1
00:00:00,719 --> 00:00:04,580
NARRATOR: For thousands of years, the course
of exploration had been determined by staring

2
00:00:04,580 --> 00:00:09,710
toward the stars and moving forward with bold
progress into the vast unknown.

3
00:00:09,710 --> 00:00:12,280
STRAUGHN: Astronomy is the oldest science.

4
00:00:12,280 --> 00:00:16,660
People have been looking up at the stars since
we sort of stopped walking around on our knuckles.

5
00:00:16,660 --> 00:00:20,099
The way astronomers become interested in astronomy
to begin with is just by looking at the sky.

6
00:00:20,099 --> 00:00:21,099
TYSON: If it's happening outside of our atmosphere
- comets, asteroids, planets, stars, galaxies

7
00:00:21,099 --> 00:00:28,730
- cosmology, the study of the birth, life,
and fate of the universe, that's what we worry

8
00:00:28,730 --> 00:00:29,730
about.

9
00:00:29,730 --> 00:00:39,380
And we use the laws of physics as discovered
here on Earth and apply them to phenomenon

10
00:00:39,380 --> 00:00:40,690
in the cosmos.

11
00:00:40,690 --> 00:00:47,500
NARRATOR: Humanity reached out and explored

farther and farther, until a place once reserved

12
00:00:47,500 --> 00:00:55,300
for the imagination and the distant view of
a telescope's lens was now walked upon by

13
00:00:55,300 --> 00:00:56,300
humankind.

14
00:00:56,300 --> 00:00:59,220
Music
ARMSTRONG: That's one small step for man.

15
00:00:59,220 --> 00:01:03,910
MUSGRAVE: I had to run outside and look at
the moon and say, "You see that thing?

16
00:01:03,910 --> 00:01:05,489
Well, there's people on there right now."

17
00:01:05,489 --> 00:01:08,550
ARMSTRONG: One giant leap for mankind.

18
00:01:08,550 --> 00:01:14,070
NARRATOR: It was 1969, as ticker tape fell
from the sky and rock and roll blazed across

19
00:01:14,070 --> 00:01:16,850
the American landscape.

20
00:01:19,580 --> 00:01:18,210
Music

21
00:01:19,580 --> 00:01:25,030
MIKULSKI: America loves discovery.

22
00:01:25,030 --> 00:01:33,200
We just--that's in our national DNA.

23
00:01:33,200 --> 00:01:38,400
When Lewis and Clark was sent out on their
expedition by a president of the United States,

24
00:01:38,400 --> 00:01:40,270
it was called discovery.

25
00:01:40,270 --> 00:01:43,140
And that's when we send out our astronauts.

26
00:01:43,140 --> 00:01:48,650
That's when we've now sent out a space telescope,
to go where no other telescopes had gone before

27
00:01:48,650 --> 00:01:51,490
and to see things that had never been seen.

28
00:01:51,490 --> 00:01:53,200
MOUNTAIN: So, astronomy is about exploration.

29
00:01:53,200 --> 00:01:54,799
It's what NASA does.

30
00:01:54,799 --> 00:01:55,799
NASA explores.

31
00:01:55,799 --> 00:02:00,490
NARRATOR: A telescope that would go beyond
the atmospheric limits of the Earth; it's

32
00:02:00,490 --> 00:02:01,900
a simple problem.

33
00:02:01,900 --> 00:02:06,650
When you desire to look at objects far away,
there are limitations.

34
00:02:06,650 --> 00:02:10,479

Through technological advancement, you can remove these limitations.

35
00:02:10,479 --> 00:02:14,590
The handheld telescope supersedes the naked eye.

36
00:02:14,590 --> 00:02:19,900
That small glass telescope was replaced by larger models, then mirrors are added and

37
00:02:19,900 --> 00:02:22,080
then more advancements.

38
00:02:22,080 --> 00:02:28,640
As the size and capacities of the device grow so do the discoveries, from mapping a few

39
00:02:28,640 --> 00:02:34,200
heavenly bodies circling the sun to seeing beyond ours and into other galaxies.

40
00:02:34,200 --> 00:02:38,590
GARCIA: Before we ever put, you know, men in space, astronomers are already thinking

41
00:02:38,590 --> 00:02:43,880
about getting, you know, off of the planet above the atmosphere in order to get the crystal

42
00:02:43,880 --> 00:02:44,920
clear view.

43
00:02:44,920 --> 00:02:50,160
NARRATOR: But, obstacles such as atmosphere, clouds, light pollution, and even our own

44
00:02:50,160 --> 00:02:56,190
sun's brightness stand in our way of seeing things clearly or watching around the clock.

45
00:02:56,190 --> 00:02:57,290
The solution?

46
00:02:57,290 --> 00:03:00,239
A non ground-based robotic observatory.

47
00:03:00,239 --> 00:03:05,060
TYSON: Well, there's that famous song, twinkle,
twinkle little star, how I wonder what you

48
00:03:05,060 --> 00:03:06,060
are.

49
00:03:06,060 --> 00:03:11,569
That left a lot of people thinking that twinkling
stars is exactly what astronomers want, BUT

50
00:03:11,569 --> 00:03:13,849
it is the opposite of what they want.

51
00:03:13,849 --> 00:03:17,770
MASSIMINO: One thing I've noticed as an astronaut
is that when you get into space and you look

52
00:03:17,770 --> 00:03:20,300
at stars, they don't twinkle like they do
on Earth.

53
00:03:20,300 --> 00:03:23,520
What you're seeing in twinkle, twinkle little
star is because the light is coming through

54
00:03:23,520 --> 00:03:26,660
the atmosphere and causing them to twinkle.

55
00:03:26,660 --> 00:03:28,890
TYSON: Starlight does not twinkle on its own.

56
00:03:28,890 --> 00:03:31,220
It twinkles coming through Earth's atmosphere.

57
00:03:31,220 --> 00:03:36,370
And it's that bump, AND grind and jiggle and
wiggle, moving through the layers, different

58
00:03:36,370 --> 00:03:43,210
temperature layers of the atmosphere, that
disrupts the precision of your imaging of

59
00:03:43,210 --> 00:03:44,210
the night sky.

60
00:03:44,210 --> 00:03:48,670
MASSIMINO: THE space telescope was thought
of originally by--Lyman Spitzer had the idea

61
00:03:48,670 --> 00:03:53,090
that if you could get above the atmosphere
you could see a lot more clearly.

62
00:03:53,090 --> 00:03:58,090
NARRATOR: Renowned astrophysicist Lyman Spitzer
gathered support in the astronomy community

63
00:03:58,090 --> 00:04:04,409
for a large space telescope, which later on
would be named in honor of astronomer Edwin

64
00:04:04,409 --> 00:04:05,970
Powell Hubble.

65
00:04:05,970 --> 00:04:08,930
It was Hubble who discovered the universe
was expanding.

66
00:04:08,930 --> 00:04:15,159
Through the lens of a hundred inch telescope,

he made calculations that the universe was

67
00:04:15,159 --> 00:04:20,160
made up of billions of galaxies, well beyond
the visible Milky Way.

68
00:04:20,160 --> 00:04:24,790
His observations pointed out that these galaxies
seemed to be moving away from us.

69
00:04:24,790 --> 00:04:28,370
IDLE: (Singing) We're 30,000 light years from
galactic central point.

70
00:04:28,370 --> 00:04:30,920
We go around every 200 million years.

71
00:04:30,920 --> 00:04:37,300
And our galaxy is only one of millions of
billions in this amazing and expanding universe.

72
00:04:37,300 --> 00:04:46,000
NARRATOR: Using known stars to calculate distances
between galaxies, Edwin Hubble confirmed this

73
00:04:46,000 --> 00:04:47,000
galactic retreat.

74
00:04:47,000 --> 00:04:48,900
WEILER: Now, let's take it ever further back.

75
00:04:48,900 --> 00:04:53,530
A lot of people don't realize this, but the
Huddle Space Telescope was dreamed up by Lyman

76
00:04:53,530 --> 00:04:56,150
Spitzer back in 1948.

77
00:04:56,150 --> 00:04:59,990

And he wrote a paper on the advantages of
putting a telescope in space to get above

78
00:04:59,990 --> 00:05:02,360
the atmosphere, etc.

79
00:05:02,360 --> 00:05:07,240
And that started a lifelong--a quest by Lyman
to get the Hubble Space Telescope up there.

80
00:05:07,240 --> 00:05:12,280
He fought with the Congress with the able
help of John Bahcall, who I consider the granduncle

81
00:05:12,280 --> 00:05:14,419
of Hubble, both at Princeton.

82
00:05:14,419 --> 00:05:20,850
And he and John fought with Congress and convinced
Congress to provide the early funding in the

83
00:05:20,850 --> 00:05:21,850
late '70s.

84
00:05:21,850 --> 00:05:27,151
ALTMAN: It looks out at galaxies and brings
them to us, crosses vast distances that we

85
00:05:27,151 --> 00:05:28,990
don't have the technology to travel.

86
00:05:28,990 --> 00:05:34,259
But, we can travel in a time machine using
the Huddle to show us what the universe was

87
00:05:34,259 --> 00:05:40,000
like 13 billion years ago with the light that
it pulls in, and also exposes us to just how

88

00:05:40,000 --> 00:05:46,710
vast the universe really is, with billions
and billions of galaxies full of billions

89
00:05:46,710 --> 00:05:47,710
of stars.

90
00:05:47,710 --> 00:05:52,979
NARRATOR: To build a telescope in many ways
is a decision to build a time machine.

91
00:05:52,979 --> 00:06:00,760
The United States Congress approved a large
space telescope in 1977, sparking work to

92
00:06:00,760 --> 00:06:06,330
begin on creating this large, complex, and
capable orbiting telescope.

93
00:06:06,330 --> 00:06:08,800
LECKRONE: Well, it wasn't easy.

94
00:06:08,800 --> 00:06:15,050
It was a long slog, difficult politically
at first to have it accepted and funded in

95
00:06:15,050 --> 00:06:16,580
the US Congress.

96
00:06:16,580 --> 00:06:18,220
And then, technically it was difficult.

97
00:06:18,220 --> 00:06:25,389
CEPOLLINA: We need to find a new way and the
new technology to approach the development

98
00:06:25,389 --> 00:06:33,590
of expensive satellites that would go to orbit,
that could somehow take advantage of human

99
00:06:33,590 --> 00:06:37,220
repair and perhaps a space transportation
system.

100
00:06:37,220 --> 00:06:42,320
NARRATOR: An advanced international observatory
with multiple tools, multiple cameras, instruments,

101
00:06:42,320 --> 00:06:43,320
and capabilities.

102
00:06:43,320 --> 00:06:45,570
MASSIMINO: It's an amazing machine.

103
00:06:45,570 --> 00:06:51,430
It can orbit around the Earth at 17,500 miles
an hour.

104
00:06:51,430 --> 00:06:55,500
And the reason it can take all these great
images is not only because it's above the

105
00:06:55,500 --> 00:07:03,020
atmosphere, but because it can very steadily
hold its gaze on an object in space.

106
00:07:03,020 --> 00:07:10,880
ROMAN: Aerospace companies came in with proposals
for a space telescope, a large space telescope.

107
00:07:10,880 --> 00:07:15,139
All of them had men riding around with the
telescope.

108
00:07:15,139 --> 00:07:17,590
This was the last thing that astronomers wanted.

109
00:07:17,590 --> 00:07:22,250
In the first place, we were trying to get

rid of the atmosphere, and a man needs an

110
00:07:22,250 --> 00:07:23,250
atmosphere.

111
00:07:23,250 --> 00:07:25,630
In the second place, a man's going to wiggle.

112
00:07:25,630 --> 00:07:31,260
I don't care how careful he is, when you're
taking a half hour or an hour exposures, he's

113
00:07:31,260 --> 00:07:33,170
going to wiggle sometimes.

114
00:07:33,170 --> 00:07:37,500
And when you wiggle in space, the spacecraft
wiggles the opposite way.

115
00:07:37,500 --> 00:07:42,240
NARRATOR: A globally connected telescope,
built through a partnership with the European

116
00:07:42,240 --> 00:07:47,419
Space Agency, which would look into the stars
well beyond international borders.

117
00:07:47,419 --> 00:07:49,009
SCOLESE: It takes a lot of people.

118
00:07:49,009 --> 00:07:54,500
You know, it takes people that--obviously
the scientists to conceive of it.

119
00:07:54,500 --> 00:07:58,880
It takes engineers to design it and build
it and test it.

120
00:07:58,880 --> 00:08:02,051

It takes technicians to actually build it.

121
00:08:02,051 --> 00:08:07,510
It takes the people to keep the rooms clean,
the facilities up and operating.

122
00:08:07,510 --> 00:08:14,270
So, it takes people from every walk of life
in order to do it, every skill set that you

123
00:08:14,270 --> 00:08:15,270
can think of.

124
00:08:15,270 --> 00:08:20,710
NARRATOR: To then place this telescope into
orbit to send back to us the data that scientists

125
00:08:20,710 --> 00:08:23,460
needed, unobstructed and unencumbered.

126
00:08:23,460 --> 00:08:28,130
WISEMAN: And when it was launched in 1990,
it really opened a new vista on the whole

127
00:08:28,130 --> 00:08:32,550
universe simply by enabling us to get sharper
images above the atmosphere.

128
00:08:32,550 --> 00:08:37,119
MUSGRAVE: Humanity has always looked out there,
to the heavens, to get the meaning and the

129
00:08:37,119 --> 00:08:39,089
hope of their life here.

130
00:08:39,089 --> 00:08:42,739
So, you look out there for what's going on
down here.

131

00:08:42,739 --> 00:08:48,249
People understood that about Hubble before
we carried it up there, and so that's the

132
00:08:48,249 --> 00:08:49,249
magic.

133
00:08:49,249 --> 00:08:53,839
Bolden: And at the time, I was the--what we
called the PLT, or the pilot for the Hubble

134
00:08:53,839 --> 00:08:58,209
deploy mission, which was STS-31 aboard the
Shuttle Discovery.

135
00:08:58,209 --> 00:09:02,499
All of us in the crew had a certain feeling
of exhilaration and excitement.

136
00:09:02,499 --> 00:09:06,160
We knew that this was going to be an important
mission.

137
00:09:06,160 --> 00:09:09,820
UNIDENTIFIED: Two, one, and liftoff of the
Space Shuttle Discovery with the Hubble Space

138
00:09:09,820 --> 00:09:14,070
Telescope, our window on the universe.

139
00:09:14,070 --> 00:09:20,089
NARRATOR: On the 25th of April in 1990, the
Space Shuttle Discovery, piloted by a future

140
00:09:20,089 --> 00:09:24,940
administrator of NASA, deployed the Hubble
Space Telescope into an orbit around Earth.

141
00:09:24,940 --> 00:09:25,940
UNIDENTIFIED: Discovery, Houston.

142
00:09:25,940 --> 00:09:32,001
You have a go to open the doors.

143
00:09:32,001 --> 00:09:33,001
UNIDENTIFIED: Roger, Houston.

144
00:09:33,001 --> 00:09:37,839
BOLDEN: The mission itself was pretty intense
in training, because we had to train for any

145
00:09:37,839 --> 00:09:42,160
number of contingencies that we all prayed
would not happen.

146
00:09:42,160 --> 00:09:43,420
UNIDENTIFIED: Morning, Story.

147
00:09:43,420 --> 00:09:44,420
REEVES: Good morning, Discovery.

148
00:09:44,420 --> 00:09:49,550
Good morning from Bill Reeves and the Orbit
One Team, and you got a go for HST deploy

149
00:09:49,550 --> 00:09:50,550
ops.

150
00:09:50,550 --> 00:09:52,480
UNIDENTIFIED: And Houston, Discovery.

151
00:09:52,480 --> 00:09:56,589
The transfer to internal power is complete.

152
00:09:56,589 --> 00:10:01,059
The umbilical is dead-faced, and we'll be
standing by for your go for umbilical release.

153

00:10:01,059 --> 00:10:04,172
MUSGRAVE It was the people's instrument long
before we launched it.

154
00:10:04,172 --> 00:10:12,490
So, and like I said, I was the lead communicator
in the carry-up and deploy mission, STS-31,

155
00:10:12,490 --> 00:10:14,690
but it was the people's machine then.

156
00:10:14,690 --> 00:10:18,079
UNIDENTIFIED CHATTER
BOLDEN: Ironically, one of those contingencies

157
00:10:18,079 --> 00:10:21,410
was failure of the solar array to deploy.

158
00:10:21,410 --> 00:10:25,809
It took us much of the day for the flight
control team to say, "Look, we--this is not

159
00:10:25,809 --> 00:10:26,809
working out.

160
00:10:26,809 --> 00:10:29,189
We don't think we're going to get the solar
arrays deployed."

161
00:10:29,189 --> 00:10:37,709
All of a sudden this great experience turned
out to just go, "This is not good," when the

162
00:10:37,709 --> 00:10:40,399
ground control team called and said, "Stop,
stop.

163
00:10:40,399 --> 00:10:42,170
We think we found a solution.

164
00:10:42,170 --> 00:10:44,809
You know, just stop where you are.

165
00:10:44,809 --> 00:10:45,809
We're going to try this."

166
00:10:45,809 --> 00:10:49,399
And they did and it worked, and so we went ahead and deployed.

167
00:10:49,399 --> 00:10:51,410
UNIDENTIFIED: The deploy activity so far is going very smoothly.

168
00:10:51,410 --> 00:10:53,299
BOLDEN: Okay, they copy you, Story.

169
00:10:53,299 --> 00:10:54,559
And we're at five--.

170
00:10:54,559 --> 00:10:59,809
BOLDEN: --It all worked out because of the incredible work of the combination of the

171
00:10:59,809 --> 00:11:06,910
crew onboard, the flight control team in Houston, but most especially very smart people at the

172
00:11:06,910 --> 00:11:13,079
Goddard Space Flight Center who actually knew the Hubble Space Telescope about as well as

173
00:11:13,079 --> 00:11:14,369
any people around.

174
00:11:14,369 --> 00:11:15,369
UNIDENTIFIED: J.C.?

175

00:11:15,369 --> 00:11:16,369
UNIDENTIFIED: Go.

176
00:11:16,369 --> 00:11:17,379
UNIDENTIFIED: Network go.

177
00:11:17,379 --> 00:11:19,100
Payloads, waiting on you.

178
00:11:19,100 --> 00:11:20,389
UNIDENTIFIED: Flight payloads.

179
00:11:20,389 --> 00:11:21,679
We are go.

180
00:11:21,679 --> 00:11:22,970
UNIDENTIFIED: Go ahead.

181
00:11:22,970 --> 00:11:25,410
CapCom, we have a go for release.

182
00:11:25,410 --> 00:11:27,989
UNIDENTIFIED: Discovery, go for Hubble release.

183
00:11:27,989 --> 00:11:29,279
BOLDEN: Houston, Discovery.

184
00:11:29,279 --> 00:11:30,999
MUSGRAVE: Go ahead, Charlie.

185
00:11:30,999 --> 00:11:32,290
BOLDEN: Okay, Story.

186
00:11:32,290 --> 00:11:34,009
We've been taking marks.

187
00:11:34,009 --> 00:11:38,970
Residuals and ratios look good, and we'd like

to go ahead and go to the filter state.

188
00:11:38,970 --> 00:11:41,499
MUSGRAVE: We concur, Charlie.

189
00:11:41,499 --> 00:11:46,660
WEILER: We launched Hubble April 24th, 1990,
and we were all on top of the world.

190
00:11:46,660 --> 00:11:52,269
Many of us astronomers had never done an interview,
and suddenly we were on Today and Nightline

191
00:11:52,269 --> 00:11:54,920
and Good Morning America, etc.

192
00:11:54,920 --> 00:11:56,489
And the media loved us.

193
00:11:56,489 --> 00:11:58,889
The Hubble was big news across the country.

194
00:11:58,889 --> 00:12:00,149
Everybody loved us.

195
00:12:00,149 --> 00:12:05,299
UNIDENTIFIED: And it's here, 381 miles up,
where the telescope is to be place in orbit

196
00:12:05,299 --> 00:12:06,299
tomorrow.

197
00:12:06,299 --> 00:12:08,160
So, the celebration will continue.

198
00:12:08,160 --> 00:12:09,399
UNIDENTIFIED: Oh, yes.

199

00:12:09,399 --> 00:12:12,850
Hey, I get to launch something here, guys.

200
00:12:12,850 --> 00:12:17,819
UNIDENTIFIED: Westfall's family, neighbors,
and colleagues who had traveled here from

201
00:12:17,819 --> 00:12:19,759
California toasted the telescope.

202
00:12:19,759 --> 00:12:23,859
BRAD BIRD: The science that is astronomy would
never be the same.

203
00:12:23,859 --> 00:12:28,179
STRAUGHN: When people think about a telescope
here on Earth, they think about a mirror with

204
00:12:28,179 --> 00:12:29,439
a tube around it.

205
00:12:29,439 --> 00:12:31,540
And that's exactly what Hubble is.

206
00:12:31,540 --> 00:12:35,889
It's a huge mirror with a huge tube around
it in space.

207
00:12:35,889 --> 00:12:39,649
And the--of course, the purpose of Hubble
is to take these beautiful images that we

208
00:12:39,649 --> 00:12:40,649
learn about.

209
00:12:40,649 --> 00:12:45,670
And so, the images are recorded on cameras,
and then the data is sent back to Earth for

210

00:12:45,670 --> 00:12:46,670
us to study.

211
00:12:46,670 --> 00:12:51,429
NARRATOR: The Hubble Space Telescope powered
up, all systems nominal, and the data began

212
00:12:51,429 --> 00:12:56,799
to stream in; images of far off distances,
galaxies, and stars, but there was something

213
00:12:56,799 --> 00:12:57,799
wrong.

214
00:12:57,799 --> 00:13:02,579
The magnificent space observatory's imagery
was not clear, not crisp.

215
00:13:02,579 --> 00:13:06,619
BOLDEN: As a member of the deploy crew, we
had come back, done our debrief, and, you

216
00:13:06,619 --> 00:13:07,619
know, we had done our job.

217
00:13:07,619 --> 00:13:08,670
And so, we were happy.

218
00:13:08,670 --> 00:13:13,069
We thought everything was okay until the word
came that, ah, we saw the first light images.

219
00:13:13,069 --> 00:13:18,059
And to the amateur like me, it looked great
because we had made this great discovery right

220
00:13:18,059 --> 00:13:22,230
off the bat; what we thought was a single
star turned out to be a binary star, when

221
00:13:22,230 --> 00:13:25,079
we learned that no, it's not really that good
an image.

222
00:13:25,079 --> 00:13:27,589
It's kind of blurred because we have this
thing.

223
00:13:27,589 --> 00:13:33,639
FRANK CEPOLLINA: From an agency perspective
and from a public perspective and a Congressional

224
00:13:33,639 --> 00:13:35,519
perspective, it was doom and gloom.

225
00:13:35,519 --> 00:13:42,359
MIKULSKI: Working on a bipartisan basis, we
used the best tools to identify was this a

226
00:13:42,359 --> 00:13:48,980
techno turkey that we would just bag as a
terrible mistake and say bye-bye boondoggle,

227
00:13:48,980 --> 00:13:51,180
or were we really going to try to fix it?

228
00:13:51,180 --> 00:13:56,639
WEILER: Couldn't get the telescope focused,
had trouble pointing it sometimes, and that

229
00:13:56,639 --> 00:14:01,250
went on until about early June when people,
smart people, finally figured out that what

230
00:14:01,250 --> 00:14:02,709
we had was a spherical aberration.

231
00:14:02,709 --> 00:14:04,529
CEPOLLINA: The mirror was polished incorrectly.

232
00:14:04,529 --> 00:14:06,369
And it wasn't by much.

233
00:14:06,369 --> 00:14:09,749
It was half the thickness of a human hair
across 100 inches.

234
00:14:09,749 --> 00:14:17,169
You know, you can try to imagine what--how
much sag something that weighed 2,300 pounds

235
00:14:17,169 --> 00:14:18,169
would have.

236
00:14:18,169 --> 00:14:24,540
And yet, we were off by half the thickness
of a human hair from center to edge.

237
00:14:24,540 --> 00:14:30,639
And that's pretty astounding, that, you know,
we could come so close and yet not make it.

238
00:14:30,639 --> 00:14:34,439
WEILER: The mirror was still a perfect smooth
curve, but it had the wrong prescription.

239
00:14:34,439 --> 00:14:36,899
It wasn't the right curve.

240
00:14:36,899 --> 00:14:40,610
Just like my eye is a perfectly good eye,
it's got a smooth curve to it, but it's the

241
00:14:40,610 --> 00:14:41,739
wrong prescription.

242
00:14:41,739 --> 00:14:43,939
Light doesn't come to a focus at the right

spot.

243
00:14:43,939 --> 00:14:45,699
So, how do we fix it?

244
00:14:45,699 --> 00:14:50,169
Well, we fix it with corrective lenses, the
opposite prescription.

245
00:14:50,169 --> 00:14:56,269
And that's what we talked about on the famous
press conference of June 27th, 1990, where

246
00:14:56,269 --> 00:15:00,899
I had the unique honor of explaining to the
American people and the press that Hubble

247
00:15:00,899 --> 00:15:02,879
wouldn't be doing the science we had promised.

248
00:15:02,879 --> 00:15:09,119
WEILER: I'm going to try to give you a perspective
on the short term ramifications of this particular

249
00:15:09,119 --> 00:15:14,869
issue and also the long term ramifications
in terms of what we can do, the science we

250
00:15:14,869 --> 00:15:20,970
can do, the science we won't be able to do
for a while in the short term, and most importantly,

251
00:15:20,970 --> 00:15:23,889
the solutions to this problem in the future.

252
00:15:23,889 --> 00:15:28,559
NARRATOR: Decades of planning and hope seemed
extinguished by a blurring spherical aberration

253

00:15:28,559 --> 00:15:30,429
in Hubble's primary mirror.

254
00:15:30,429 --> 00:15:36,139
WEILER: We feel that we can characterize the
problem, this spherical aberration problem,

255
00:15:36,139 --> 00:15:40,579
well enough that we can take advantage of
an insurance policy that we haven't talked

256
00:15:40,579 --> 00:15:43,239
much about and that hasn't been in the press
much.

257
00:15:43,239 --> 00:15:46,449
And that is we started a long time ago to
plan a maintenance program.

258
00:15:46,449 --> 00:15:51,459
GRUNSFELD: The truly remarkable feature of
the Hubble Space Telescope is that it was

259
00:15:51,459 --> 00:15:54,350
designed to be upgraded and fixed.

260
00:15:54,350 --> 00:15:58,569
NARRATOR: On Earth, you'd order a replacement
part and correct the problem when the shipment

261
00:15:58,569 --> 00:15:59,569
arrived.

262
00:15:59,569 --> 00:16:06,819
But, Hubble was over 340 miles from the Earth's
surface, moving at nearly 18,000 miles per

263
00:16:06,819 --> 00:16:07,819
hour.

264
00:16:07,819 --> 00:16:09,380
You'd need a special repair team.

265
00:16:09,380 --> 00:16:15,079
MUSGRAVE: The team comes together through multiple domains, multiple disciplines, and

266
00:16:15,079 --> 00:16:17,739
multiple organizations, multiple divisions.

267
00:16:17,739 --> 00:16:22,639
You got to get a job done, and NASA is absolutely expertise on this.

268
00:16:22,639 --> 00:16:28,680
When you got to get the job done, the team comes from many different places.

269
00:16:28,680 --> 00:16:32,699
SEMBACH: When Hubble was first launched, it had the spherical aberration on its primary

270
00:16:32,699 --> 00:16:35,860
mirror, so the prescription for the mirror wasn't right.

271
00:16:35,860 --> 00:16:41,259
It took a team of people to figure out what that prescription actually was in practice

272
00:16:41,259 --> 00:16:45,359
as opposed to what it should have been, and then people to figure out how to actually

273
00:16:45,359 --> 00:16:49,489
solve Hubble's blurry vision at the time.

274
00:16:49,489 --> 00:16:59,819
This institute and NASA and its contractors

figured out a way to put together a prescription

275
00:16:59,819 --> 00:17:03,009
for correcting that spherical aberration.

276
00:17:03,009 --> 00:17:08,290
MUSGRAVE: After those two failures, the big
boss came over and looked at me and said,

277
00:17:08,290 --> 00:17:09,500
"Story, fix it."

278
00:17:09,500 --> 00:17:10,980
Okay, I'll fix it.

279
00:17:10,980 --> 00:17:12,600
UNIDENTIFIED: Two, one.

280
00:17:12,600 --> 00:17:16,990
And we have liftoff, liftoff of the Space
Shuttle Endeavor on an ambitious mission to

281
00:17:16,990 --> 00:17:18,660
service the Hubble Space Telescope.

282
00:17:18,660 --> 00:17:23,429
MUSGRAVE: The real magic on the Hubble mission
is almost 40 hours of spacewalking, and we

283
00:17:23,429 --> 00:17:25,079
had almost no surprises.

284
00:17:25,079 --> 00:17:27,389
We had 13 major systems to fix.

285
00:17:27,389 --> 00:17:31,299
And day after day we just kept working away
getting the system fixed, and they'd tell

286
00:17:31,299 --> 00:17:35,970
us this one is up and running and it's fixed.

287
00:17:35,970 --> 00:17:39,830
And we kept on going through five days.

288
00:17:39,830 --> 00:17:44,220
And finally we finished the job and, hey,
it's totally restored.

289
00:17:44,220 --> 00:17:49,340
MOUNTAIN: Because astronauts from NASA have
been able to go back and refurbish it, put

290
00:17:49,340 --> 00:17:53,429
in new instruments, repair it, and so that
25 years has made it an increasingly more

291
00:17:53,429 --> 00:17:54,429
powerful telescope.

292
00:17:54,429 --> 00:17:58,460
And it's the fact the Hubble is so powerful
today which is so remarkable.

293
00:17:58,460 --> 00:18:03,309
After 25 years, it's basically 10 to 100 times
more powerful than when it was first launched.

294
00:18:03,309 --> 00:18:07,600
GRUNSFELD: Crew members, women and men in
white spacesuits rode to the recue like a

295
00:18:07,600 --> 00:18:08,880
great Western.

296
00:18:08,880 --> 00:18:14,180
And so, this was a huge deal for me personally
as an astronomer, astrophysicist, and astronaut,

297
00:18:14,180 --> 00:18:19,279
to have the privilege of going to Hubble on
my first mission in 1999.

298
00:18:19,279 --> 00:18:22,480
GOOD: Like taking the car in for an oil change,
rotate the tires.

299
00:18:22,480 --> 00:18:24,230
So, we were changing out batteries.

300
00:18:24,230 --> 00:18:29,549
We were changing out the gyros, things that
just made the telescope work.

301
00:18:29,549 --> 00:18:33,909
MUSGRAVE: So, you have a satellite out there,
and you got to maintain its attitude and you

302
00:18:33,909 --> 00:18:38,220
got to maneuver to point very closely.

303
00:18:38,220 --> 00:18:42,179
The only ultimate force that you impose on
the machine is magnets.

304
00:18:42,179 --> 00:18:47,540
Now, as Hubble goes around the Earth, here's
the magnetic field of Earth.

305
00:18:47,540 --> 00:18:54,820
And the magnetometers, which I replaced, those
magnetometers, they sense where the magnetic

306
00:18:54,820 --> 00:18:59,789
field of the Earth is, and the computers say,
"Okay, I'm going to turn these magnets on

307

00:18:59,789 --> 00:19:00,789
or off.

308
00:19:00,789 --> 00:19:02,360
And that's the way I'm going to control Hubble
attitude."

309
00:19:02,360 --> 00:19:05,789
SEMBACH: Remember, up in space, you know,
there isn't anything for Hubble to push against,

310
00:19:05,789 --> 00:19:09,289
so it has to push against something internal
like these spinning wheels.

311
00:19:09,289 --> 00:19:15,910
FOALE: I did a mission to the Hubble Space
Telescope, and it was a--it wasn't really

312
00:19:15,910 --> 00:19:16,970
a refurbishment.

313
00:19:16,970 --> 00:19:25,309
It was a rescue mission, because the Hubble
Telescope uses gyroscopes to determine how

314
00:19:25,309 --> 00:19:30,000
it's moving and how to point, with absolutely
no motion, at a star.

315
00:19:30,000 --> 00:19:32,549
And those gyroscopes, six of them, were failing.

316
00:19:32,549 --> 00:19:37,190
And then, by the time we got there, only one,
I think, was working.

317
00:19:37,190 --> 00:19:44,009
And so, it was a dead telescope at that point,
and our role on that mission was to basically

318
00:19:44,009 --> 00:19:45,769
repair the Hubble Telescope.

319
00:19:45,769 --> 00:19:50,870
It was a real repair mission, just like the
first repair mission to change the optics.

320
00:19:50,870 --> 00:19:54,929
If I had messed that up, I would be the one
that had broken the telescope forever.

321
00:19:54,929 --> 00:19:59,139
MCARTHUR: This amazing telescope with all
this history and, you know, what if I wreck

322
00:19:59,139 --> 00:20:00,139
it?

323
00:20:00,139 --> 00:20:01,139
What if I do something bad?

324
00:20:01,139 --> 00:20:04,070
GRUNSFELD: Then I got the opportunity to go
a second time as the payload commander on

325
00:20:04,070 --> 00:20:05,740
STS-109.

326
00:20:05,740 --> 00:20:10,769
And when we actually were doing the spacewalks
and I went out and shook hands with Mr. Hubble,

327
00:20:10,769 --> 00:20:16,160
the telescope, you know, holding on to the
side, I truly felt like, you know, this was

328
00:20:16,160 --> 00:20:19,250
my partner and that we were here, you know,

to help.

329
00:20:19,250 --> 00:20:22,940
REZAC: I guess that's part of the excitement
of having worked a Hubble mission, because

330
00:20:22,940 --> 00:20:27,710
you know you've got the best team on the ground,
the best crew upstairs.

331
00:20:27,710 --> 00:20:31,059
It's exciting, but there is a level of confidence
you're going to pull through this.

332
00:20:31,059 --> 00:20:32,940
MCARTHUR: It's incredible, the things that
they can come up with.

333
00:20:32,940 --> 00:20:36,659
And they have the time and the resources to
develop that here, and then we take, you know,

334
00:20:36,659 --> 00:20:40,160
sort of the best solution up with us to implement
in space.

335
00:20:40,160 --> 00:20:41,160
There is it.

336
00:20:41,160 --> 00:20:42,429
It looks exactly the way it's supposed to
look.

337
00:20:42,429 --> 00:20:47,712
It's exactly where it's supposed to be and
I'm just going to reach over and grab it.

338
00:20:47,712 --> 00:20:48,712
So, it was a really good feeling.

339
00:20:48,712 --> 00:20:52,919
And what we did after we grappled the telescope
and put it in the payload bay was, every day

340
00:20:52,919 --> 00:20:57,169
that the spacewalks were going on, which was
the five days after we grappled the telescope,

341
00:20:57,169 --> 00:21:00,730
the two guys go outside and one of them is
pretty much always on the end of the arm.

342
00:21:00,730 --> 00:21:01,730
Unidentified: Go on three, bueno.

343
00:21:01,730 --> 00:21:02,730
GOOD: Copy.

344
00:21:02,730 --> 00:21:03,730
Go three.

345
00:21:03,730 --> 00:21:04,730
Unidentified: So, we'd drive them around and
put them into position to do their work.

346
00:21:04,730 --> 00:21:05,730
Unidentified: You are clear to continue and
increase the rate of your--.

347
00:21:05,730 --> 00:21:06,730
UNIDENTIFIED: --Yep.

348
00:21:06,730 --> 00:21:07,730
You can increase the rate, Megan.

349
00:21:07,730 --> 00:21:08,730
MCARTHUR: Copy, picking up the rate.

350

00:21:08,730 --> 00:21:11,030
Unidentified Man: Oh, what a beautiful view.

351
00:21:11,030 --> 00:21:19,710
MCARTHUR: They'd ask me to bring them in closer
or move them by the telescope.

352
00:21:19,710 --> 00:21:23,240
I'd have to ask them, "Hey, you need to check
and verify how much space do I have."

353
00:21:23,240 --> 00:21:26,570
And of course, their mind is on their job,
the instrument that they're holding, the tools,

354
00:21:26,570 --> 00:21:27,570
whatever.

355
00:21:27,570 --> 00:21:30,539
And so, having to work that coordination,
training really helps there.

356
00:21:30,539 --> 00:21:34,370
But, it is--it's delicate in the sense of
you don't want to hurt the hardware, you don't

357
00:21:34,370 --> 00:21:36,330
want to hurt the person, and you certainly
don't want to hurt the telescope.

358
00:21:36,330 --> 00:21:38,600
Unidentified Man: Okay, you can stop there,
Megan.

359
00:21:38,600 --> 00:21:39,740
MCARTHUR: Motion stopped, check.

360
00:21:39,740 --> 00:21:40,870
Unidentified Man: Thank you.

361
00:21:40,870 --> 00:21:45,370
GOOD: It was 19 years old at the time when
we went up there, and the batteries were original

362
00:21:45,370 --> 00:21:46,480
equipment.

363
00:21:46,480 --> 00:21:50,399
And so, they're charging and discharging,
you know, like your--think about your phone,

364
00:21:50,399 --> 00:21:51,399
your cell phone.

365
00:21:51,399 --> 00:21:54,039
You know, you're lucky to get a year or two
out of that battery, right?

366
00:21:54,039 --> 00:21:57,380
So, this is original batteries, so we replaced
the batteries.

367
00:21:57,380 --> 00:21:58,539
Those are still working great.

368
00:21:58,539 --> 00:22:03,870
But, then some of the more interesting parts
were actually replacing some of the science

369
00:22:03,870 --> 00:22:04,870
instruments.

370
00:22:04,870 --> 00:22:09,429
So, we took up a new camera and a new spectrograph
and put those in.

371
00:22:09,429 --> 00:22:12,330
And then, we also fixed some broken instruments
up there.

372
00:22:12,330 --> 00:22:15,210
There was a broken camera and a broken spectrograph.

373
00:22:15,210 --> 00:22:18,850
These are the science instruments so that
when the light comes in the telescope, these

374
00:22:18,850 --> 00:22:23,910
are the things that take the pictures and
do all the science for the--you know, for

375
00:22:23,910 --> 00:22:24,910
the astronomers and everybody back here on
Earth.

376
00:22:24,910 --> 00:22:30,450
JOHNSON: The breaking off of one of the hand
tools that Massimino--Mike Massimino had to

377
00:22:30,450 --> 00:22:31,450
do.

378
00:22:31,450 --> 00:22:32,450
Unidentified Man: Houston, you ready for this?

379
00:22:32,450 --> 00:22:33,450
Unidentified Man: Go.

380
00:22:33,450 --> 00:22:34,450
We're ready.

381
00:22:34,450 --> 00:22:35,450
Unidentified Man: Okay, Mass, you have a go.

382
00:22:35,450 --> 00:22:36,450
MASSIMINO: Here we go.

383

00:22:36,450 --> 00:22:38,410
It's off.

384
00:22:38,410 --> 00:22:41,550
Disposal bag, please?

385
00:22:41,550 --> 00:22:48,860
JOHNSON: It was pretty exciting watching that
from inside, 'cause that had a lot of bearing

386
00:22:48,860 --> 00:22:51,720
on whether we got that part of the mission
accomplished.

387
00:22:51,720 --> 00:22:52,970
So, it was pretty interesting.

388
00:22:52,970 --> 00:22:54,860
GRUNSFELD: A third time I got to go back.

389
00:22:54,860 --> 00:23:01,110
And, you know, I just can't tell you how thrilled
I was and how thrilled I was that we had a

390
00:23:01,110 --> 00:23:05,350
great team and we were able to leave the Hubble
in even better shape, such that now we're

391
00:23:05,350 --> 00:23:08,370
able to celebrate the 25th anniversary.

392
00:23:08,370 --> 00:23:12,769
I was a little bit worried that when we deployed
the Hubble, you know, I'd feel really sad

393
00:23:12,769 --> 00:23:14,759
again, but this time I didn't.

394
00:23:14,759 --> 00:23:18,389

I just felt thrilled that we hadn't broken
the Hubble, that we'd upgraded it, that it

395
00:23:18,389 --> 00:23:22,690
was in the best shape of its life, and that
we'd done our job and a little bit more to

396
00:23:22,690 --> 00:23:28,120
give Hubble a very long life, bringing back
all of its rewards to us here on planet Earth

397
00:23:28,120 --> 00:23:29,470
in terms of great discoveries.

398
00:23:29,470 --> 00:23:35,330
STRAUGHN: The fact that astronauts were able
to go up and fix Hubble was really a groundbreaking

399
00:23:35,330 --> 00:23:36,330
thing.

400
00:23:36,330 --> 00:23:41,580
And it tells a really critical part of NASA's
history, when science and human space exploration

401
00:23:41,580 --> 00:23:44,120
worked together really critically for the
first time.

402
00:23:44,120 --> 00:23:50,930
SEMBACH: Without the repair missions, you
wouldn't have Hubble lasting 25 years.

403
00:23:50,930 --> 00:23:53,510
Hubble's best days are still to come.

404
00:23:53,510 --> 00:23:57,279
NARRATOR: Astronauts and support staff on
the ground had made tremendous improvements

405
00:23:57,279 --> 00:24:00,480
to Hubble's already majestic payload.

406
00:24:00,480 --> 00:24:05,940
With the repairs completed, Hubble blew the
world away with what it saw and what we now

407
00:24:05,940 --> 00:24:13,740
could behold: sharp, clean, and crisp data,
images of stars forming, and Ultra Deep Field

408
00:24:13,740 --> 00:24:19,529
images of thousands of galaxies showing just
a glimpse at how big this universe is.

409
00:24:19,529 --> 00:24:22,049
MASSIMINO: I do have a favorite Hubble image.

410
00:24:22,049 --> 00:24:27,429
I have a couple of them, but the one that
pops into my mind is the Cone Nebula.

411
00:24:27,429 --> 00:24:32,080
And it is an early release image, and the
reason I like that is because it showed that

412
00:24:32,080 --> 00:24:35,200
we installed the advanced camera for surveys
correctly.

413
00:24:35,200 --> 00:24:41,210
JOHNSON: Hubble has brought just knowledge
of the universe that I think is beyond belief

414
00:24:41,210 --> 00:24:42,899
to the normal person.

415
00:24:42,899 --> 00:24:48,690
And some of the discoveries of the Hubble

Space Telescope in terms of the universe expanding

416
00:24:48,690 --> 00:24:50,409
are just mindboggling.

417
00:24:50,409 --> 00:24:56,509
FLANAGAN: Every time I look at it, I stare
and I stare and I want to see what's in that

418
00:24:56,509 --> 00:24:58,860
finger, you know, what's in that pillar?

419
00:24:58,860 --> 00:25:03,779
And interestingly, if you look at it in the
infrared, you can actually see into it.

420
00:25:03,779 --> 00:25:06,809
STRAUGHN: The Hubble Ultra Deep Field was
released in 2004 when I was in grad school.

421
00:25:06,809 --> 00:25:12,559
And to this day, I really remember the day
when that image came out.

422
00:25:12,559 --> 00:25:18,399
My grad advisor printed this image, this beautiful
image with galaxies that we'd never seen before

423
00:25:18,399 --> 00:25:22,529
on a huge sheet of paper and rolled it out
on the table for us grad students to look

424
00:25:22,529 --> 00:25:24,879
at, and just said, you know, "Look at this
image.

425
00:25:24,879 --> 00:25:25,970
Look what's here.

426

00:25:25,970 --> 00:25:28,179
What can we learn from this?"

427
00:25:28,179 --> 00:25:33,360
And so, I really loved that visual, sort of
tangible representation of look at this beautiful

428
00:25:33,360 --> 00:25:34,870
thing and what can we learn.

429
00:25:34,870 --> 00:25:40,130
NARRATOR: Circling the globe at five miles
per second, this school bus sized observatory

430
00:25:40,130 --> 00:25:45,760
was the most technologically advanced device
ever launched, and has stayed amazingly advanced

431
00:25:45,760 --> 00:25:50,870
through five repair and upgrade missions,
from the first mission critical optics repair

432
00:25:50,870 --> 00:25:58,289
on Space Shuttle mission STS-61 to the last
servicing mission, STS-125, which added the

433
00:25:58,289 --> 00:26:04,129
wide field camera three and replaced or improved
sensors, batteries, and numerous other components.

434
00:26:04,129 --> 00:26:07,610
BOLDEN: The Hubble was an incredible undertaking.

435
00:26:07,610 --> 00:26:13,909
If I look at the very last Hubble servicing
mission, STS-125, it was perhaps the most

436
00:26:13,909 --> 00:26:18,659
ambitious single mission that this agency
has ever undertaken.

437
00:26:18,659 --> 00:26:24,309
It was five spacewalks back to back to back
to back to back.

438
00:26:24,309 --> 00:26:28,950
That's no break in between the spacewalks
like we normally will do.

439
00:26:28,950 --> 00:26:34,570
The magnitude of the things that they wanted
to accomplish almost meant certain failure

440
00:26:34,570 --> 00:26:35,570
somewhere.

441
00:26:35,570 --> 00:26:39,370
But, the crew said--the crew and the whole
team, the team that put the mission together

442
00:26:39,370 --> 00:26:41,019
said, "Look, we can do this.

443
00:26:41,019 --> 00:26:45,779
You know, we will have accomplished so much
more in making Hubble better than it is ever

444
00:26:45,779 --> 00:26:46,999
believed to be."

445
00:26:46,999 --> 00:26:53,929
So, Hubble gave us an excellent example of
people, a team, that was not afraid of failure.

446
00:26:53,929 --> 00:26:55,889
SCOLESE: Failure was not an option.

447
00:26:55,889 --> 00:26:57,590
We were going to succeed.

448
00:26:57,590 --> 00:27:01,509
GRUNSFELD: What's really exciting to me is
just the breadth of the scientific discoveries

449
00:27:01,509 --> 00:27:06,240
it's been able to make, everything from the
age of the universe to proving the existence

450
00:27:06,240 --> 00:27:12,330
of black holes to discovering brand new things
like the universe is accelerating due to mysterious

451
00:27:12,330 --> 00:27:13,330
dark energy.

452
00:27:13,330 --> 00:27:17,260
TYSON: I grew up, telescopes put into orbit
wouldn't last more than three, at most five

453
00:27:17,260 --> 00:27:18,260
years.

454
00:27:18,260 --> 00:27:25,480
So, they never had a chance to grow on you,
to become part of your soul of expectation

455
00:27:25,480 --> 00:27:28,110
for the next astronomical discovery.

456
00:27:28,110 --> 00:27:35,090
With Hubble, the fact--I think the fact that
it was repairable meant it could just stay

457
00:27:35,090 --> 00:27:39,410
with you for decades, now 25 years.

458
00:27:39,410 --> 00:27:41,600
GARCIA: Everybody knows Hubble.

459
00:27:41,600 --> 00:27:43,179
It's really true.

460
00:27:43,179 --> 00:27:48,669
Worldwide, all throughout the US, everybody,
all ages, all walks of life, you say Hubble

461
00:27:48,669 --> 00:27:52,070
Space Telescope, people know what you're talking
about.

462
00:27:52,070 --> 00:27:53,070
That's extraordinary.

463
00:27:53,070 --> 00:27:58,350
NARRATOR: More than a simple telescope, Hubble
is humanity's grand observatory of the vastness

464
00:27:58,350 --> 00:27:59,870
of space.

465
00:27:59,870 --> 00:28:03,960
And we've kept exploring by staring into the
universe and moving forward.

466
00:28:03,960 --> 00:28:07,789
STRAUGHN: The great thing about Hubble now,
this year, is that it's still going strong.

467
00:28:07,789 --> 00:28:11,919
And we expect it to last out 'til 2020, maybe
even longer.

468
00:28:11,919 --> 00:28:14,519
But, we definitely have to start thinking
about the future.

469
00:28:14,519 --> 00:28:19,230

And NASA right now is building and putting together and testing the James Webb Space

470
00:28:19,230 --> 00:28:20,230
Telescope.

471
00:28:20,230 --> 00:28:24,090
MASSIMINO: That's going to be put even further away from the Earth than Hubble, and be able

472
00:28:24,090 --> 00:28:29,370
to see much further into the universe and provide even more information and even better

473
00:28:29,370 --> 00:28:30,370
images.

474
00:28:30,370 --> 00:28:32,980
I think that's going to be very exciting when we get that into space.

475
00:28:32,980 --> 00:28:38,230
NARRATOR:: The team here at NASA will continue that momentum with the next great observatory

476
00:28:38,230 --> 00:28:44,779
coming soon to the NASA inventory, the James Webb Space Telescope, with a primary mirror

477
00:28:44,779 --> 00:28:48,840
six times larger than Hubble's and over a hundred times more powerful.

478
00:28:48,840 --> 00:28:52,350
GRUNSFELD: There are places that the Hubble just can't see.

479
00:28:52,350 --> 00:28:58,179
The Hubble Space Telescope can't see inside the dark cocoons of dust and gas where baby

480
00:28:58,179 --> 00:29:01,659
stars are born and planets form.

481
00:29:01,659 --> 00:29:05,559
The James Webb Space Telescope and the infrared
will be able to peer into those cocoons and

482
00:29:05,559 --> 00:29:09,160
show us the details of those first moments
of star and planet formation.

483
00:29:09,160 --> 00:29:14,070
ALTMAN: The big thing is how exciting space
is for the future.

484
00:29:14,070 --> 00:29:15,580
It's going to be incredible.

485
00:29:15,580 --> 00:29:21,710
We're at the cusp of a new era with new machines
being designed, new missions being flown.

486
00:29:21,710 --> 00:29:27,039
We are going to visit other planets, and I'm--I
just hope that young people can get excited

487
00:29:27,039 --> 00:29:29,009
about taking us that next step.

488
00:29:29,009 --> 00:29:31,169
I can't wait to watch them do it.

489
00:29:31,169 --> 00:29:32,179
It's a great time.

490
00:29:32,179 --> 00:29:37,710
JOHNSON: Growth in space; for kids that are
involved in science and technology, I think

491
00:29:37,710 --> 00:29:42,029
space is a great way to aim your career at.

492
00:29:42,029 --> 00:29:44,230
I think we're going to discover new things.

493
00:29:44,230 --> 00:29:49,010
I'm really excited that NASA's got a number
of programs going, including the James Webb

494
00:29:49,010 --> 00:29:53,179
Telescope, which'll bring the same kind of
discoveries Hubble has.

495
00:29:53,179 --> 00:29:55,080
So, the future's pretty bright.

496
00:29:55,080 --> 00:30:00,169
NARRATOR: Today Hubble is still making new
discoveries, seeing distant stars and galaxies

497
00:30:00,169 --> 00:30:05,590
that have never been seen before, improving
our knowledge of the early universe, and clarifying

498
00:30:05,590 --> 00:30:07,409
images of our closest neighbors.

499
00:30:07,409 --> 00:30:08,830
CEPOLLINA: Look at the Washington Post.

500
00:30:08,830 --> 00:30:14,009
On the front page of the Washington Post there
is a colored picture of a brand new galaxy

501
00:30:14,009 --> 00:30:15,730
just discovered by Hubble.

502
00:30:15,730 --> 00:30:22,010
And to be able to look at that picture and
say, "My gosh, we did that," that's exciting.

503
00:30:22,010 --> 00:30:23,010
That's exciting.

504
00:30:23,010 --> 00:30:33,190
TYSON: Hubble has consistently taken us to
places we've never been visually, of course,

505
00:30:33,190 --> 00:30:38,990
and given--and empowered us to answer questions
that, in a previous generation of telescopes,

506
00:30:38,990 --> 00:30:40,940
we couldn't even pose.

507
00:30:40,940 --> 00:30:47,000
NARRATOR:: From comets and asteroids to some
of the most distant galaxies yet discovered,

508
00:30:47,000 --> 00:30:52,059
Hubble continues to revolutionize astronomy
in our solar system and beyond.

509
00:30:52,059 --> 00:30:56,090
Hubble has changed the way we view our universe
and ourselves.

510
00:30:56,090 --> 00:30:59,941
STRAUGHN: There is no doubt that the Hubble
Space Telescope has changed the way that we

511
00:30:59,941 --> 00:31:02,169
as astronomers understand the universe.

512
00:31:02,169 --> 00:31:06,909
But, I think even more significantly than

that, Hubble's changed the way that the world

513
00:31:06,909 --> 00:31:07,909
views space.

514
00:31:07,909 --> 00:31:11,549
WEILER: You know, when you look back on the last 25 years of Hubble, it's just incredible

515
00:31:11,549 --> 00:31:19,389
because we have made major breakthroughs in almost every field of astrophysics, from planetary

516
00:31:19,389 --> 00:31:24,690
nearby to our own galaxy to the very, very beginning of time.

517
00:31:24,690 --> 00:31:32,279
And to think that we mere humans are sitting here and getting close to understanding this

518
00:31:32,279 --> 00:31:37,679
incredible universe that's around us, and Hubble has been a key component in that over

519
00:31:37,679 --> 00:31:38,740
the last 25 years.

520
00:31:38,740 --> 00:31:40,419
NARRATOR: We're on a never-ending journey.

521
00:31:40,419 --> 00:31:45,779
And the Hubble Space Telescope celebrates its quarter century of exploration as part