
SONY

1
00:00:00,000 --> 00:00:19,770
Oh

2
00:00:30,910 --> 00:00:26,440
plane engine start five four three two

3
00:00:33,610 --> 00:00:30,920
one zero booster ignition and liftoff of

4
00:01:38,039 --> 00:00:33,620
Columbia a new decade of spaceflight

5
00:01:46,149 --> 00:01:43,630
Roger Atlantis here go previa we're

6
00:01:49,210 --> 00:01:46,159
aboard the space shuttle Atlantis 280

7
00:01:51,190 --> 00:01:49,220
miles above the earth it's a busy time

8
00:01:53,170 --> 00:01:51,200
up here right now two of our crew

9
00:01:55,570 --> 00:01:53,180
members are preparing for one of space

10
00:01:59,469 --> 00:01:55,580
travels most exciting adventures space

11
00:02:01,749 --> 00:01:59,479
walking at NASA space walking is known

12
00:02:07,090 --> 00:02:01,759
as extra vehicular activity but most of

13
00:02:09,370 --> 00:02:07,100

the time we just call it an Eevee a EVs

14
00:02:12,340 --> 00:02:09,380
allow us to do a lot of useful things in

15
00:02:14,949 --> 00:02:12,350
space we can do many interesting

16
00:02:17,740 --> 00:02:14,959
experiments in the payload Bay and test

17
00:02:19,600 --> 00:02:17,750
new types of equipment we can also

18
00:02:22,930 --> 00:02:19,610
spacewalk out to an orbiting satellite

19
00:02:25,420 --> 00:02:22,940
to work on it but doing an Eevee a

20
00:02:28,140 --> 00:02:25,430
involves a lot more than just opening

21
00:02:31,090 --> 00:02:28,150
the door and stepping out into space

22
00:02:33,340 --> 00:02:31,100
EPA's take us into an environment that's

23
00:02:35,650 --> 00:02:33,350
entirely different from the one we live

24
00:02:40,539 --> 00:02:35,660
in on earth an environment that's

25
00:02:43,090 --> 00:02:40,549
hostile to human life that's because

26
00:02:45,030 --> 00:02:43,100
space is almost a perfect vacuum and

27
00:02:47,470 --> 00:02:45,040
that presents us with several problems

28
00:02:51,729 --> 00:02:47,480
problems that take a good knowledge of

29
00:02:57,520 --> 00:02:51,739
science to solve the first problem is no

30
00:02:59,710 --> 00:02:57,530
air to breathe the Sun poses another

31
00:03:01,690 --> 00:02:59,720
problem for space walkers because in

32
00:03:04,569 --> 00:03:01,700
space there's nothing to protect us from

33
00:03:06,759 --> 00:03:04,579
his harmful ultraviolet radiation the

34
00:03:09,099 --> 00:03:06,769
radiation from the Sun also affects the

35
00:03:11,740 --> 00:03:09,109
temperature in space in direct sunlight

36
00:03:14,199 --> 00:03:11,750
the temperature can soared over 120

37
00:03:17,020 --> 00:03:14,209
degrees Celsius more than hot enough to

38
00:03:18,849 --> 00:03:17,030

boil water back on earth but when we get

39
00:03:21,420 --> 00:03:18,859
away from the sun's rays the temperature

40
00:03:23,979 --> 00:03:21,430
can drop to minus 100 degrees Celsius

41
00:03:29,160 --> 00:03:23,989
far colder than Antarctica in the dead

42
00:03:31,630 --> 00:03:29,170
of winter space debris is also a problem

43
00:03:33,280 --> 00:03:31,640
so what makes the environment on earth

44
00:03:35,640 --> 00:03:33,290
and the environment in space so

45
00:03:39,069 --> 00:03:35,650
different

46
00:03:42,009 --> 00:03:39,079
the answer is Earth's atmosphere it is a

47
00:03:44,410 --> 00:03:42,019
dense mixture of nitrogen oxygen carbon

48
00:03:48,399 --> 00:03:44,420
dioxide and water vapor that surrounds

49
00:03:49,390 --> 00:03:48,409
our planet and makes life possible the

50
00:03:51,610 --> 00:03:49,400
atmosphere

51
00:03:53,949 --> 00:03:51,620
turns out harmful radiation and protects

52
00:03:56,589 --> 00:03:53,959
us from debris flying through space as

53
00:03:58,449 --> 00:03:56,599
it moves over the Earth's surface it

54
00:04:00,339 --> 00:03:58,459
distributes heat from the Sun and

55
00:04:04,330 --> 00:04:00,349
balances the temperature around the

56
00:04:07,509 --> 00:04:04,340
world think of the atmosphere as an

57
00:04:09,280 --> 00:04:07,519
ocean of gases when we're on the surface

58
00:04:11,920 --> 00:04:09,290
of the earth it's like being on the

59
00:04:13,720 --> 00:04:11,930
bottom of this ocean like the seawater

60
00:04:16,479 --> 00:04:13,730
all of the ingredients at this

61
00:04:18,849 --> 00:04:16,489
atmospheric ocean have weight too we

62
00:04:20,830 --> 00:04:18,859
measure this force as pressure this

63
00:04:23,230 --> 00:04:20,840

pressure pushes against us in all

64
00:04:28,779 --> 00:04:23,240
directions but the pressure can also

65
00:04:29,860 --> 00:04:28,789
change imagine that Jay and Jerry are on

66
00:04:32,710 --> 00:04:29,870
the Earth's surface

67
00:04:43,810 --> 00:04:32,720
we'll put Jamie in a dive suit and send

68
00:04:44,529 --> 00:04:43,820
him to the bottom of the ocean on the

69
00:04:47,890 --> 00:04:44,539
ocean floor

70
00:04:49,659 --> 00:04:47,900
jay is under tremendous pressure but as

71
00:04:54,189 --> 00:04:49,669
he starts back toward the surface the

72
00:04:56,170 --> 00:04:54,199
pressure decreases when Jay reaches the

73
00:04:59,020 --> 00:04:56,180
surface he's still under a small amount

74
00:05:00,850 --> 00:04:59,030
of pressure that pressure is the weight

75
00:05:05,740 --> 00:05:00,860
of the atmosphere and we call it

76
00:05:07,779 --> 00:05:05,750
atmospheric pressure now watch what

77
00:05:13,750 --> 00:05:07,789
happens when we put Gerry in a spacesuit

78
00:05:15,700 --> 00:05:13,760
and send him up to the shuttle as he

79
00:05:17,620 --> 00:05:15,710
rises through the atmosphere the

80
00:05:20,399 --> 00:05:17,630
pressure continues to decrease until

81
00:05:22,990 --> 00:05:20,409
he's in the near perfect vacuum of space

82
00:05:28,870 --> 00:05:23,000
there's no longer an atmosphere and

83
00:05:30,430 --> 00:05:28,880
there's no longer any pressure luckily I

84
00:05:32,050 --> 00:05:30,440
was wearing a spacesuit during that

85
00:05:36,779 --> 00:05:32,060
demonstration or I would have been in

86
00:05:44,560 --> 00:05:39,550
imagine that this balloon is my body and

87
00:05:47,500 --> 00:05:44,570
the water inside is my body fluids well

88
00:05:49,960 --> 00:05:47,510

put the balloon in a jar now we're going

89
00:05:52,480 --> 00:05:49,970
to pump all the air or atmosphere out of

90
00:05:56,310 --> 00:05:52,490
the jar so it will be similar to the

91
00:05:58,870 --> 00:05:56,320
vacuum of space look what's happening as

92
00:06:01,029 --> 00:05:58,880
air is removed from the jar the balloon

93
00:06:03,879 --> 00:06:01,039
swells and the water begins to boil like

94
00:06:05,709 --> 00:06:03,889
a soda pop that's the same thing that

95
00:06:29,120 --> 00:06:05,719
would happen to me if I didn't have on a

96
00:06:34,680 --> 00:06:31,940
but where did pressure suits come from

97
00:06:37,530 --> 00:06:34,690
aviation pioneers like Wiley Post were

98
00:06:39,330 --> 00:06:37,540
among the first to use them that's

99
00:06:41,310 --> 00:06:39,340
because those pilots who wanted to fly

100
00:06:43,550 --> 00:06:41,320
at high altitudes had to come up with a

101
00:06:46,200 --> 00:06:43,560
way to take their environment with them

102
00:06:49,710 --> 00:06:46,210
early pressure suits came in all shapes

103
00:06:52,200 --> 00:06:49,720
and sizes and although most of them were

104
00:06:53,940 --> 00:06:52,210
stiff and hard to move around in they

105
00:07:30,499 --> 00:06:53,950
laid the foundation for the suits we'd

106
00:07:41,570 --> 00:07:39,799
go for docking we know that space is a

107
00:07:44,089 --> 00:07:41,580
vacuum and we're going to have to take

108
00:07:47,869 --> 00:07:44,099
our environment with us when we go Evie

109
00:07:49,040 --> 00:07:47,879
a so let's build a spacesuit first it's

110
00:07:51,200 --> 00:07:49,050
going to get pretty hot in the suit

111
00:07:53,170 --> 00:07:51,210
after we've been working for a while so

112
00:07:55,579 --> 00:07:53,180
we need a garment laced with small tubes

113
00:07:58,610 --> 00:07:55,589

now we can flow chilled water through

114
00:08:00,619 --> 00:07:58,620
the tubes to cool us off on top of that

115
00:08:02,929 --> 00:08:00,629
we place a garment that creates the

116
00:08:05,540 --> 00:08:02,939
pressure we need and holds in oxygen for

117
00:08:07,489 --> 00:08:05,550
breathing now we need something to

118
00:08:09,950 --> 00:08:07,499
protect us from the extreme hot and cold

119
00:08:12,320 --> 00:08:09,960
of space and protect the entire suit

120
00:08:15,230 --> 00:08:12,330
from tearing and from tiny meteorite

121
00:08:17,360 --> 00:08:15,240
impacts we will use many layers of

122
00:08:21,409 --> 00:08:17,370
thermal insulation covered by a tough

123
00:08:23,149 --> 00:08:21,419
layer of white fabric let's give

124
00:08:25,820 --> 00:08:23,159
ourselves a helmet to enclose our head

125
00:08:27,200 --> 00:08:25,830
and will include a visor to protect our

126
00:08:30,139 --> 00:08:27,210
eyes from the sun's ultraviolet

127
00:08:31,639 --> 00:08:30,149
radiation on the front of the suit we'll

128
00:08:34,870 --> 00:08:31,649
put a console with some valves and

129
00:08:37,850 --> 00:08:34,880
gauges working everything else gave me

130
00:08:41,240 --> 00:08:37,860
like oxygen tanks cooling water

131
00:08:44,149 --> 00:08:41,250
batteries and radios we'll put in a

132
00:08:45,280 --> 00:08:44,159
backpack called the primary life-support

133
00:08:47,720 --> 00:08:45,290
system

134
00:08:49,730 --> 00:08:47,730
donning the suit is just a matter of

135
00:08:52,490 --> 00:08:49,740
putting on the pants just like I'd put

136
00:08:56,090 --> 00:08:52,500
on a pair of jeans then slipping into

137
00:09:00,470 --> 00:08:56,100
the top and locking the two halves

138
00:09:03,520 --> 00:09:00,480

together at the waist next come the

139
00:09:15,970 --> 00:09:14,050
and finally the helmet I've also got

140
00:09:19,570 --> 00:09:15,980
some tethers to keep me from floating on

141
00:09:22,470 --> 00:09:19,580
and this wrist mirror so that I can read

142
00:09:24,940 --> 00:09:22,480
the dials on my life support system

143
00:09:26,650 --> 00:09:24,950
putting the suit on is not the only

144
00:09:29,230 --> 00:09:26,660
thing Jay and Jerry have to practice

145
00:09:32,410 --> 00:09:29,240
they also have to practice working in

146
00:09:34,780 --> 00:09:32,420
the suit and that's done here at the

147
00:09:48,100 --> 00:09:34,790
weightless environment training facility

148
00:09:51,030 --> 00:09:48,110
or wet F this big swimming pool holds

149
00:09:53,830 --> 00:09:51,040
almost half a million gallons of water

150
00:10:03,960 --> 00:09:53,840
that's big enough to hold a full-size

151
00:10:09,340 --> 00:10:06,939
scuba divers are adding weights to Jerry

152
00:10:12,879 --> 00:10:09,350
and Jay suits to make them neutrally

153
00:10:17,110 --> 00:10:12,889
buoyant this means that they won't float

154
00:10:19,150 --> 00:10:17,120
to the surface or sink to the bottom the

155
00:10:21,310 --> 00:10:19,160
wet F isn't the perfect simulation of

156
00:10:49,650 --> 00:10:21,320
weightlessness but it's the closest we

157
00:10:57,580 --> 00:10:51,860
we spend a lot of time in the water

158
00:10:57,590 --> 00:11:52,290
it's time for the real thing

159
00:11:56,829 --> 00:11:54,819
during the next few hours Jerry and Jay

160
00:11:58,509 --> 00:11:56,839
are going to experiment with new ways of

161
00:12:01,960 --> 00:11:58,519
moving people and equipment around in

162
00:12:04,300 --> 00:12:01,970
space in the future we'll be going EBA

163
00:12:07,090 --> 00:12:04,310

to service satellites in orbit and to

164
00:12:09,160 --> 00:12:07,100
help build space station freedom beyond

165
00:12:11,650 --> 00:12:09,170
that people will work on the moon from

166
00:12:17,110 --> 00:12:11,660
permanent lunar bases and even explore

167
00:12:18,610 --> 00:12:17,120
the surface of Mars the spacesuit has a

168
00:12:21,610 --> 00:12:18,620
big role to play in our use and

169
00:12:23,499 --> 00:12:21,620
exploration of space and as new

170
00:12:26,139 --> 00:12:23,509
challenges come our way we're going to

171
00:12:28,389 --> 00:12:26,149
develop better suits but no matter where

172
00:12:30,759 --> 00:12:28,399
the epa's take us one thing will always

173
00:12:33,040 --> 00:12:30,769
remain the same as long as humans