1
00:00:26,150 --> 00:00:24,790
this is our crew patch and here's the

2
00:00:28,150 --> 00:00:26,160
patch on

3
00:00:30,710 --> 00:00:28,160
the cake they make us traditionally at

4
00:00:32,150 --> 00:00:30,720
our last meal on earth before we go

5
00:00:33,590 --> 00:00:32,160
into space

6
00:00:35,270 --> 00:00:33,600
we usually get cranked up about three

7
00:00:37,830 --> 00:00:35,280
hours prior we had a really relaxed

8
00:00:39,750 --> 00:00:37,840
schedule this flow uh we woke up about

9
00:00:42,229 --> 00:00:39,760
nine or ten o'clock in the morning and

10
00:00:44,310 --> 00:00:42,239
we're going to launch at 9 48 at night

11
00:00:46,869 --> 00:00:44,320
the first picture was of me in the suit

12
00:00:48,869 --> 00:00:46,879
up room here's our pilot joe edwards

13
00:00:50,630 --> 00:00:48,879

payload commander bonnie dunbar who also

14
00:00:52,069 --> 00:00:50,640
served as mission specialist number

15
00:00:53,510 --> 00:00:52,079
three

16
00:00:57,110 --> 00:00:53,520
jim reilly

17
00:00:57,120 --> 00:01:02,950
mike anderson ms number two

18
00:01:08,550 --> 00:01:05,030
andy thomas our long duration crew

19
00:01:13,270 --> 00:01:11,350
salazan sharypov our russian cosmonaut

20
00:01:14,390 --> 00:01:13,280
who served as one of our mission

21
00:01:16,149 --> 00:01:14,400
specialists

22
00:01:17,030 --> 00:01:16,159
here's the walk out to the orbiter again

23
00:01:18,469 --> 00:01:17,040
we

24
00:01:24,710 --> 00:01:18,479
walk out and get strapped into the

25
00:01:28,070 --> 00:01:26,230
angie's

26
00:01:30,310 --> 00:01:28,080
yeah this is what greets us on our way

27
00:01:32,550 --> 00:01:30,320
out to the pad

28
00:01:35,030 --> 00:01:32,560
and it's simply spectacular

29
00:01:36,950 --> 00:01:35,040
uh the main engines light about 6.6

30
00:01:39,510 --> 00:01:36,960
seconds prior to liftoff the computers

31
00:01:41,350 --> 00:01:39,520
check them out if they're all okay

32
00:01:42,950 --> 00:01:41,360
then the solids are given the command of

33
00:01:44,710 --> 00:01:42,960
fire

34
00:01:46,230 --> 00:01:44,720
that was the twang

35
00:01:48,389 --> 00:01:46,240
the whole ascent takes about eight and a

36
00:01:49,190 --> 00:01:48,399
half minutes and the first two minutes

37
00:01:50,950 --> 00:01:49,200
you're

38
00:01:52,710 --> 00:01:50,960

getting most your thrust out of the two

39
00:01:55,429 --> 00:01:52,720
side rocket boosters as you can see so

40
00:01:58,630 --> 00:01:55,439
clearly there the vehicle shakes quite a

41
00:02:00,630 --> 00:01:58,640
bit under the solids

42
00:02:02,789 --> 00:02:00,640
and together the three main engines and

43
00:02:06,389 --> 00:02:02,799
the two sods put out around seven

44
00:02:09,430 --> 00:02:07,990
the vehicle itself weighs about four and

45
00:02:10,949 --> 00:02:09,440
a half million pounds when we leave the

46
00:02:12,630 --> 00:02:10,959
pad

47
00:02:15,750 --> 00:02:12,640
now here's a good picture of the sod

48
00:02:17,430 --> 00:02:15,760
rockets coming off the orbiter

49
00:02:19,670 --> 00:02:17,440
and again once that happens then you've

50
00:02:20,830 --> 00:02:19,680
got about six more minutes uh

51
00:02:22,470 --> 00:02:20,840
before you get to

52
00:02:25,430 --> 00:02:22,480
orbit

53
00:02:26,790 --> 00:02:25,440
there's a view inside the cockpit

54
00:02:27,670 --> 00:02:26,800
all the shaking the main engines just

55
00:02:31,430 --> 00:02:27,680
lit

56
00:02:33,670 --> 00:02:31,440
again about six seconds prior to liftoff

57
00:02:35,750 --> 00:02:33,680
then the big flash from the sod rocket

58
00:02:37,270 --> 00:02:35,760
plume and

59
00:02:40,150 --> 00:02:37,280
little more severe shaking comes from

60
00:02:41,589 --> 00:02:40,160
the side rockets

61
00:02:43,270 --> 00:02:41,599
if you look carefully at our windows

62
00:02:46,949 --> 00:02:43,280
you'll see a cloud layer that we went

63
00:02:52,150 --> 00:02:50,229

here come the clouds

64
00:02:55,430 --> 00:02:52,160
and again the flash was from the

65
00:02:57,190 --> 00:02:55,440
reflection off of our own rocket plume

66
00:02:58,790 --> 00:02:57,200
then one more flash this is a real

67
00:03:00,949 --> 00:02:58,800
attention getter when the sod rockets

68
00:03:04,550 --> 00:03:00,959
come off and a lot of debris goes past

69
00:03:07,509 --> 00:03:05,910
for the next six and a half minutes we

70
00:03:09,830 --> 00:03:07,519
ride on the main engines and that's when

71
00:03:11,430 --> 00:03:09,840
we get most of our orbital velocity

72
00:03:14,070 --> 00:03:11,440
uh once we get in space we open up the

73
00:03:16,229 --> 00:03:14,080
payload bay doors

74
00:03:18,869 --> 00:03:16,239
we start turning our rocket ship into a

75
00:03:21,110 --> 00:03:18,879
laboratory

76
00:03:22,149 --> 00:03:21,120
this exposes the pale bay to the vacuum

77
00:03:24,070 --> 00:03:22,159
of space

78
00:03:25,430 --> 00:03:24,080
and also lets us glimpse

79
00:03:27,830 --> 00:03:25,440
earth out the back windows of the

80
00:03:29,350 --> 00:03:27,840
orbiter

81
00:03:31,830 --> 00:03:29,360
back in the payload you can see the

82
00:03:33,430 --> 00:03:31,840
space laboratory in the back and there

83
00:03:34,470 --> 00:03:33,440
are several experiments in the payload

84
00:03:36,869 --> 00:03:34,480
bay

85
00:03:38,550 --> 00:03:36,879
we had 23 science and technology

86
00:03:40,470 --> 00:03:38,560
experiments distributed throughout the

87
00:03:41,990 --> 00:03:40,480
shuttle all operated by different

88
00:03:44,309 --> 00:03:42,000

members of the crew

89
00:03:45,910 --> 00:03:44,319
back here in the space hab we had both

90
00:03:47,589 --> 00:03:45,920
science and technology experiments as

91
00:03:49,670 --> 00:03:47,599
well as all of the cargo that would be

92
00:03:51,430 --> 00:03:49,680
eventually transferred back and forth to

93
00:03:53,350 --> 00:03:51,440
the mirror of course we had many mission

94
00:03:55,990 --> 00:03:53,360
objectives our primary one was to

95
00:03:58,149 --> 00:03:56,000
exchange the crew members uh andy thomas

96
00:04:00,390 --> 00:03:58,159
and dave wolf and along with that the

97
00:04:03,830 --> 00:04:00,400
cargo that you can see shown here

98
00:04:06,149 --> 00:04:03,840
the space hub is a multi-uh disciplinary

99
00:04:08,470 --> 00:04:06,159
objective type of pressurized cargo

100
00:04:10,390 --> 00:04:08,480
holder we can perform experiments from

101
00:04:12,390 --> 00:04:10,400
around the world in it in this

102
00:04:14,470 --> 00:04:12,400
particular scene

103
00:04:16,069 --> 00:04:14,480
i'm setting up a radiation experiment

104
00:04:18,469 --> 00:04:16,079
from japan called the real-time

105
00:04:20,710 --> 00:04:18,479
radiation monitor that actually looks at

106
00:04:22,870 --> 00:04:20,720
the radiation that we're exposed to in

107
00:04:25,189 --> 00:04:22,880
an anomaly in the earth's magnetic field

108
00:04:27,189 --> 00:04:25,199
called the south atlantic anomaly this

109
00:04:29,590 --> 00:04:27,199
is part of it called the detector unit

110
00:04:32,310 --> 00:04:29,600
also had some biospecimens on it that

111
00:04:33,990 --> 00:04:32,320
looked at the effect of radiation on

112
00:04:36,550 --> 00:04:34,000
regeneration

113
00:04:38,310 --> 00:04:36,560

over on the right those spheres are part

114
00:04:40,710 --> 00:04:38,320
of another radiation experiment here

115
00:04:42,390 --> 00:04:40,720
we're using materials of different

116
00:04:44,150 --> 00:04:42,400
thicknesses to shield

117
00:04:46,390 --> 00:04:44,160
from the radiation determining what the

118
00:04:48,790 --> 00:04:46,400
best materials are to be used in future

119
00:04:49,909 --> 00:04:48,800
space station and exploration vehicle

120
00:04:51,749 --> 00:04:49,919
design

121
00:04:53,830 --> 00:04:51,759
on the flight deck this digital camera

122
00:04:55,670 --> 00:04:53,840
pointed out over the window and was

123
00:04:57,670 --> 00:04:55,680
connected to a computer which students

124
00:04:59,350 --> 00:04:57,680
from across the country commanded to to

125
00:05:01,670 --> 00:04:59,360
take pictures of the earth

126
00:05:03,909 --> 00:05:01,680
we also used a computer a laptop to look

127
00:05:06,629 --> 00:05:03,919
at our human performance or reflexes in

128
00:05:08,070 --> 00:05:06,639
space as a function of the environment

129
00:05:09,590 --> 00:05:08,080
in addition to things that we looked at

130
00:05:10,950 --> 00:05:09,600
in space we did look at things on the

131
00:05:13,110 --> 00:05:10,960
ground with some of our palettes in this

132
00:05:14,790 --> 00:05:13,120
case the mechanics of granular materials

133
00:05:15,830 --> 00:05:14,800
was actually looking at what happens in

134
00:05:17,749 --> 00:05:15,840
soils

135
00:05:20,310 --> 00:05:17,759
in earthquake and landslide terrains

136
00:05:22,790 --> 00:05:20,320
where soils can fail by modeling these

137
00:05:24,390 --> 00:05:22,800
features on on orbit we are able to take

138
00:05:26,070 --> 00:05:24,400

advantage of the lack of gravity which

139
00:05:27,510 --> 00:05:26,080
overprints most of the forces so we're

140
00:05:29,670 --> 00:05:27,520
able to look at the small forces that

141
00:05:31,830 --> 00:05:29,680
work in these systems

142
00:05:33,670 --> 00:05:31,840
well on flight day three

143
00:05:35,749 --> 00:05:33,680
we got set up and started doing the

144
00:05:36,790 --> 00:05:35,759
rendezvous the rendezvous actually began

145
00:05:39,590 --> 00:05:36,800
with our

146
00:05:40,870 --> 00:05:39,600
our launch and we basically chase the

147
00:05:42,950 --> 00:05:40,880
the mirror around the earth till we

148
00:05:44,710 --> 00:05:42,960
catch up through a series of burns

149
00:05:47,350 --> 00:05:44,720
this depicts the way we rendezvous with

150
00:05:48,870 --> 00:05:47,360
mirror we come up from below and we try

151
00:05:50,310 --> 00:05:48,880
to position ourselves to stay within the

152
00:05:52,070 --> 00:05:50,320
green corridor

153
00:05:53,270 --> 00:05:52,080
this is the view from the of the orbiter

154
00:05:56,310 --> 00:05:53,280
from mir

155
00:06:01,670 --> 00:05:56,320
and you can see clearly some jets firing

156
00:06:06,390 --> 00:06:03,749
again a view out the top window

157
00:06:08,550 --> 00:06:06,400
we rendezvoused at night and this works

158
00:06:10,150 --> 00:06:08,560
out to be a lot better for visibility we

159
00:06:12,550 --> 00:06:10,160
use cameras and

160
00:06:14,629 --> 00:06:12,560
sun glaring off parts of the mirror can

161
00:06:16,870 --> 00:06:14,639
make our cameras bloom

162
00:06:18,870 --> 00:06:16,880
this is dave's view

163
00:06:20,390 --> 00:06:18,880

it's a real pleasure watching you guys

164
00:06:23,350 --> 00:06:20,400
come out of the sky

165
00:06:25,270 --> 00:06:23,360
and the actual docking itself

166
00:06:27,189 --> 00:06:25,280
couldn't even feel it from inside

167
00:06:29,029 --> 00:06:27,199
all right and this is the view out the

168
00:06:31,510 --> 00:06:29,039
back window and as mike has said

169
00:06:33,350 --> 00:06:31,520
previously uh there's no view quite like

170
00:06:36,150 --> 00:06:33,360
looking at a space station and the earth

171
00:06:38,390 --> 00:06:36,160
attached to the orbiter

172
00:06:40,309 --> 00:06:38,400
this is a view through the hatches into

173
00:06:41,830 --> 00:06:40,319
mirror and you can kind of see some

174
00:06:44,870 --> 00:06:41,840
anticipation there on the part of

175
00:06:49,110 --> 00:06:47,189
some regret and some happiness when that

176
00:06:51,029 --> 00:06:49,120
hatch opens

177
00:06:53,110 --> 00:06:51,039
the hatch opening it's a russian

178
00:06:55,189 --> 00:06:53,120
superstition not to shake hands across

179
00:06:57,749 --> 00:06:55,199
the hatch it brings you bad luck across

180
00:07:00,070 --> 00:06:57,759
the threshold so i'm going to pull the

181
00:07:04,150 --> 00:07:00,080
russian commander anatoly into the space

182
00:07:09,350 --> 00:07:07,189
it's really quite emotional to

183
00:07:12,309 --> 00:07:09,360
rendezvous and doc and see friends at

184
00:07:14,390 --> 00:07:12,319
such a remote outpost

185
00:07:23,830 --> 00:07:14,400
and that's anatoly the russian mirror

186
00:07:30,629 --> 00:07:26,710
here's pavel the russian board engineer

187
00:07:34,390 --> 00:07:32,070
this is the man who remembers where

188
00:07:36,469 --> 00:07:34,400

everything is in the whole station

189
00:07:38,230 --> 00:07:36,479
these two really know how to live in

190
00:07:40,309 --> 00:07:38,240
space

191
00:07:43,270 --> 00:07:40,319
anatoly is one of the most experienced

192
00:07:45,110 --> 00:07:43,280
uh space travelers in the world

193
00:07:47,670 --> 00:07:45,120
it's interesting anatoly was also

194
00:07:50,070 --> 00:07:47,680
bonnie's uh commander when she was in

195
00:07:52,870 --> 00:07:50,080
star city training

196
00:07:55,430 --> 00:07:52,880
we spent about 13 months at one point in

197
00:07:57,270 --> 00:07:55,440
1994

198
00:07:59,670 --> 00:07:57,280
and then dave

199
00:08:04,629 --> 00:07:59,680
we've got him back on american soil good

200
00:08:09,110 --> 00:08:06,390
and the first thing we do is get

201
00:08:11,189 --> 00:08:09,120
together for a meal we have something to

202
00:08:13,110 --> 00:08:11,199
eat with the russians exchange a few

203
00:08:16,150 --> 00:08:13,120
gifts before we get

204
00:08:17,510 --> 00:08:16,160
settled down to work

205
00:08:19,510 --> 00:08:17,520
here we are

206
00:08:21,670 --> 00:08:19,520
in the crestal module

207
00:08:23,749 --> 00:08:21,680
and you see the air hoses that provide

208
00:08:25,510 --> 00:08:23,759
ventilation very important in zero

209
00:08:27,909 --> 00:08:25,520
gravity not to have dead spots and we

210
00:08:29,350 --> 00:08:27,919
can reroute these hoses as necessary to

211
00:08:30,869 --> 00:08:29,360
change the air flow

212
00:08:32,790 --> 00:08:30,879
depending where the hot and cold spots

213
00:08:34,310 --> 00:08:32,800

are in the vehicle that's a yellow

214
00:08:36,149 --> 00:08:34,320
oxygen tank you just saw on the left

215
00:08:38,550 --> 00:08:36,159
there's a space suit on the right this

216
00:08:41,589 --> 00:08:38,560
is a storage area and you can see that

217
00:08:43,670 --> 00:08:41,599
we have to transfer all the 9000 items

218
00:08:45,750 --> 00:08:43,680
down this corridor to get into the rest

219
00:08:47,350 --> 00:08:45,760
of the mirror space station

220
00:08:50,230 --> 00:08:47,360
it's not very wide there's the area i

221
00:08:52,070 --> 00:08:50,240
slept in above we pull ourselves with

222
00:08:55,190 --> 00:08:52,080
sets of these bungees you see that black

223
00:08:56,710 --> 00:08:55,200
bungee on the top so we have prepared

224
00:08:58,150 --> 00:08:56,720
this area before the shuttle docking

225
00:09:00,710 --> 00:08:58,160
cleared it it's actually much more

226
00:09:02,710 --> 00:09:00,720
crowded than this during actual life

227
00:09:04,550 --> 00:09:02,720
storage lockers on the left panels on

228
00:09:06,710 --> 00:09:04,560
the right there are systems

229
00:09:08,230 --> 00:09:06,720
and storage behind all these panels

230
00:09:10,150 --> 00:09:08,240
there's the treadmill above that's

231
00:09:11,670 --> 00:09:10,160
really the floor you might say we were

232
00:09:13,509 --> 00:09:11,680
upside down

233
00:09:15,430 --> 00:09:13,519
we're approaching the dot the node the

234
00:09:18,150 --> 00:09:15,440
main node to which all the modules six

235
00:09:19,430 --> 00:09:18,160
main sections of the station station are

236
00:09:21,190 --> 00:09:19,440
attached

237
00:09:23,990 --> 00:09:21,200
now we're turning

238
00:09:26,150 --> 00:09:24,000

literally turning rolling into the base

239
00:09:28,070 --> 00:09:26,160
block these modules are attached so

240
00:09:30,310 --> 00:09:28,080
orientation is not necessarily the same

241
00:09:32,230 --> 00:09:30,320
in each module and there's andy and

242
00:09:33,910 --> 00:09:32,240
we're spending our time

243
00:09:35,990 --> 00:09:33,920
transferring information and making sure

244
00:09:37,509 --> 00:09:36,000
he knows where things are and giving him

245
00:09:39,670 --> 00:09:37,519
the tips i've learned in four and a half

246
00:09:41,430 --> 00:09:39,680
months in space

247
00:09:44,070 --> 00:09:41,440
and here we've turned to the parota

248
00:09:45,910 --> 00:09:44,080
module it's our main laboratory it's

249
00:09:49,030 --> 00:09:45,920
mostly packed up at this point i'd spent

250
00:09:50,630 --> 00:09:49,040
the last two to three weeks

251
00:09:52,550 --> 00:09:50,640
packing up items

252
00:09:54,470 --> 00:09:52,560
so uh

253
00:09:57,110 --> 00:09:54,480
final preparations there's the computer

254
00:09:59,590 --> 00:09:57,120
very important as you were many purposes

255
00:10:02,949 --> 00:09:59,600
for a laptop on orbit including watching

256
00:10:04,470 --> 00:10:02,959
videos which i had some not much time to

257
00:10:06,230 --> 00:10:04,480
watch

258
00:10:08,070 --> 00:10:06,240
but they were interesting as uh they

259
00:10:11,190 --> 00:10:08,080
were they impacted me strongly as an

260
00:10:12,870 --> 00:10:11,200
attachment to earth somehow the movies

261
00:10:14,870 --> 00:10:12,880
seemed very important

262
00:10:16,310 --> 00:10:14,880
dave was there inventorying the

263
00:10:18,069 --> 00:10:16,320

materials and equipment that he's taken

264
00:10:20,310 --> 00:10:18,079
back to earth and here he's brought some

265
00:10:21,269 --> 00:10:20,320
of the stuff to space have on the

266
00:10:22,870 --> 00:10:21,279
orbiter

267
00:10:24,790 --> 00:10:22,880
and we transferred approximately nine

268
00:10:26,470 --> 00:10:24,800
thousand pounds of

269
00:10:27,829 --> 00:10:26,480
equipment which covered all of dave's

270
00:10:29,030 --> 00:10:27,839
equipment plus all the stuff andy was

271
00:10:31,910 --> 00:10:29,040
going to be using for the next four

272
00:10:33,110 --> 00:10:31,920
months that was approximately 1400 items

273
00:10:35,030 --> 00:10:33,120
all told

274
00:10:37,350 --> 00:10:35,040
in zero g you have the advantage of

275
00:10:39,829 --> 00:10:37,360
being able to maneuver and carry

276
00:10:41,750 --> 00:10:39,839
the items just about any way you want as

277
00:10:43,509 --> 00:10:41,760
terry was showing here and one of the

278
00:10:45,190 --> 00:10:43,519
people who really helped out here was

279
00:10:47,829 --> 00:10:45,200
saljan sharifah

280
00:10:49,030 --> 00:10:47,839
our cosmonaut who was part of our crew

281
00:10:50,630 --> 00:10:49,040
his knowledge of the mirror was

282
00:10:51,829 --> 00:10:50,640
invaluable on being able to transfer all

283
00:10:53,350 --> 00:10:51,839
that material

284
00:10:54,870 --> 00:10:53,360
and even at the height of transfer when

285
00:10:56,790 --> 00:10:54,880
we had stuff temp sewed all over the

286
00:10:59,350 --> 00:10:56,800
space hub we were still able to operate

287
00:11:00,389 --> 00:10:59,360
as both a as a freighter and as a

288
00:11:01,750 --> 00:11:00,399

laboratory

289
00:11:03,910 --> 00:11:01,760
this is a

290
00:11:07,430 --> 00:11:03,920
module quantum you see some of the

291
00:11:09,910 --> 00:11:07,440
deliberate things this is jaradan there

292
00:11:11,110 --> 00:11:09,920
are about 15 on station

293
00:11:14,550 --> 00:11:11,120
that used for

294
00:11:15,550 --> 00:11:14,560
latitude control this is our

295
00:11:18,230 --> 00:11:15,560
pressure

296
00:11:21,030 --> 00:11:18,240
pressurization unit

297
00:11:23,110 --> 00:11:21,040
this is a bioreactor and many medical

298
00:11:24,630 --> 00:11:23,120
discoveries will will be made in space

299
00:11:26,310 --> 00:11:24,640
that can't be made on the ground here

300
00:11:28,230 --> 00:11:26,320
we're growing three-dimensional cancer

301
00:11:30,230 --> 00:11:28,240
tissue breast cancer in a way it can't

302
00:11:32,710 --> 00:11:30,240
be grown on the ground and this is a

303
00:11:35,030 --> 00:11:32,720
great tool for cancer research

304
00:11:36,949 --> 00:11:35,040
well this is a microgravity laboratory

305
00:11:38,870 --> 00:11:36,959
and i'm way back in the back there but

306
00:11:40,310 --> 00:11:38,880
working on this technology experiment

307
00:11:42,630 --> 00:11:40,320
that is going to be used for space

308
00:11:45,110 --> 00:11:42,640
station looking at contaminants in our

309
00:11:47,269 --> 00:11:45,120
air about 23 different compounds has a

310
00:11:48,790 --> 00:11:47,279
lot of technological applications to the

311
00:11:50,710 --> 00:11:48,800
ground as well

312
00:11:52,790 --> 00:11:50,720
we also carried the first telemedicine

313
00:11:54,870 --> 00:11:52,800

instrument instrumentation package to

314
00:11:56,470 --> 00:11:54,880
orbit which allows doctors on the ground

315
00:11:58,949 --> 00:11:56,480
to monitor

316
00:12:00,790 --> 00:11:58,959
crew members for instance here

317
00:12:02,630 --> 00:12:00,800
terry's looking at my eye he was taking

318
00:12:04,790 --> 00:12:02,640
my blood pressure earlier we can send

319
00:12:07,030 --> 00:12:04,800
ekgs or heart monitoring data to the

320
00:12:09,110 --> 00:12:07,040
ground it's also being used as a remote

321
00:12:10,470 --> 00:12:09,120
package in rural areas across the united

322
00:12:12,150 --> 00:12:10,480
states

323
00:12:14,150 --> 00:12:12,160
well as they say all good things have to

324
00:12:16,389 --> 00:12:14,160
come to an end and after five days of

325
00:12:17,990 --> 00:12:16,399
docked operations we

326
00:12:19,910 --> 00:12:18,000
exchange the traditional gifts instead

327
00:12:22,310 --> 00:12:19,920
of goodbyes

328
00:12:24,310 --> 00:12:22,320
terry and mike here prepare to close the

329
00:12:29,509 --> 00:12:24,320
hatches anatoly closes the hatch on the

330
00:12:37,269 --> 00:12:32,069
followed by our closing of the hatch on

331
00:12:41,509 --> 00:12:39,190
we undocked and this view is from the

332
00:12:43,430 --> 00:12:41,519
payload bay from one of the payload bay

333
00:12:44,790 --> 00:12:43,440
cameras you can see the two docking

334
00:12:47,030 --> 00:12:44,800
adapters

335
00:12:49,509 --> 00:12:47,040
separating there

336
00:12:51,590 --> 00:12:49,519
and then the next scene is the view that

337
00:12:53,269 --> 00:12:51,600
we had from the orbiter

338
00:12:54,870 --> 00:12:53,279

through our centerline camera and

339
00:12:57,190 --> 00:12:54,880
through the overhead window you can see

340
00:12:58,949 --> 00:12:57,200
the docking target there that we use to

341
00:13:00,550 --> 00:12:58,959
align the vehicles during docking and

342
00:13:02,069 --> 00:13:00,560
during undocking

343
00:13:03,829 --> 00:13:02,079
it looks nice and peaceful in those

344
00:13:04,710 --> 00:13:03,839
pictures but it's a flurry of activity

345
00:13:06,870 --> 00:13:04,720
on the

346
00:13:09,030 --> 00:13:06,880
flight deck as we

347
00:13:11,670 --> 00:13:09,040
take a look at the attitude of mir and

348
00:13:13,430 --> 00:13:11,680
the attitude of the orbiter position and

349
00:13:15,110 --> 00:13:13,440
adjust the relative velocity between the

350
00:13:16,310 --> 00:13:15,120
vehicles

351
00:13:21,110 --> 00:13:16,320
you can see the view here that the

352
00:13:25,750 --> 00:13:22,790
as we backed away from there we moved to

353
00:13:27,829 --> 00:13:25,760
a position about 240 feet below them

354
00:13:30,710 --> 00:13:27,839
so that we could fly around the mirror

355
00:13:32,870 --> 00:13:30,720
to do a photographic survey

356
00:13:35,509 --> 00:13:32,880
taking still photography and the video

357
00:13:38,389 --> 00:13:35,519
that you see here

358
00:13:40,389 --> 00:13:38,399
and as beautiful as this scene is it

359
00:13:42,310 --> 00:13:40,399
frankly just doesn't compare with the

360
00:13:44,069 --> 00:13:42,320
view that we had there looking out the

361
00:13:45,910 --> 00:13:44,079
overhead windows seeing this beautiful

362
00:13:47,750 --> 00:13:45,920
spacecraft

363
00:13:53,509 --> 00:13:47,760

slicing through the horizon of the earth

364
00:13:57,269 --> 00:13:55,030
on the right side of this picture you

365
00:13:58,710 --> 00:13:57,279
can see the parodium or the spectre

366
00:14:00,629 --> 00:13:58,720
module which is the module that was

367
00:14:02,949 --> 00:14:00,639
damaged in the collision you can't quite

368
00:14:04,790 --> 00:14:02,959
see the damage to the solar ray

369
00:14:07,269 --> 00:14:04,800
in this view

370
00:14:08,949 --> 00:14:07,279
but in the next view i believe you can

371
00:14:10,710 --> 00:14:08,959
you can't see the soyuz spacecraft at

372
00:14:12,230 --> 00:14:10,720
the bottom of the node there the black

373
00:14:13,750 --> 00:14:12,240
and gray

374
00:14:17,670 --> 00:14:13,760
spacecraft that's

375
00:14:21,350 --> 00:14:17,680
doctor mir and used by the cosmonauts to

376
00:14:23,750 --> 00:14:21,360
to rendezvous and dock and for entry

377
00:14:26,629 --> 00:14:23,760
and in the case of an emergency escape

378
00:14:28,389 --> 00:14:26,639
it's comforting to know it's there

379
00:14:30,310 --> 00:14:28,399
as we continued our flower around

380
00:14:31,829 --> 00:14:30,320
through our last 90 degrees or so this

381
00:14:34,230 --> 00:14:31,839
is the picture that you would have seen

382
00:14:37,030 --> 00:14:34,240
from mir had you been there with us and

383
00:14:39,509 --> 00:14:37,040
we're prepared to do our separation burn

384
00:14:40,629 --> 00:14:39,519
to move away from here enter a different

385
00:14:42,230 --> 00:14:40,639
orbit and

386
00:14:43,670 --> 00:14:42,240
continue our preparations for coming

387
00:14:45,430 --> 00:14:43,680
home

388
00:14:47,350 --> 00:14:45,440

in this view in the middle you can see

389
00:14:49,430 --> 00:14:47,360
the in the middle of the spacecraft the

390
00:14:51,829 --> 00:14:49,440
space station you can see the node

391
00:14:54,470 --> 00:14:51,839
and above that is the parota module and

392
00:14:56,710 --> 00:14:54,480
below that is the

393
00:14:59,990 --> 00:14:56,720
crystal and the docking module in orange

394
00:15:02,310 --> 00:15:00,000
down below it to the left of the node is

395
00:15:05,670 --> 00:15:02,320
covant 2 and to the right of the node is

396
00:15:07,269 --> 00:15:05,680
the spectre module and if you look from

397
00:15:08,629 --> 00:15:07,279
left to right the first array that you

398
00:15:10,870 --> 00:15:08,639
see on top there is a ray that was

399
00:15:14,310 --> 00:15:10,880
damaged in the collision

400
00:15:15,670 --> 00:15:14,320
and the last view here is from mir as we

401
00:15:17,509 --> 00:15:15,680
burn to

402
00:15:19,990 --> 00:15:17,519
enter a new orbit and you can actually

403
00:15:22,710 --> 00:15:20,000
see the uh could see the lights of

404
00:15:24,150 --> 00:15:22,720
cities below the earth in the picture

405
00:15:26,230 --> 00:15:24,160
as big as that looks our new

406
00:15:28,069 --> 00:15:26,240
international space station will be

407
00:15:30,870 --> 00:15:28,079
three times as much volume inside and

408
00:15:32,550 --> 00:15:30,880
increase our science productivity

409
00:15:34,069 --> 00:15:32,560
after we left the mirror it was back to

410
00:15:35,750 --> 00:15:34,079
science this is a canadian built

411
00:15:37,350 --> 00:15:35,760
experiment called orbiter space vision

412
00:15:38,949 --> 00:15:37,360
system i'm going to use this to build

413
00:15:40,550 --> 00:15:38,959

the international space station actually

414
00:15:42,870 --> 00:15:40,560
uses the orbiter's cameras sort of like

415
00:15:44,389 --> 00:15:42,880
electronic eyes to help determine the

416
00:15:46,069 --> 00:15:44,399
exact position and orientation of

417
00:15:47,990 --> 00:15:46,079
grappled payloads

418
00:15:49,509 --> 00:15:48,000
we carried four gas cans or gateway

419
00:15:51,590 --> 00:15:49,519
specials on board

420
00:15:53,430 --> 00:15:51,600
two from germany one from the university

421
00:15:55,430 --> 00:15:53,440
of michigan and one from the chinese

422
00:15:56,710 --> 00:15:55,440
academy of science

423
00:15:58,629 --> 00:15:56,720
this is how you take your weight in

424
00:16:00,550 --> 00:15:58,639
space this device takes advantage of

425
00:16:02,790 --> 00:16:00,560
newton's second law of motion actually

426
00:16:03,990 --> 00:16:02,800
allows an astronaut to measure his mass

427
00:16:05,509 --> 00:16:04,000
it's going to be important for long

428
00:16:07,670 --> 00:16:05,519
duration space flight members who want

429
00:16:11,030 --> 00:16:07,680
to keep a close track of their health

430
00:16:13,269 --> 00:16:11,040
and fitness you know i lost 20 pounds

431
00:16:14,710 --> 00:16:13,279
we don't know why exactly

432
00:16:16,710 --> 00:16:14,720
this is another experiment that we flew

433
00:16:18,629 --> 00:16:16,720
up there called cebus this was a closed

434
00:16:21,269 --> 00:16:18,639
aquatic ecosystem and aboard this

435
00:16:26,310 --> 00:16:21,279
aquarium we had over 200 sore tail fish

436
00:16:29,350 --> 00:16:27,829
here's salazan taking a few brief

437
00:16:31,829 --> 00:16:29,360
moments to look at the earth out of one

438
00:16:33,990 --> 00:16:31,839

of the many viewports

439
00:16:35,749 --> 00:16:34,000
we have to use our timer wisely up there

440
00:16:37,829 --> 00:16:35,759
nine days without gravity takes a toll

441
00:16:40,550 --> 00:16:37,839
on your legs so it's important for us to

442
00:16:42,629 --> 00:16:40,560
exercise keep in shape

443
00:16:44,310 --> 00:16:42,639
the shadow provides a great platform to

444
00:16:45,509 --> 00:16:44,320
view the earth here you see terry using

445
00:16:49,670 --> 00:16:45,519
some of our cameras to take some

446
00:16:53,430 --> 00:16:51,509
we below a lot of computers on board the

447
00:16:55,350 --> 00:16:53,440
shuttle and we use them for a variety of

448
00:16:57,590 --> 00:16:55,360
things here you see joe typing out an

449
00:16:58,949 --> 00:16:57,600
email message to his wife back home he's

450
00:17:04,069 --> 00:16:58,959
actually on the ceiling of the orbiter

451
00:17:07,590 --> 00:17:05,750
first time space fliers just cannot

452
00:17:09,510 --> 00:17:07,600
resist playing with their food

453
00:17:13,270 --> 00:17:09,520
you see joe using a bunch of m ms to

454
00:17:15,990 --> 00:17:14,630
strawberry drink can be used to

455
00:17:18,470 --> 00:17:16,000
demonstrate some pretty advanced

456
00:17:19,829 --> 00:17:18,480
principles of fluid physics

457
00:17:21,829 --> 00:17:19,839
you know in the absence of gravity

458
00:17:24,150 --> 00:17:21,839
surface tension alone is enough to keep

459
00:17:25,590 --> 00:17:24,160
a fluid in a perfect sphere

460
00:17:27,270 --> 00:17:25,600
if you blow on it you can cause it to

461
00:17:34,150 --> 00:17:27,280
wiggle but it still stays together

462
00:17:36,630 --> 00:17:35,430
of course the best part about an

463
00:17:47,750 --> 00:17:36,640

experiment like this is when you're all

464
00:17:50,950 --> 00:17:49,110
but when we were finished with all the

465
00:17:52,870 --> 00:17:50,960
science we put everything away and

466
00:17:54,230 --> 00:17:52,880
closed up the space hab and prepared to

467
00:17:55,270 --> 00:17:54,240
come home

468
00:17:56,870 --> 00:17:55,280
just like when we went up there we

469
00:17:58,950 --> 00:17:56,880
opened up the payload bay doors now it's

470
00:18:00,470 --> 00:17:58,960
time to close the payload bay doors we

471
00:18:03,110 --> 00:18:00,480
get our final good view of the earth

472
00:18:04,390 --> 00:18:03,120
below and get ready to say goodbye you

473
00:18:05,750 --> 00:18:04,400
know we sort of do this with mixed

474
00:18:07,909 --> 00:18:05,760
emotions we're

475
00:18:09,190 --> 00:18:07,919
kind of sad to go home and and leave

476
00:18:10,630 --> 00:18:09,200
space we've had a really wonderful

477
00:18:12,710 --> 00:18:10,640
mission had a great time up there and

478
00:18:14,070 --> 00:18:12,720
really enjoyed doing what we did

479
00:18:15,990 --> 00:18:14,080
but at the same time i think everyone

480
00:18:17,430 --> 00:18:16,000
was sort of eager to get home and share

481
00:18:19,110 --> 00:18:17,440
this experience with their family and

482
00:18:20,310 --> 00:18:19,120
friends and their loved ones and really

483
00:18:28,789 --> 00:18:20,320
tell them what it was like up there in

484
00:18:32,470 --> 00:18:30,870
this is a view over my right shoulder in

485
00:18:34,230 --> 00:18:32,480
the commander seat during entry you can

486
00:18:36,950 --> 00:18:34,240
see the earth down below south to the

487
00:18:41,990 --> 00:18:39,190
we go from 25 times the speed of sound

488
00:18:43,270 --> 00:18:42,000

or about 17 500 miles an hour down to a

489
00:18:46,150 --> 00:18:43,280
landing speed

490
00:18:48,070 --> 00:18:46,160
of around 230 miles an hour

491
00:18:50,870 --> 00:18:48,080
we usually overfly the landing runway

492
00:18:53,270 --> 00:18:50,880
and then descend in a left turn down to

493
00:18:55,590 --> 00:18:53,280
line up with the runway to touch down

494
00:18:59,029 --> 00:18:55,600
our descent path is about six times

495
00:19:00,950 --> 00:18:59,039
steeper than a commercial airliners and

496
00:19:02,390 --> 00:19:00,960
again we're decelerating the entire

497
00:19:08,150 --> 00:19:02,400
direction here we are in the left turn

498
00:19:11,669 --> 00:19:10,230
on final doing about 300 knots you'll

499
00:19:13,510 --> 00:19:11,679
see the heads-up view here in just a

500
00:19:14,870 --> 00:19:13,520
moment yeah here's a view out the

501
00:19:17,430 --> 00:19:14,880
pilot's window

502
00:19:19,750 --> 00:19:17,440
and it gives you all your descent glide

503
00:19:22,470 --> 00:19:19,760
path your airspeed your altitude we're

504
00:19:24,310 --> 00:19:22,480
doing almost 300 knots going through 11

505
00:19:25,430 --> 00:19:24,320
000 feet and you can see the runway

506
00:19:26,870 --> 00:19:25,440
overlay

507
00:19:28,310 --> 00:19:26,880
well this view really gives you an

508
00:19:29,669 --> 00:19:28,320
appreciation of how quickly we're

509
00:19:31,510 --> 00:19:29,679
descending

510
00:19:35,510 --> 00:19:31,520
and about 2000 feet we pick up the nose

511
00:19:39,190 --> 00:19:37,909
the pilot joe put the gear down at 300

512
00:19:47,029 --> 00:19:39,200
feet

513
00:19:50,230 --> 00:19:48,870

view out the back

514
00:19:51,669 --> 00:19:50,240
if you look carefully you can see some

515
00:19:55,350 --> 00:19:51,679
of the smoke from the tires get caught

516
00:20:02,630 --> 00:19:59,190
touchdown's around 210 miles an hour

517
00:20:03,909 --> 00:20:02,640
shoot gets deployed at about 200.

518
00:20:05,510 --> 00:20:03,919
even though the runway is over three

519
00:20:06,950 --> 00:20:05,520
miles long it's nice to have something

520
00:20:11,029 --> 00:20:06,960
like that drags you to bring you to a

521
00:20:13,909 --> 00:20:12,549
you continue to roll out and then you'll

522
00:20:19,430 --> 00:20:13,919
see in jettison

523
00:20:23,510 --> 00:20:21,029
when that hatch was open the smell of

524
00:20:26,630 --> 00:20:23,520
that grass was almost overwhelming after

525
00:20:29,350 --> 00:20:26,640
four and a half months of processed air

526
00:20:31,110 --> 00:20:29,360
and then after 138 orbits and 3.6

527
00:20:32,870 --> 00:20:31,120
million miles in a little over nine days

528
00:20:42,310 --> 00:20:32,880
it would come to a wheel stop and terry