> 00:01:42,159

object in the pool but in terms of

47

00:01:46,710 --> 00:01:44,399

distances to a science instrument or

48

00:01:49,590 --> 00:01:46,720

like a handrail sill those are all the

49

00:01:51,590 --> 00:01:49,600

same this particular mock-up which means

50

00:01:53,429 --> 00:01:51,600

model of what we have on orbit on the

51  
00:01:54,389 --> 00:01:53,439  
hubble actually had on my desk for a

52  
00:01:56,709 --> 00:01:54,399  
long time

53  
00:01:59,429 --> 00:01:56,719  
because i wanted to practice over and

54  
00:02:01,190 --> 00:01:59,439  
over and over again my goal was to you

55  
00:02:03,510 --> 00:02:01,200  
know memorize to learn

56  
00:02:05,590 --> 00:02:03,520  
every single screw of the hundreds of

57  
00:02:07,030 --> 00:02:05,600  
screws that we had to remove on hubble

58  
00:02:09,270 --> 00:02:07,040  
so that when i got to orbit there were

59  
00:02:12,309 --> 00:02:09,280  
no surprises same for how to use the

60  
00:02:13,670 --> 00:02:12,319  
tools you know how to turn the lights on

61  
00:02:16,150 --> 00:02:13,680  
run the tool

62  
00:02:18,710 --> 00:02:16,160  
change the torques change the direction

63  
00:02:20,869 --> 00:02:18,720

of the tool all those things had to be

64

00:02:23,030 --> 00:02:20,879

second nature so when i got to orbit it

65

00:02:24,790 --> 00:02:23,040

was just about fixing the hubble

66

00:02:26,309 --> 00:02:24,800

sometimes i would come to the goddard

67

00:02:28,949 --> 00:02:26,319

space flight center where we had the

68

00:02:32,070 --> 00:02:28,959

full mock-up of the camera and i would

69

00:02:34,309 --> 00:02:32,080

put on eva gloves space walking gloves

70

00:02:36,150 --> 00:02:34,319

and practice removing the screws and

71

00:02:37,509 --> 00:02:36,160

doing the whole task and one thing about

72

00:02:39,509 --> 00:02:37,519

doing these tasks with goddard because

73

00:02:42,150 --> 00:02:39,519

they did have higher fidelity mock-up

74

00:02:44,390 --> 00:02:42,160

units in the building 29 clean room was

75

00:02:46,150 --> 00:02:44,400

understanding not only the tasks at hand

76

00:02:48,070 --> 00:02:46,160

but what areas you can't touch when

77

00:02:50,070 --> 00:02:48,080

you're in a spacesuit so in a higher

78

00:02:52,070 --> 00:02:50,080

fidelity volumetric simulator at goddard

79

00:02:53,750 --> 00:02:52,080

for example when john is performing the

80

00:02:56,070 --> 00:02:53,760

duties on this advanced camera for

81

00:02:57,830 --> 00:02:56,080

survey upgrade task he can look around

82

00:02:59,350 --> 00:02:57,840

inside the telescope and it looks more

83

00:03:01,110 --> 00:02:59,360

like what it would actually look like in

84

00:03:02,470 --> 00:03:01,120

space as compared to the neutral

85

00:03:04,229 --> 00:03:02,480

buoyancy tank where you just see kind of

86

00:03:06,229 --> 00:03:04,239

a lot of plastic around you and you can

87

00:03:07,750 --> 00:03:06,239

envision there are certain areas like

88

00:03:09,750 --> 00:03:07,760

seals and radiators that you're not

89

00:03:11,430 --> 00:03:09,760

supposed to touch and sharp edges you

90

00:03:13,190 --> 00:03:11,440

learn so you piece all those parts

91

00:03:15,110 --> 00:03:13,200

together we also have the virtual

92

00:03:16,790 --> 00:03:15,120

reality lab so the pool you know the

93

00:03:18,710 --> 00:03:16,800

pool is good for body positioning and

94

00:03:20,229 --> 00:03:18,720

translating and managing tools but it's

95

00:03:22,070 --> 00:03:20,239

not really good because there's drag in

96

00:03:23,190 --> 00:03:22,080

the water right so you're not really you

97

00:03:24,630 --> 00:03:23,200

don't really you know you're moving a

98

00:03:27,430 --> 00:03:24,640

mock-up but you're not really feeling

99

00:03:29,030 --> 00:03:27,440

what a 500 pound mass feels like so we

100

00:03:30,630 --> 00:03:29,040

take that into the virtual reality lab

101  
00:03:32,470 --> 00:03:30,640  
where we have a mass simulator called

102  
00:03:34,390 --> 00:03:32,480  
charlotte and we could take the giant

103  
00:03:37,270 --> 00:03:34,400  
axial instruments that weigh what 800

104  
00:03:39,270 --> 00:03:37,280  
900 pounds or a battery put in all the

105  
00:03:41,190 --> 00:03:39,280  
mass specs into the simulator and then

106  
00:03:42,710 --> 00:03:41,200  
the crew like john can stand there with

107  
00:03:44,710 --> 00:03:42,720  
a headset on that makes it look like

108  
00:03:46,390 --> 00:03:44,720  
he's in space holding hand rolls on a

109  
00:03:48,309 --> 00:03:46,400  
mock-up and simulates what it would feel

110  
00:03:49,830 --> 00:03:48,319  
like to move an 800-pound mass around an

111  
00:03:52,229 --> 00:03:49,840  
orbit

112  
00:03:54,550 --> 00:03:52,239  
all in all the tools the training the

113  
00:03:56,149 --> 00:03:54,560

mock-ups allowed us to repair and

114

00:03:59,510 --> 00:03:56,159

upgrade the hubble space telescope so

115

00:04:09,589 --> 00:03:59,520

that now it's doing better than ever

116

00:04:13,350 --> 00:04:11,270

don't be late don't be like i hate when

117

00:04:15,920 --> 00:04:13,360

people are late by the way

118

00:04:21,110 --> 00:04:15,930

okay ready

119

00:04:25,110 --> 00:04:23,590

hi i'm john do i need to do this do it