



1  
00:00:27,689 --> 00:00:24,120  
throughout America's involvement in

2  
00:00:31,409 --> 00:00:27,699  
space exploration the importance of the

3  
00:00:34,850 --> 00:00:31,419  
human element has become clear the human

4  
00:00:37,890 --> 00:00:34,860  
beings ability to reconfigure repair and

5  
00:00:40,079 --> 00:00:37,900  
in general to react to unforeseen

6  
00:00:42,810 --> 00:00:40,089  
experiment conditions is still

7  
00:00:46,710 --> 00:00:42,820  
unsurpassed by any existing automatic

8  
00:00:48,810 --> 00:00:46,720  
system with each spaceflight NASA

9  
00:00:51,149 --> 00:00:48,820  
astronauts have gathered a wealth of

10  
00:00:55,400 --> 00:00:51,159  
information and operational experience

11  
00:00:57,750 --> 00:00:55,410  
in a wide variety of scientific areas

12  
00:01:00,209 --> 00:00:57,760  
astronauts must understand both the

13  
00:01:03,479 --> 00:01:00,219

science and the capabilities and

14

00:01:06,510 --> 00:01:03,489

limitations of the spacecraft as a

15

00:01:08,760 --> 00:01:06,520

result science and operations have

16

00:01:31,790 --> 00:01:08,770

become intimately linked and should not

17

00:01:39,120 --> 00:01:35,340

today America's space shuttle provides

18

00:01:41,850 --> 00:01:39,130

continued access to near-earth space for

19

00:01:43,590 --> 00:01:41,860

science this vehicle is an excellent

20

00:01:45,810 --> 00:01:43,600

platform for research and

21

00:01:52,950 --> 00:01:45,820

experimentation in a multitude of

22

00:01:54,660 --> 00:01:52,960

disciplines scientists and engineers on

23

00:01:57,149 --> 00:01:54,670

the shuttle crew must actively

24

00:02:01,139 --> 00:01:57,159

participate in scientific planning and

25

00:02:03,870 --> 00:02:01,149

implementation not as mere operators but

26  
00:02:06,300 --> 00:02:03,880  
as frontline investigators who possess

27  
00:02:11,040 --> 00:02:06,310  
an optimum balance of scientific and

28  
00:02:12,660 --> 00:02:11,050  
operational knowledge six of these crew

29  
00:02:15,090 --> 00:02:12,670  
members are part of the astronaut

30  
00:02:18,600 --> 00:02:15,100  
offices newly created science support

31  
00:02:20,850 --> 00:02:18,610  
group their objective is to aid future

32  
00:02:22,979 --> 00:02:20,860  
scientists and payload designers in

33  
00:02:25,050 --> 00:02:22,989  
perfecting their flight hard work in

34  
00:02:27,620 --> 00:02:25,060  
order to profit more bullying from the

35  
00:02:33,949 --> 00:02:27,630  
human capabilities of the shuttle crew

36  
00:02:39,690 --> 00:02:37,140  
space shuttle is a unique laboratory and

37  
00:02:41,970 --> 00:02:39,700  
platform for example it allows us to

38  
00:02:43,920 --> 00:02:41,980

study the effects of gravity on through

39

00:02:46,830 --> 00:02:43,930

behavior in place simply not possible

40

00:02:49,470 --> 00:02:46,840

from ground-based facilities it is much

41

00:02:51,780 --> 00:02:49,480

like a great experimental laboratories

42

00:02:54,090 --> 00:02:51,790

of the world hello my name is Bonnie

43

00:02:55,979 --> 00:02:54,100

Dunbar I'm a material scientist an

44

00:02:56,890 --> 00:02:55,989

engineer with a background in biomedical

45

00:03:00,100 --> 00:02:56,900

and canary

46

00:03:01,869 --> 00:03:00,110

in October of 1985 I who as a mission

47

00:03:03,880 --> 00:03:01,879

specialist on a space shuttle mission

48

00:03:06,850 --> 00:03:03,890

dedicated to material science and life

49

00:03:08,380 --> 00:03:06,860

time just as we hope the profits from

50

00:03:10,720 --> 00:03:08,390

the lessons learned and ground-based

51  
00:03:12,429 --> 00:03:10,730  
agility showing us profits from the

52  
00:03:15,250 --> 00:03:12,439  
insights and lessons learned of

53  
00:03:17,319 --> 00:03:15,260  
spaceflight missions the space shuttle

54  
00:03:19,599 --> 00:03:17,329  
contains three physical areas for

55  
00:03:22,479 --> 00:03:19,609  
scientific experiments and technology

56  
00:03:25,089 --> 00:03:22,489  
development the flight deck is the

57  
00:03:26,949 --> 00:03:25,099  
commanding spokesman of the orbiter from

58  
00:03:29,280 --> 00:03:26,959  
this position panels and displays

59  
00:03:31,599 --> 00:03:29,290  
control payloads in the payload a

60  
00:03:33,129 --> 00:03:31,609  
experiments on the mid-deck and in the

61  
00:03:36,129 --> 00:03:33,139  
spacelab are not controlling this

62  
00:03:38,140 --> 00:03:36,139  
position mid deck which was originally

63  
00:03:40,629 --> 00:03:38,150

designed at the living area for the crew

64

00:03:43,390 --> 00:03:40,639

has been utilized for Locker size

65

00:03:46,089 --> 00:03:43,400

experiments these require limited power

66

00:03:47,800 --> 00:03:46,099

from the orbiters the integration time

67

00:03:50,259 --> 00:03:47,810

maybe less for these experiments that

68

00:03:53,559 --> 00:03:50,269

they also must provide their own cooling

69

00:03:55,629 --> 00:03:53,569

sentence and data processing usual no

70

00:03:56,890 --> 00:03:55,639

down lease data is available so two

71

00:03:59,410 --> 00:03:56,900

members work closely to the

72

00:04:04,090 --> 00:03:59,420

experimenters from monitors hardware and

73

00:04:08,130 --> 00:04:06,220

the Space Lab is can only facility

74

00:04:11,440 --> 00:04:08,140

designed specifically to pressurize

75

00:04:13,350 --> 00:04:11,450

experimentation while a shuttle flight

76

00:04:16,270 --> 00:04:13,360

may carry only a few experiments

77

00:04:19,810 --> 00:04:16,280

Spacelab slides can carry up to as many

78

00:04:22,420 --> 00:04:19,820

as 100 they stop flights are dedicated

79

00:04:24,280 --> 00:04:22,430

primary payload if they fly up to 10

80

00:04:30,190 --> 00:04:24,290

days to keep working and shift

81

00:04:36,600 --> 00:04:32,050

from the moment that the lab was

82

00:04:38,770 --> 00:04:36,610

activated on SPF 50 1a it was clear

83

00:04:41,890 --> 00:04:38,780

investigators representing the more than

84

00:04:44,500 --> 00:04:41,900

100 experiments on board were anxiously

85

00:04:46,420 --> 00:04:44,510

awaiting the video down even if their

86

00:04:49,660 --> 00:04:46,430

experiments are completely automated in

87

00:04:51,370 --> 00:04:49,670

fact he be allowed the ground observe

88

00:04:53,530 --> 00:04:51,380

the activity for the speed so the

89

00:04:56,170 --> 00:04:53,540

communication between to be made to

90

00:04:59,080 --> 00:04:56,180

enhance the efficiency of activity not

91

00:05:00,880 --> 00:04:59,090

conceded the onboard procedures with

92

00:05:03,670 --> 00:05:00,890

very few in the three years training

93

00:05:05,530 --> 00:05:03,680

period extension however there were

94

00:05:07,930 --> 00:05:05,540

occasions where the ground scientists

95

00:05:09,940 --> 00:05:07,940

altered rivers new procedures based on

96

00:05:14,150 --> 00:05:09,950

preliminary results we observed by way

97

00:05:18,290 --> 00:05:16,490

the use of liquid fluid procurement

98

00:05:20,600 --> 00:05:18,300

whether they be low or high temperatures

99

00:05:23,240 --> 00:05:20,610

has not only builded value than the

100

00:05:26,630 --> 00:05:23,250

inside and too acidic but has presented

101  
00:05:28,460 --> 00:05:26,640  
design problems well many experiments

102  
00:05:30,830 --> 00:05:28,470  
and hardware have suffered from

103  
00:05:33,310 --> 00:05:30,840  
surprises 2g spectrum mrs. Weddington a

104  
00:05:35,240 --> 00:05:33,320  
guerilla marketing environment

105  
00:05:37,220 --> 00:05:35,250  
experimenters and liquids should be

106  
00:05:40,310 --> 00:05:37,230  
evaluated in ground-based facilities

107  
00:05:43,970 --> 00:05:40,320  
such as the kc-135 hero jean-eric aft

108  
00:05:46,130 --> 00:05:43,980  
car shuttle flights in addition it

109  
00:05:48,260 --> 00:05:46,140  
spills or inadvertent wedding occur in

110  
00:05:51,650 --> 00:05:48,270  
cleaning methods and internal access to

111  
00:05:53,210 --> 00:05:51,660  
the design developed prior to flight low

112  
00:05:55,790 --> 00:05:53,220  
viscosity liquids are more susceptible

113  
00:05:57,830 --> 00:05:55,800

to mechanical disturbances so

114

00:05:59,780 --> 00:05:57,840

restrictions to both true and orbiter

115

00:06:04,370 --> 00:05:59,790

motion should be articulated early in

116

00:06:06,500 --> 00:06:04,380

the flight planning process recent

117

00:06:08,420 --> 00:06:06,510

flight experience is also demonstrated

118

00:06:11,420 --> 00:06:08,430

that is more efficient cost-effective

119

00:06:14,600 --> 00:06:11,430

automate only when a process is secure

120

00:06:16,970 --> 00:06:14,610

for example on this slide the true

121

00:06:19,310 --> 00:06:16,980

routine rates change material samples in

122

00:06:21,440 --> 00:06:19,320

high-temperature furniture rather than

123

00:06:24,050 --> 00:06:21,450

rely and mechanized sample of changes

124

00:06:26,420 --> 00:06:24,060

this allowed alterations in the sample

125

00:06:28,450 --> 00:06:26,430

sequence and timelines change who

126

00:06:30,860 --> 00:06:28,460

sympathizes in flight leader

127

00:06:33,470 --> 00:06:30,870

additionally more samples process

128

00:06:36,790 --> 00:06:33,480

information to them present automated

129

00:06:41,840 --> 00:06:39,680

face lab has also allowed to use a glove

130

00:06:44,719 --> 00:06:41,850

boxes for handling contaminants such as

131

00:06:47,529 --> 00:06:44,729

transferring fixative and working with

132

00:06:49,430 --> 00:06:47,539

blood samples however as shown here

133

00:06:51,740 --> 00:06:49,440

conversation with the crews to be

134

00:06:54,200 --> 00:06:51,750

limited and two-handed operations are

135

00:06:59,629 --> 00:06:54,210

required true and must not interrupt

136

00:07:01,279 --> 00:06:59,639

operation in order to install in-flight

137

00:07:04,219 --> 00:07:01,289

maintenance has been an important part

138

00:07:06,020 --> 00:07:04,229

of science operations over forty percent

139

00:07:08,659 --> 00:07:06,030

of experiment hardware has failed in

140

00:07:11,300 --> 00:07:08,669

first flight most has been recovered

141

00:07:17,190 --> 00:07:11,310

who's who in events hardware should be

142

00:07:22,200 --> 00:07:20,280

I'm ra7 I'm a physician who first clue

143

00:07:25,260 --> 00:07:22,210

aboard the space shuttle discovery in

144

00:07:30,810 --> 00:07:25,270

April 1985 I have a particular interest

145

00:07:33,600 --> 00:07:30,820

in space life sciences any life sciences

146

00:07:37,140 --> 00:07:33,610

experiments require humans in space as

147

00:07:39,480 --> 00:07:37,150

operator subject observer scientists and

148

00:07:42,390 --> 00:07:39,490

repair man but it must be remembered

149

00:07:44,970 --> 00:07:42,400

that humans are not machines in this

150

00:07:47,610 --> 00:07:44,980

vestibular experiment changes in the

151

00:07:50,610 --> 00:07:47,620

perception of motion zero-gravity are

152

00:07:53,310 --> 00:07:50,620

being studied however the spinning chair

153

00:07:55,890 --> 00:07:53,320

may cause disorientation vertigo and

154

00:08:00,030 --> 00:07:55,900

motion sickness that may impact the next

155

00:08:01,770 --> 00:08:00,040

experiment the time-lock experiments

156

00:08:04,110 --> 00:08:01,780

must be integrated so they don't

157

00:08:09,540 --> 00:08:04,120

interfere with one another both Kapoor

158

00:08:11,250 --> 00:08:09,550

comfort and clean science return counter

159

00:08:13,280 --> 00:08:11,260

measures to maintain muscle and bone

160

00:08:16,200 --> 00:08:13,290

strength in space must be devised

161

00:08:18,270 --> 00:08:16,210

however exercise to the point of extreme

162

00:08:20,790 --> 00:08:18,280

fatigue may be great performance after

163

00:08:23,250 --> 00:08:20,800

its completion the proper rest periods

164

00:08:27,910 --> 00:08:23,260

are not allowed this is especially food

165

00:08:32,890 --> 00:08:30,820

in this vestibular experiment a crewman

166

00:08:35,500 --> 00:08:32,900

has taken the place of a machine to make

167

00:08:36,910 --> 00:08:35,510

motion inputs this may permit an

168

00:08:39,430 --> 00:08:36,920

experiment to be flown that would

169

00:08:42,460 --> 00:08:39,440

otherwise be too complex for costly to

170

00:08:44,950 --> 00:08:42,470

automate in addition it is much easier

171

00:08:47,110 --> 00:08:44,960

to ask a human for modify a protocol

172

00:08:49,870 --> 00:08:47,120

than to reprogram a machine that is

173

00:08:52,300 --> 00:08:49,880

orbiting the earth when a human is a

174

00:08:54,160 --> 00:08:52,310

subject as in this test of leg reflexes

175

00:08:56,950 --> 00:08:54,170

he or she may need to be heavily

176  
00:08:58,420 --> 00:08:56,960  
instrument who inputs early can help to

177  
00:09:01,690 --> 00:08:58,430  
integrate this equipment with other

178  
00:09:04,210 --> 00:09:01,700  
orbiter crew worn hardware flying

179  
00:09:05,380 --> 00:09:04,220  
animals in space promises to provide us

180  
00:09:07,780 --> 00:09:05,390  
with a great deal of information

181  
00:09:09,550 --> 00:09:07,790  
unobtainable and humans but

182  
00:09:14,110 --> 00:09:09,560  
accommodating animals is a new

183  
00:09:15,760 --> 00:09:14,120  
technology who people can be very

184  
00:09:19,120 --> 00:09:15,770  
helpful in this type of hardware

185  
00:09:21,400 --> 00:09:19,130  
development and pre-flight evaluation in

186  
00:09:24,250 --> 00:09:21,410  
flight observation and with on-the-spot

187  
00:09:26,200 --> 00:09:24,260  
repair if the crew is expected to be

188  
00:09:28,900 --> 00:09:26,210

caretakers for other living species

189

00:09:32,410 --> 00:09:28,910

their input into equipment design and

190

00:09:37,060 --> 00:09:34,900

plants are also intriguing for study in

191

00:09:39,579 --> 00:09:37,070

space to understand gravity receptor

192

00:09:41,829 --> 00:09:39,589

function but many of the plant or animal

193

00:09:43,569 --> 00:09:41,839

samples require fixation during the

194

00:09:46,360 --> 00:09:43,579

flight for later study on the ground

195

00:09:52,060 --> 00:09:46,370

however fixative the plant and animal

196

00:09:54,040 --> 00:09:52,070

tissues can also fix humans in this

197

00:09:57,340 --> 00:09:54,050

scene fixative is being transferred

198

00:09:59,710 --> 00:09:57,350

between two containers there are rules

199

00:10:02,259 --> 00:09:59,720

that chemicals such as formaldehyde must

200

00:10:04,420 --> 00:10:02,269

be triple contained so that if there are

201  
00:10:06,009 --> 00:10:04,430  
breaks in one or two of the containers

202  
00:10:08,860 --> 00:10:06,019  
the crew will not be exposed to the

203  
00:10:11,290 --> 00:10:08,870  
chemical this is especially important

204  
00:10:13,480 --> 00:10:11,300  
than zero g since materials tend to

205  
00:10:18,310 --> 00:10:13,490  
float around the cabin and may get into

206  
00:10:20,439 --> 00:10:18,320  
eyes will be inhaled or swallowed when

207  
00:10:23,139 --> 00:10:20,449  
humans are used as subjects sometimes

208  
00:10:25,150 --> 00:10:23,149  
sterilization of equipment is needed you

209  
00:10:27,819 --> 00:10:25,160  
can see the many small pieces that must

210  
00:10:30,790 --> 00:10:27,829  
be located in unwrapped and connected to

211  
00:10:32,319 --> 00:10:30,800  
do this blood place since sampling

212  
00:10:34,720 --> 00:10:32,329  
through blood is such an important

213  
00:10:37,030 --> 00:10:34,730

aspect of many life sciences experiments

214

00:10:40,360 --> 00:10:37,040

this hardware has evolved over time into

215

00:10:41,949 --> 00:10:40,370

a well-organized system however war

216

00:10:44,019 --> 00:10:41,959

could still be done to assemble

217

00:10:45,730 --> 00:10:44,029

component of free flight speed

218

00:10:48,460 --> 00:10:45,740

procedures and eliminate some of the

219

00:10:52,260 --> 00:10:48,470

sterile overlaps which generate a great

220

00:10:56,970 --> 00:10:54,900

it is possible to modify off-the-shelf

221

00:10:59,610 --> 00:10:56,980

medical diagnostic equipment such as

222

00:11:02,790 --> 00:10:59,620

this echocardiographic see so that it

223

00:11:05,190 --> 00:11:02,800

can fly in a locker on the river in this

224

00:11:07,830 --> 00:11:05,200

case crew input on hardware design and

225

00:11:09,930 --> 00:11:07,840

operations was solicited early in the

226

00:11:12,090 --> 00:11:09,940

design and contributed to a very

227

00:11:13,710 --> 00:11:12,100

successful flight which brought back

228

00:11:17,070 --> 00:11:13,720

some of the first pictures of the

229

00:11:19,710 --> 00:11:17,080

functioning human parking space so

230

00:11:22,380 --> 00:11:19,720

humans are vital not only as subjects

231

00:11:24,390 --> 00:11:22,390

but as scientists who can assist in

232

00:11:31,260 --> 00:11:24,400

experiment design and make direct

233

00:11:37,050 --> 00:11:34,680

hello I'm Jeff Hoffman my background is

234

00:11:39,060 --> 00:11:37,060

in astrophysics I'm going to talk to you

235

00:11:41,280 --> 00:11:39,070

about the great variety of experiments

236

00:11:42,990 --> 00:11:41,290

that we can do in the trouble or be and

237

00:11:46,590 --> 00:11:43,000

show you some of the equipment that you

238

00:11:48,540 --> 00:11:46,600

need to carry out though he found it is

239

00:11:50,100 --> 00:11:48,550

often possible to use run building

240

00:11:52,590 --> 00:11:50,110

equipment in case experiments

241

00:11:55,200 --> 00:11:52,600

introducing additional flexibility or

242

00:11:57,630 --> 00:11:55,210

allowing for late planning but it is

243

00:12:00,210 --> 00:11:57,640

important to make sure plan in advance

244

00:12:04,080 --> 00:12:00,220

where these wouldn't you be used and how

245

00:12:06,090 --> 00:12:04,090

it will be secure here is an example of

246

00:12:09,150 --> 00:12:06,100

an inexpensive but effective way one

247

00:12:11,430 --> 00:12:09,160

experiment disappear face white would be

248

00:12:14,250 --> 00:12:11,440

impossible without Bell cone Grape Ape

249

00:12:16,860 --> 00:12:14,260

this configuration is planned in the

250

00:12:21,960 --> 00:12:16,870

first several time prior to flight and

251  
00:12:23,550 --> 00:12:21,970  
the shuttle simulator in Houston PD is

252  
00:12:25,680 --> 00:12:23,560  
one of the most common methods of

253  
00:12:28,440 --> 00:12:25,690  
collecting visual data on experiments

254  
00:12:30,420 --> 00:12:28,450  
both the post-flight analysis and for

255  
00:12:33,690 --> 00:12:30,430  
real-time down Linkin to down base

256  
00:12:36,300 --> 00:12:33,700  
Thurman lighting is critical to obtain

257  
00:12:38,280 --> 00:12:36,310  
good results photographic and TV

258  
00:12:40,110 --> 00:12:38,290  
requirement to be playing barring

259  
00:12:41,610 --> 00:12:40,120  
advantage of the flight and should be

260  
00:12:44,400 --> 00:12:41,620  
rehearsed by the two working together

261  
00:12:46,350 --> 00:12:44,410  
with the experiment gun from space

262  
00:12:48,000 --> 00:12:46,360  
center person health and provide a lot

263  
00:12:50,990 --> 00:12:48,010

of support for its members we've not

264

00:12:53,100 --> 00:12:51,000

familiar with NASA's photographic system

265

00:12:55,830 --> 00:12:53,110

notice the things we take for granted

266

00:12:57,780 --> 00:12:55,840

and lurk like table blind lead me out of

267

00:12:59,970 --> 00:12:57,790

the way on the ground did not occur in

268

00:13:01,590 --> 00:12:59,980

weightlessness tables have a memory of

269

00:13:04,200 --> 00:13:01,600

their own and often get in the way of

270

00:13:05,940 --> 00:13:04,210

operations it is necessary to plan

271

00:13:09,000 --> 00:13:05,950

potato with strings and designing

272

00:13:11,790 --> 00:13:09,010

experiments notice also that would seem

273

00:13:13,530 --> 00:13:11,800

to be a fairly small experiment has by

274

00:13:15,180 --> 00:13:13,540

the time that is all set up the cameras

275

00:13:17,130 --> 00:13:15,190

and lighting taking over the entire

276

00:13:20,160 --> 00:13:17,140

subtle mid deck that has occupied the

277

00:13:21,780 --> 00:13:20,170

time of crew members never assume that

278

00:13:23,940 --> 00:13:21,790

an experiment is so simple that it

279

00:13:27,150 --> 00:13:23,950

carried out with no impact flight

280

00:13:32,440 --> 00:13:29,620

material science experiments are often

281

00:13:35,190 --> 00:13:32,450

sensitive to orbiter acceleration such

282

00:13:37,690 --> 00:13:35,200

as that caused by shuttle and inspiring

283

00:13:40,060 --> 00:13:37,700

objects inside the shuttle completing

284

00:13:42,820 --> 00:13:40,070

experimental apparatus must be secured

285

00:13:44,650 --> 00:13:42,830

before engine under the effects of

286

00:13:46,800 --> 00:13:44,660

engine firings on any experiments

287

00:13:49,510 --> 00:13:46,810

involving liquid are quite impressive

288

00:13:52,090 --> 00:13:49,520

similarly in the experiments requiring

289

00:13:54,430 --> 00:13:52,100

jetfire have an effect on crew members

290

00:13:56,620 --> 00:13:54,440

we may be trying to sleep clearly

291

00:13:58,780 --> 00:13:56,630

experimental operations can not be found

292

00:14:04,030 --> 00:13:58,790

without checking for compatibility the

293

00:14:06,430 --> 00:14:04,040

total mission carmel the shuttle at the

294

00:14:08,440 --> 00:14:06,440

capability of carrying out sophisticated

295

00:14:11,740 --> 00:14:08,450

observations of the sun and astronomical

296

00:14:14,170 --> 00:14:11,750

objects this infinite pointing system

297

00:14:16,300 --> 00:14:14,180

smoothes out the shuttled residual

298

00:14:19,570 --> 00:14:16,310

motion to provide arc second pointing

299

00:14:21,580 --> 00:14:19,580

stability even without the IPS fine

300

00:14:23,860 --> 00:14:21,590

astronomical photographs of course ha

301  
00:14:25,930 --> 00:14:23,870  
such high magnification have been

302  
00:14:31,030 --> 00:14:25,940  
obtained using time exposures with

303  
00:14:32,950 --> 00:14:31,040  
cameras hard-mounted to settle certain

304  
00:14:35,680 --> 00:14:32,960  
photographic equipment needs to be

305  
00:14:37,600 --> 00:14:35,690  
shielded from stray light several crew

306  
00:14:40,090 --> 00:14:37,610  
members have worked with NASA engineers

307  
00:14:42,310 --> 00:14:40,100  
to develop this camera hood it is a

308  
00:14:44,640 --> 00:14:42,320  
multi-purpose device and can be used for

309  
00:14:47,230 --> 00:14:44,650  
many light field and applications

310  
00:14:49,780 --> 00:14:47,240  
experimenters with special requirements

311  
00:14:53,410 --> 00:14:49,790  
to talk with two representatives to see

312  
00:14:58,570 --> 00:14:55,900  
the crew spends a lot of home taking out

313  
00:15:00,510 --> 00:14:58,580

the window photographs often these are

314

00:15:03,910 --> 00:15:00,520

used for scientific purposes

315

00:15:06,730 --> 00:15:03,920

oceanography geology and urology and

316

00:15:09,780 --> 00:15:06,740

ecology the proof can sometimes take

317

00:15:11,800 --> 00:15:09,790

pictures on request of certain areas

318

00:15:14,290 --> 00:15:11,810

scientists with potential earth

319

00:15:16,210 --> 00:15:14,300

photographic requirements that contact

320

00:15:18,430 --> 00:15:16,220

through representatives who can assist

321

00:15:20,170 --> 00:15:18,440

him in obtaining archival photos or

322

00:15:25,300 --> 00:15:20,180

perhaps in scheduling nude photography

323

00:15:26,920 --> 00:15:25,310

were appropriate this shot of a team

324

00:15:28,930 --> 00:15:26,930

member changing the role of movie film

325

00:15:30,910 --> 00:15:28,940

is a good reminder that although it may

326

00:15:33,910 --> 00:15:30,920

eventually be possible to automate many

327

00:15:35,200 --> 00:15:33,920

tasks in space laboratories this time it

328

00:15:38,350 --> 00:15:35,210

is often most efficient and

329

00:15:40,510 --> 00:15:38,360

cost-effective you people this applies

330

00:15:42,790 --> 00:15:40,520

to many areas of space investigations

331

00:15:45,070 --> 00:15:42,800

too many times experiments have been

332

00:15:46,630 --> 00:15:45,080

artificially limited in scope or invaded

333

00:15:48,550 --> 00:15:46,640

collection capability because

334

00:15:50,440 --> 00:15:48,560

experimenters did not realize the

335

00:15:53,470 --> 00:15:50,450

flexibility they could obtain by using

336

00:15:55,240 --> 00:15:53,480

human operators obviously crew time must

337

00:15:57,070 --> 00:15:55,250

be used efficiently and it is not

338

00:15:58,810 --> 00:15:57,080

normally make sense to ask a person

339

00:16:00,940 --> 00:15:58,820

could be repetitive tasks that a

340

00:16:03,610 --> 00:16:00,950

computer could do however when we

341

00:16:05,230 --> 00:16:03,620

participation is called for astronauts

342

00:16:07,780 --> 00:16:05,240

normally spend a lot of time with

343

00:16:11,319 --> 00:16:07,790

experiment is planning how best to carry

344

00:16:16,809 --> 00:16:13,509

here is an example of how astronauts

345

00:16:19,960 --> 00:16:16,819

participation in the potential failure

346

00:16:21,999 --> 00:16:19,970

is success this paper transport

347

00:16:23,889 --> 00:16:22,009

experiment is computer controlled and

348

00:16:25,929 --> 00:16:23,899

was designed to operate autonomously

349

00:16:28,389 --> 00:16:25,939

which is entirely appropriate under

350

00:16:30,669 --> 00:16:28,399

normal circumstances if you member

351  
00:16:32,259 --> 00:16:30,679  
assigned to carry out the expend spent a

352  
00:16:34,449 --> 00:16:32,269  
lot of time with the experiment who's

353  
00:16:35,769 --> 00:16:34,459  
during the last year before flight and

354  
00:16:38,829 --> 00:16:35,779  
together they developed a way of

355  
00:16:40,869 --> 00:16:38,839  
monitoring and possibly modifying this

356  
00:16:44,109 --> 00:16:40,879  
operation using the small controller

357  
00:16:46,269 --> 00:16:44,119  
visible here as often happens in space

358  
00:16:48,039 --> 00:16:46,279  
where there's no convective cooling the

359  
00:16:49,689 --> 00:16:48,049  
thermal environment was different from

360  
00:16:51,819 --> 00:16:49,699  
what had been calculated three flights

361  
00:16:54,129 --> 00:16:51,829  
and the automatic sequence would not

362  
00:16:56,259 --> 00:16:54,139  
work the crew member working together

363  
00:16:58,629 --> 00:16:56,269

with scientists from the ground using

364

00:17:00,340 --> 00:16:58,639

the controller is able to diagnose the

365

00:17:02,289 --> 00:17:00,350

problem and manually operate the

366

00:17:04,360 --> 00:17:02,299

apparatus this made the difference

367

00:17:09,819 --> 00:17:04,370

between a failed experiment will be no

368

00:17:11,710 --> 00:17:09,829

data success the crew members are going

369

00:17:13,000 --> 00:17:11,720

to operate equipment it is important to

370

00:17:16,210 --> 00:17:13,010

consider the effects of weightlessness

371

00:17:17,980 --> 00:17:16,220

and communion operations notice that the

372

00:17:19,990 --> 00:17:17,990

crew member is able to hold onto this

373

00:17:23,049 --> 00:17:20,000

apparatus by squeezing with legs around

374

00:17:25,389 --> 00:17:23,059

the sides this is perfectly acceptable

375

00:17:27,220 --> 00:17:25,399

in his circumstance and illustrates the

376

00:17:29,310 --> 00:17:27,230

novel ways people operate in space

377

00:17:32,350 --> 00:17:29,320

compared to when the earth however

378

00:17:34,840 --> 00:17:32,360

required operations took a long time his

379

00:17:39,090 --> 00:17:34,850

legs would become fatigued a better body

380

00:17:43,750 --> 00:17:41,230

interaction between scientists from the

381

00:17:46,539 --> 00:17:43,760

ground crew members in orbit be crucial

382

00:17:48,669 --> 00:17:46,549

for the success of many experiments here

383

00:17:50,740 --> 00:17:48,679

the onboard key member is examining the

384

00:17:53,769 --> 00:17:50,750

crystal grown during the Spacelab flight

385

00:17:55,690 --> 00:17:53,779

he sets up a shuttle TV camera to send

386

00:17:58,269 --> 00:17:55,700

pictures down to scientists on the

387

00:18:00,460 --> 00:17:58,279

ground the picture is available both on

388

00:18:02,470 --> 00:18:00,470

the ground and in the shuttle so the few

389

00:18:04,750 --> 00:18:02,480

members can discuss experimental results

390

00:18:06,580 --> 00:18:04,760

in proceedings scientists on the ground

391

00:18:10,389 --> 00:18:06,590

will both are looking at the singing

392

00:18:12,070 --> 00:18:10,399

beta here the ground-based scientists

393

00:18:13,840 --> 00:18:12,080

see the results of the crystal growing

394

00:18:16,269 --> 00:18:13,850

experiment almost as soon as the

395

00:18:18,610 --> 00:18:16,279

astronaut food they have far more time

396

00:18:20,560 --> 00:18:18,620

available between 140 and have no

397

00:18:22,509 --> 00:18:20,570

responsibilities for other experiments

398

00:18:24,009 --> 00:18:22,519

therefore for the two members are

399

00:18:26,019 --> 00:18:24,019

operating other experiments the

400

00:18:28,149 --> 00:18:26,029

scientists in the ground can proceed

401  
00:18:30,700 --> 00:18:28,159  
with detailed real-time analysis of

402  
00:18:32,500 --> 00:18:30,710  
their data this may be you can modify

403  
00:18:34,539 --> 00:18:32,510  
the protocol of subsequent flight

404  
00:18:40,060 --> 00:18:34,549  
experiment carried out later in the

405  
00:18:42,820 --> 00:18:40,070  
mission I'm Mary clue an environmental

406  
00:18:45,909 --> 00:18:42,830  
engineer and the RMS operator on 61 be

407  
00:18:47,710 --> 00:18:45,919  
the RMS remote manipulator system is a

408  
00:18:51,730 --> 00:18:47,720  
Tele robotic arm and the payload bay of

409  
00:18:53,440 --> 00:18:51,740  
the shuttle it is a valuable tool which

410  
00:18:58,299 --> 00:18:53,450  
has been used for many pre-planned and

411  
00:19:00,519 --> 00:18:58,309  
real time operations understanding

412  
00:19:02,769 --> 00:19:00,529  
unique operating capabilities and

413  
00:19:04,629 --> 00:19:02,779

limitations of this system before

414

00:19:09,490 --> 00:19:04,639

designing hardware that will interface

415

00:19:11,500 --> 00:19:09,500

with it cannot be stressed enough here

416

00:19:15,549 --> 00:19:11,510

we see a sink I'm satellite it didn't

417

00:19:17,379 --> 00:19:15,559

activate properly after deployment in an

418

00:19:19,570 --> 00:19:17,389

attempt to correct this problem the crew

419

00:19:21,940 --> 00:19:19,580

working with grand engineers is able to

420

00:19:24,159 --> 00:19:21,950

improvise using existing on board

421

00:19:26,490 --> 00:19:24,169

materials a special tool that could be

422

00:19:28,840 --> 00:19:26,500

attached to the RMS during a spacewalk

423

00:19:30,789 --> 00:19:28,850

this tool was used to catch the

424

00:19:35,139 --> 00:19:30,799

activation switch to ensure it had been

425

00:19:37,660 --> 00:19:35,149

hung we copy we estimate we got a hard

426

00:19:40,000 --> 00:19:37,670

physical contact or the bleep to attend

427

00:19:43,210 --> 00:19:40,010

and we concur with that that was a great

428

00:19:46,450 --> 00:19:43,220

job the RMS was designed to deploy our

429

00:19:48,370 --> 00:19:46,460

three foreign objects this free flying

430

00:19:50,080 --> 00:19:48,380

payload courier is supporting a mass

431

00:19:52,840 --> 00:19:50,090

spectrometer on to other optical

432

00:19:55,420 --> 00:19:52,850

scanners grapple fixtures should be

433

00:19:57,780 --> 00:19:55,430

placed on free flying experiments in

434

00:20:01,390 --> 00:19:57,790

case they may require on-orbit approval

435

00:20:04,210 --> 00:20:01,400

servicing and or repair and you can see

436

00:20:06,730 --> 00:20:04,220

if very smooth operation coming in at

437

00:20:10,590 --> 00:20:06,740

the RMS very easily control oh and that

438

00:20:13,660 --> 00:20:10,600

bothered self is very stable platform

439

00:20:15,940 --> 00:20:13,670

the RMS was also used as a mobile work

440

00:20:18,970 --> 00:20:15,950

cut from corfu man working outside of

441

00:20:21,820 --> 00:20:18,980

the shuttle you can see the crew man

442

00:20:24,130 --> 00:20:21,830

inside the cabin operating the RMS to

443

00:20:27,460 --> 00:20:24,140

position a space-suited crewman running

444

00:20:29,890 --> 00:20:27,470

a cable along a trust although the arm

445

00:20:31,930 --> 00:20:29,900

was not designed for this purpose this

446

00:20:34,150 --> 00:20:31,940

mode of operation because we're now

447

00:20:36,610 --> 00:20:34,160

positive and really increase the

448

00:20:42,790 --> 00:20:36,620

flexibility of operations in the payload

449

00:20:45,190 --> 00:20:42,800

bay and above it ready to go up here

450

00:20:46,990 --> 00:20:45,200

with the aid of Kelly robotics through

451  
00:20:48,760 --> 00:20:47,000  
rendezvous with a non-functional

452  
00:20:52,540 --> 00:20:48,770  
satellite prepared it and then

453  
00:20:54,490 --> 00:20:52,550  
redeployed it for this test we use the

454  
00:20:56,650 --> 00:20:54,500  
arm to position a crewman to manually

455  
00:20:58,930 --> 00:20:56,660  
spin up and deploy the satellite after

456  
00:21:01,150 --> 00:20:58,940  
the crew had repaired it although a

457  
00:21:04,960 --> 00:21:01,160  
contingency operation this deployment

458  
00:21:10,270 --> 00:21:07,390  
the RMS can also be used positioned

459  
00:21:11,980 --> 00:21:10,280  
larger structures here a large trust is

460  
00:21:14,860 --> 00:21:11,990  
being manipulated to define how

461  
00:21:17,020 --> 00:21:14,870  
manageable a task like this is this

462  
00:21:19,960 --> 00:21:17,030  
experiment also highlights the benefits

463  
00:21:21,669 --> 00:21:19,970

of man manipulator interaction this

464

00:21:23,890 --> 00:21:21,679

information is important to construction

465

00:21:28,630 --> 00:21:23,900

casts on Space Station and other future

466

00:21:30,700 --> 00:21:28,640

projects we have also used the arm

467

00:21:32,560 --> 00:21:30,710

through damage satellites in conjunction

468

00:21:36,940 --> 00:21:32,570

with replying crewmen on the manned

469

00:21:38,799 --> 00:21:36,950

maneuvering unit this Kelly robotic

470

00:21:41,289 --> 00:21:38,809

system can be used in both planned or

471

00:21:43,149 --> 00:21:41,299

contingency operations of experiments

472

00:21:45,310 --> 00:21:43,159

outside of the shuttle much more

473

00:21:50,970 --> 00:21:45,320

effectively if proper considerations are

474

00:21:56,130 --> 00:21:53,130

hi I'm Jerry Ross I'm going to talk to

475

00:21:58,320 --> 00:21:56,140

you about space walks or EDA I have

476  
00:21:59,970 --> 00:21:58,330  
worked various aspects of ETA almost

477  
00:22:03,060 --> 00:21:59,980  
ever since the shuttle first flew in

478  
00:22:06,330 --> 00:22:03,070  
fact I perform tevs myself on this test

479  
00:22:11,100 --> 00:22:06,340  
51 be in 1985 to investigate space

480  
00:22:12,780 --> 00:22:11,110  
construction techniques EBA provides

481  
00:22:15,060 --> 00:22:12,790  
unique capabilities for operating

482  
00:22:17,120 --> 00:22:15,070  
servicing fixing or assembling

483  
00:22:19,770 --> 00:22:17,130  
spacecraft and experimental hardware

484  
00:22:21,720 --> 00:22:19,780  
many uva's have already been conducted

485  
00:22:25,080 --> 00:22:21,730  
on space shuttle mission utilizing these

486  
00:22:26,520 --> 00:22:25,090  
capabilities several future satellites

487  
00:22:29,010 --> 00:22:26,530  
are being designed for on-orbit

488  
00:22:30,690 --> 00:22:29,020

maintenance and servicing the space

489

00:22:34,940 --> 00:22:30,700

station will be heavily dependent upon

490

00:22:40,440 --> 00:22:37,770

payloads can request DBA to support

491

00:22:42,210 --> 00:22:40,450

their requirement no more than te das

492

00:22:44,730 --> 00:22:42,220

can be planned for a specific space

493

00:22:48,360 --> 00:22:44,740

shuttle mission and each vba will have a

494

00:22:50,039 --> 00:22:48,370

maximum duration at six hour ebas are

495

00:22:52,020 --> 00:22:50,049

not normally planned before flight day

496

00:22:55,200 --> 00:22:52,030

for and are not performed on the day

497

00:22:59,430 --> 00:22:55,210

before reentry nor our ETA is normally

498

00:23:02,130 --> 00:22:59,440

planned consecutively and ETA is at

499

00:23:04,710 --> 00:23:02,140

least a three-person task with 2 eb a

500

00:23:06,960 --> 00:23:04,720

crew person and at least one food person

501  
00:23:09,810 --> 00:23:06,970  
that supports the EDA from inside the

502  
00:23:11,630 --> 00:23:09,820  
orbiter crew coordination is essential

503  
00:23:14,039 --> 00:23:11,640  
to avoid entanglement of feathers and

504  
00:23:18,240 --> 00:23:14,049  
conflicts with orbiter operations such

505  
00:23:20,520 --> 00:23:18,250  
as RMS community since EPA's do require

506  
00:23:23,010 --> 00:23:20,530  
a large measure of the crews on orbit as

507  
00:23:24,980 --> 00:23:23,020  
well as training time they should not be

508  
00:23:28,350 --> 00:23:24,990  
planned or used in discriminatory

509  
00:23:30,650 --> 00:23:28,360  
however when edas are contemplated there

510  
00:23:32,820 --> 00:23:30,660  
are several factors to be considered

511  
00:23:34,799 --> 00:23:32,830  
hardware that is being designed to

512  
00:23:37,200 --> 00:23:34,809  
incorporate EBA task needs to be

513  
00:23:39,990 --> 00:23:37,210

designed such that an ensures safe

514

00:23:42,280 --> 00:23:40,000

operation for the orbiter the uva crew

515

00:23:44,590 --> 00:23:42,290

person and the spacecraft

516

00:23:46,570 --> 00:23:44,600

to meet these requirements NASA safety

517

00:23:48,850 --> 00:23:46,580

and your own safety and quality

518

00:23:50,680 --> 00:23:48,860

assurance organization should be

519

00:23:54,010 --> 00:23:50,690

involved from the earliest stages of the

520

00:23:55,950 --> 00:23:54,020

design process the harbor should also be

521

00:23:57,670 --> 00:23:55,960

designed to be can be a friendly

522

00:23:59,890 --> 00:23:57,680

workstation should be properly

523

00:24:03,070 --> 00:23:59,900

positioned and must provide adequate

524

00:24:05,770 --> 00:24:03,080

restraints designs that minimize loose

525

00:24:08,320 --> 00:24:05,780

parts utilize standard interfaces and

526  
00:24:10,660 --> 00:24:08,330  
tools provide adequate marking and

527  
00:24:12,520 --> 00:24:10,670  
indication and that utilize large

528  
00:24:15,730 --> 00:24:12,530  
muscles which will help maximize

529  
00:24:20,500 --> 00:24:15,740  
productivity of the BBA and help ensure

530  
00:24:22,420 --> 00:24:20,510  
a successful operation insertive

531  
00:24:24,580 --> 00:24:22,430  
timelines are used when planning the

532  
00:24:27,400 --> 00:24:24,590  
yeas and whenever possible the

533  
00:24:30,190 --> 00:24:27,410  
unexpected is anticipated and Becca

534  
00:24:31,930 --> 00:24:30,200  
procedures are developed backup

535  
00:24:34,360 --> 00:24:31,940  
procedures have been used on several

536  
00:24:36,600 --> 00:24:34,370  
previous settle the age when some of the

537  
00:24:38,950 --> 00:24:36,610  
hardware didn't pumpkin have planned

538  
00:24:41,770 --> 00:24:38,960

most of these problems could have been

539

00:24:43,690 --> 00:24:41,780

avoided had the as flown configuration

540

00:24:46,890 --> 00:24:43,700

of the spacecraft than adequately

541

00:24:51,090 --> 00:24:49,320

ETA is a very unique undertaking that

542

00:24:54,030 --> 00:24:51,100

has special considerations and

543

00:24:57,420 --> 00:24:54,040

limitation the best and most effective

544

00:24:59,430 --> 00:24:57,430

way to design for ETA is to establish an

545

00:25:01,590 --> 00:24:59,440

early working relationship with the

546

00:25:07,500 --> 00:25:01,600

Johnson Space Center and the astronaut

547

00:25:09,840 --> 00:25:07,510

offices science report through some of

548

00:25:12,690 --> 00:25:09,850

the most operationally demanded types of

549

00:25:14,850 --> 00:25:12,700

research in doing space involved in use

550

00:25:17,340 --> 00:25:14,860

of the orbiter itself as part of the

551  
00:25:19,740 --> 00:25:17,350  
experimental apparatus the orbiter

552  
00:25:22,620 --> 00:25:19,750  
becomes more than a payload carrier it

553  
00:25:24,870 --> 00:25:22,630  
becomes an easier hello my name is

554  
00:25:27,330 --> 00:25:24,880  
Franklin chang-diaz and I flew on

555  
00:25:30,000 --> 00:25:27,340  
mission 61c onboard the space shuttle

556  
00:25:31,950 --> 00:25:30,010  
for me my background is in plastic

557  
00:25:34,470 --> 00:25:31,960  
physics and mechanical engineering and

558  
00:25:36,930 --> 00:25:34,480  
I'd like to talk to you a bit about some

559  
00:25:39,170 --> 00:25:36,940  
of the lessons we have learned and using

560  
00:25:41,730 --> 00:25:39,180  
the orbiter as an experimental platform

561  
00:25:43,890 --> 00:25:41,740  
there are three significant lessons

562  
00:25:46,140 --> 00:25:43,900  
which must be considered by pelo

563  
00:25:49,650 --> 00:25:46,150

designers in preparing experiments to be

564

00:25:51,410 --> 00:25:49,660

conducted outside the orbiter first we

565

00:25:54,720 --> 00:25:51,420

must understand the outside environment

566

00:25:56,970 --> 00:25:54,730

this is important as it will affect many

567

00:25:58,950 --> 00:25:56,980

other free flying experiments and

568

00:26:03,000 --> 00:25:58,960

disciplines ranging from microgravity

569

00:26:05,190 --> 00:26:03,010

research remote sensing a partial

570

00:26:08,250 --> 00:26:05,200

characterization of the near environment

571

00:26:10,110 --> 00:26:08,260

was accomplished on Spacelab to during

572

00:26:14,210 --> 00:26:10,120

the activities with the university of

573

00:26:17,430 --> 00:26:14,220

iowa's plasma diagnostics package a PDP

574

00:26:19,050 --> 00:26:17,440

the PDP is a probe to study the

575

00:26:22,290 --> 00:26:19,060

properties and dynamics of the

576

00:26:24,600 --> 00:26:22,300

ionospheric classroom using PDP

577

00:26:27,450 --> 00:26:24,610

scientists can study the effects large

578

00:26:30,480 --> 00:26:27,460

orbital vehicles like the show have on

579

00:26:32,820 --> 00:26:30,490

there near environment the PDP can be

580

00:26:35,100 --> 00:26:32,830

flown attached to the mechanical arm to

581

00:26:37,920 --> 00:26:35,110

sample the near environment or as an

582

00:26:39,380 --> 00:26:37,930

inertial and stabilized require to study

583

00:26:43,990 --> 00:26:39,390

wake effects and electromagnetic

584

00:26:48,550 --> 00:26:46,600

the second lesson you have learned is

585

00:26:51,310 --> 00:26:48,560

the importance of school involvement in

586

00:26:55,840 --> 00:26:51,320

experiment definition planning and of

587

00:26:58,420 --> 00:26:55,850

course execution the crew must

588

00:27:00,580 --> 00:26:58,430

understand not just assigned by the

589

00:27:02,970 --> 00:27:00,590

capabilities and limitations of the

590

00:27:06,310 --> 00:27:02,980

vehicle which makes it possible for

591

00:27:08,440 --> 00:27:06,320

example in the case of PDP the orbiter

592

00:27:11,670 --> 00:27:08,450

is used to generate known disturbances

593

00:27:14,530 --> 00:27:11,680

at precise points in space and time

594

00:27:17,320 --> 00:27:14,540

precise alignment of the orbiter PDP

595

00:27:20,050 --> 00:27:17,330

combination prior to release was crucial

596

00:27:22,180 --> 00:27:20,060

and was a conflict by the crew through

597

00:27:26,350 --> 00:27:22,190

controlled inputs to the orbiter and the

598

00:27:28,420 --> 00:27:26,360

RMS to carry out the experiment the crew

599

00:27:31,900 --> 00:27:28,430

performed an intricate set of maneuvers

600

00:27:34,270 --> 00:27:31,910

around the bdp shown in the diagram this

601  
00:27:37,480 --> 00:27:34,280  
operation produced a map of the plasma

602  
00:27:39,400 --> 00:27:37,490  
weight structure because the orbiter

603  
00:27:42,040 --> 00:27:39,410  
required a large number of maneuvers to

604  
00:27:44,050 --> 00:27:42,050  
accomplish the science objectives the

605  
00:27:46,420 --> 00:27:44,060  
crew devoted a great deal of time

606  
00:27:49,630 --> 00:27:46,430  
planning and fine-tuning these maneuvers

607  
00:27:52,300 --> 00:27:49,640  
to such an extent that without their

608  
00:27:55,420 --> 00:27:52,310  
participation parts of the experiments

609  
00:27:57,790 --> 00:27:55,430  
would have been impossible for example

610  
00:27:59,830 --> 00:27:57,800  
in two of the orbital path leads the

611  
00:28:02,080 --> 00:27:59,840  
orbiter was taken slightly out of the

612  
00:28:04,870 --> 00:28:02,090  
orbital plane the intersect and connect

613  
00:28:07,110 --> 00:28:04,880

with your magnetic field line passing

614

00:28:10,510 --> 00:28:07,120

through the PDP at a precise instant

615

00:28:12,820 --> 00:28:10,520

these operations required critical than

616

00:28:15,100 --> 00:28:12,830

burns and precise adequate maneuvers

617

00:28:18,070 --> 00:28:15,110

using the orbiters reaction control

618

00:28:22,480 --> 00:28:20,200

the third lesson we have learned is that

619

00:28:25,269 --> 00:28:22,490

the unique capabilities of the orbiter

620

00:28:27,909 --> 00:28:25,279

RMS combination to deploy and retrieve

621

00:28:30,759 --> 00:28:27,919

scientific payloads give us access to a

622

00:28:34,810 --> 00:28:30,769

much more quiet and pure environment

623

00:28:37,149 --> 00:28:34,820

than the orbiter itself is provide these

624

00:28:42,220 --> 00:28:37,159

capabilities should be utilize in future

625

00:28:44,440 --> 00:28:42,230

experiment planet in now mature flying

626  
00:28:46,930 --> 00:28:44,450  
technique which we call proximity

627  
00:28:49,930 --> 00:28:46,940  
operations can be used in the skypes of

628  
00:28:52,629 --> 00:28:49,940  
investigations it is being demonstrated

629  
00:28:56,500 --> 00:28:52,639  
here during the recaptured maneuvers or

630  
00:28:59,019 --> 00:28:56,510  
Disqus 01 sub satellite the crew uses

631  
00:29:01,180 --> 00:28:59,029  
visual cues of the orbiters overhead

632  
00:29:03,669 --> 00:29:01,190  
window during the deployment and

633  
00:29:06,100 --> 00:29:03,679  
subsequent recapture of the payload it

634  
00:29:11,409 --> 00:29:06,110  
requires a coordinated action of several

635  
00:29:13,299 --> 00:29:11,419  
two members at once the value of human

636  
00:29:15,940 --> 00:29:13,309  
beings as observers cannot be

637  
00:29:19,779 --> 00:29:15,950  
overemphasized and time available can be

638  
00:29:20,799 --> 00:29:19,789

used productively for example being at

639

00:29:23,620 --> 00:29:20,809

the right place at the right time

640

00:29:25,419 --> 00:29:23,630

produced this spectacular low light

641

00:29:28,600 --> 00:29:25,429

level motion pictures of the Aurora

642

00:29:31,180 --> 00:29:28,610

Australis your imperious of high solar

643

00:29:33,009 --> 00:29:31,190

activity astronauts acting as onboard

644

00:29:35,230 --> 00:29:33,019

scientists could use handheld

645

00:29:38,110 --> 00:29:35,240

instruments like spectrometers and

646

00:29:40,149 --> 00:29:38,120

humans intensifiers to make a more

647

00:29:44,980 --> 00:29:40,159

complete recording of this interesting

648

00:29:47,379 --> 00:29:44,990

plasma phenomena these comments also

649

00:29:49,690 --> 00:29:47,389

apply to another plasma process with

650

00:29:53,830 --> 00:29:49,700

which we are infinitely familiar mainly

651  
00:29:56,080 --> 00:29:53,840  
reentry for example handheld photography

652  
00:29:58,539 --> 00:29:56,090  
reveal the interesting weight structures

653  
00:30:01,360 --> 00:29:58,549  
which develop downstream as the orbiter

654  
00:30:03,250 --> 00:30:01,370  
descent as the orbiter decelerates

655  
00:30:05,680 --> 00:30:03,260  
through the atmosphere this pattern

656  
00:30:08,649 --> 00:30:05,690  
sking and exhibit clones to the links

657  
00:30:11,019 --> 00:30:08,659  
for those wanting to study this

658  
00:30:13,210 --> 00:30:11,029  
phenomenon it is possible with early

659  
00:30:15,250 --> 00:30:13,220  
crew involvement to plan simple

660  
00:30:17,340 --> 00:30:15,260  
experiments with crew operated

661  
00:30:19,930 --> 00:30:17,350  
instruments from inside the cabin the

662  
00:30:22,149 --> 00:30:19,940  
knowledge gained from these observations

663  
00:30:24,330 --> 00:30:22,159

will help us understand the allowable

664

00:30:27,340 --> 00:30:24,340

maneuver envelope of the shuttle

665

00:30:29,740 --> 00:30:27,350

in addition it will enable us to design

666

00:30:32,020 --> 00:30:29,750

better lightweight re-entry vehicles and

667

00:30:34,000 --> 00:30:32,030

develop aerobraking techniques for

668

00:30:37,600 --> 00:30:34,010

future orbit transfers vehicles and

669

00:30:42,730 --> 00:30:40,090

the greatest advantage of human space

670

00:30:44,830 --> 00:30:42,740

exploration is attuned to the unique

671

00:30:47,980 --> 00:30:44,840

perspective astronauts can bring to the

672

00:30:50,560 --> 00:30:47,990

operation in early involvement in the

673

00:30:53,140 --> 00:30:50,570

science objectives their ability to

674

00:30:55,860 --> 00:30:53,150

react to a known phenomena to

675

00:30:59,740 --> 00:30:55,870

reconfigure experiments in real time and

676

00:31:02,919 --> 00:30:59,750

repair those systems for sale this

677

00:31:05,169 --> 00:31:02,929

approach using the orbiters test bed and

678

00:31:08,140 --> 00:31:05,179

the goo is a critical interacting

679

00:31:11,350 --> 00:31:08,150

element greatly enhances designed to get

680

00:31:14,140 --> 00:31:11,360

return for each mission flown these

681

00:31:16,000 --> 00:31:14,150

again lessons learned we are now

682

00:31:19,090 --> 00:31:16,010

attempting to communicate them the

683

00:31:22,270 --> 00:31:19,100

scientists halo designers working in

684

00:31:25,419 --> 00:31:22,280

their laboratories to ensure that future

685

00:31:28,299 --> 00:31:25,429

experiments are designed not a sealed

686

00:31:31,659 --> 00:31:28,309

black boxes but as flexible elements

687

00:31:34,060 --> 00:31:31,669

with human interaction the facilitate

688

00:31:37,000 --> 00:31:34,070

gives the astronaut office has created

689

00:31:39,130 --> 00:31:37,010

the science support group these

690

00:31:42,130 --> 00:31:39,140

astronauts will combine their scientific

691

00:31:44,680 --> 00:31:42,140

and operational skills to provide an

692

00:31:47,770 --> 00:31:44,690

early interface with space scientists

693

00:31:50,169 --> 00:31:47,780

and principal investigators to optimize

694

00:31:52,990 --> 00:31:50,179

the design of operational scientific

695

00:31:55,480 --> 00:31:53,000

hardware and to ensure its proper