1
00:00:21,150 --> 00:00:19,590
we are t minus 30 seconds initiate

2
00:00:23,109 --> 00:00:21,160
systems check

3
00:00:27,269 --> 00:00:23,119
musculoskeletal system

4
00:00:31,269 --> 00:00:27,279
neural vestibular system

5
00:00:35,510 --> 00:00:31,279
cardiopulmonary system

6
00:00:42,310 --> 00:00:35,520
cardiovascular system

7
00:00:43,510 --> 00:00:42,320
all systems are go we are t minus 10

8
00:00:44,630 --> 00:00:43,520
9

9
00:00:45,750 --> 00:00:44,640
eight

10
00:00:46,790 --> 00:00:45,760
seven

11
00:00:47,910 --> 00:00:46,800
six

12
00:00:49,029 --> 00:00:47,920
five

13
00:00:50,069 --> 00:00:49,039

four

14
00:00:51,110 --> 00:00:50,079
three

15
00:00:51,990 --> 00:00:51,120
two

16
00:01:08,710 --> 00:00:52,000
one

17
00:01:46,789 --> 00:01:11,030
liftoff of the space shuttle and it has

18
00:01:51,670 --> 00:01:48,630
hi welcome aboard the space shuttle

19
00:01:53,510 --> 00:01:51,680
columbia and space lab life sciences 1.

20
00:01:55,270 --> 00:01:53,520
after 10 years of flying space shuttle

21
00:01:56,870 --> 00:01:55,280
missions we're becoming accustomed to

22
00:02:00,950 --> 00:01:56,880
the strange things that can happen in

23
00:02:02,950 --> 00:02:00,960
space but it hasn't always been that way

24
00:02:04,709 --> 00:02:02,960
when we first went into space no one

25
00:02:06,389 --> 00:02:04,719
knew how the human body would react to

26
00:02:07,990 --> 00:02:06,399
space flight

27
00:02:13,110 --> 00:02:08,000
we wondered if we could survive in

28
00:02:17,030 --> 00:02:14,630
and we wondered if we could work in

29
00:02:19,350 --> 00:02:17,040
space okay i'm out

30
00:02:24,470 --> 00:02:21,190
thirty years later we know that the

31
00:02:27,030 --> 00:02:24,480
answer to both of these questions is yes

32
00:02:28,869 --> 00:02:27,040
but in spite of our successes in space

33
00:02:30,949 --> 00:02:28,879
many questions about the effects of

34
00:02:33,190 --> 00:02:30,959
space flight on the human body remain

35
00:02:34,949 --> 00:02:33,200
unanswered

36
00:02:37,350 --> 00:02:34,959
during the flight of space lab life

37
00:02:40,390 --> 00:02:37,360
sciences 1 my colleagues and i will try

38
00:02:43,509 --> 00:02:40,400

to answer some of these questions

39
00:02:46,309 --> 00:02:43,519
the human body is much like the shuttle

40
00:02:48,710 --> 00:02:46,319
it is a very complex sophisticated piece

41
00:02:50,790 --> 00:02:48,720
of living machinery that relies on

42
00:02:51,910 --> 00:02:50,800
several subsystems to perform its

43
00:02:53,750 --> 00:02:51,920
mission

44
00:02:57,030 --> 00:02:53,760
where the shuttle has a propulsion

45
00:03:00,229 --> 00:02:57,040
system a life support system a guidance

46
00:03:04,070 --> 00:03:00,239
system and so on our bodies have systems

47
00:03:07,750 --> 00:03:04,080
like the cardiovascular system

48
00:03:11,750 --> 00:03:07,760
the cardiopulmonary system

49
00:03:18,869 --> 00:03:15,350
the blood and immune systems

50
00:03:23,910 --> 00:03:18,879
the musculoskeletal system

51
00:03:28,309 --> 00:03:25,990
the shuttle systems communicate with

52
00:03:30,149 --> 00:03:28,319
each other to keep the spacecraft flying

53
00:03:32,869 --> 00:03:30,159
smoothly

54
00:03:35,190 --> 00:03:32,879
in a similar way our body systems also

55
00:03:37,190 --> 00:03:35,200
talk to each other to maintain what is

56
00:03:40,390 --> 00:03:37,200
called homeostasis

57
00:03:42,550 --> 00:03:40,400
or a stable internal environment

58
00:03:45,110 --> 00:03:42,560
all of our body systems are affected to

59
00:03:47,270 --> 00:03:45,120
some degree by space flight

60
00:03:50,470 --> 00:03:47,280
the most dramatic change occurs

61
00:03:53,270 --> 00:03:50,480
immediately after we become weightless

62
00:03:56,470 --> 00:03:53,280
on earth the pull of gravity normally

63
00:03:58,949 --> 00:03:56,480

pulls our body fluids in our feet legs

64
00:04:00,949 --> 00:03:58,959
and abdomen

65
00:04:03,429 --> 00:04:00,959
but when we enter space and become

66
00:04:05,990 --> 00:04:03,439
weightless the fluid in our bodies is no

67
00:04:08,869 --> 00:04:06,000
longer pulled down toward our feet

68
00:04:10,470 --> 00:04:08,879
instead it shifts up to our chest and

69
00:04:13,429 --> 00:04:10,480
head

70
00:04:15,750 --> 00:04:13,439
since 80 percent of our body is fluid

71
00:04:17,909 --> 00:04:15,760
that changes the way we look

72
00:04:20,069 --> 00:04:17,919
our faces get puffy

73
00:04:24,070 --> 00:04:20,079
and our legs get skinny

74
00:04:26,550 --> 00:04:24,080
we call this the bird legs of space

75
00:04:28,550 --> 00:04:26,560
after we're up here for a while we adapt

76
00:04:30,629 --> 00:04:28,560
somewhat to the fluid shift

77
00:04:34,870 --> 00:04:30,639
but our bodies remain in this altered

78
00:04:39,189 --> 00:04:36,629
the weightlessness affects our bodies in

79
00:04:41,909 --> 00:04:39,199
another way too it's called space motion

80
00:04:43,030 --> 00:04:41,919
sickness it's much like being seasick on

81
00:04:45,270 --> 00:04:43,040
earth

82
00:04:47,110 --> 00:04:45,280
but luckily our bodies adapt to this new

83
00:04:50,790 --> 00:04:47,120
environment and so it isn't really a

84
00:04:52,629 --> 00:04:50,800
problem after the first couple of days

85
00:04:55,189 --> 00:04:52,639
the fluid shift and space motion

86
00:04:57,350 --> 00:04:55,199
sickness are easily recognizable changes

87
00:04:59,830 --> 00:04:57,360
that take place in weightlessness but

88
00:05:03,350 --> 00:04:59,840

less obvious changes also occur

89
00:05:05,990 --> 00:05:03,360
right down to individual cells

90
00:05:08,629 --> 00:05:06,000
during the flight of sts-40 space lab

91
00:05:10,550 --> 00:05:08,639
life sciences 1 my fellow crew members

92
00:05:12,469 --> 00:05:10,560
and i will introduce you to the six

93
00:05:15,350 --> 00:05:12,479
major body systems

94
00:05:32,790 --> 00:05:15,360
we'll learn how they function on earth

95
00:05:37,350 --> 00:05:34,870
our cardiovascular system is a network

96
00:05:39,510 --> 00:05:37,360
of over 96 000 kilometers of blood

97
00:05:41,749 --> 00:05:39,520
vessels enough to go more than twice

98
00:05:43,670 --> 00:05:41,759
around the earth

99
00:05:45,909 --> 00:05:43,680
these blood vessels include arteries

100
00:05:47,990 --> 00:05:45,919
which carry freshly oxygenated blood to

101
00:05:50,310 --> 00:05:48,000
all the tissues in our bodies and other

102
00:05:52,629 --> 00:05:50,320
vessels called veins which bring back

103
00:05:53,990 --> 00:05:52,639
waste-laden blood so the process can be

104
00:05:56,070 --> 00:05:54,000
repeated

105
00:05:57,990 --> 00:05:56,080
the driving force of the cardiovascular

106
00:05:59,830 --> 00:05:58,000
system is the heart

107
00:06:02,070 --> 00:05:59,840
it's a pump that forces blood through

108
00:06:04,870 --> 00:06:02,080
the arteries and the veins

109
00:06:08,070 --> 00:06:04,880
our heart pumps or beats about 60 times

110
00:06:10,390 --> 00:06:08,080
a minute every minute of our lives

111
00:06:12,710 --> 00:06:10,400
if you live to be 70 years old your

112
00:06:14,309 --> 00:06:12,720
heart will pump more than 2 billion

113
00:06:16,309 --> 00:06:14,319

times

114
00:06:17,270 --> 00:06:16,319
our cardiovascular system works well in

115
00:06:19,270 --> 00:06:17,280
gravity

116
00:06:21,189 --> 00:06:19,280
whether we're lying or standing we

117
00:06:23,990 --> 00:06:21,199
always have an adequate supply of blood

118
00:06:25,990 --> 00:06:24,000
for vital organs like the brain

119
00:06:28,150 --> 00:06:26,000
but when we go into space and take our

120
00:06:31,830 --> 00:06:28,160
hearts out of their normal environment

121
00:06:35,749 --> 00:06:33,990
the upward shift of fluid in our bodies

122
00:06:37,110 --> 00:06:35,759
tricks the heart and its sensors into

123
00:06:38,710 --> 00:06:37,120
believing that there's an increased

124
00:06:41,189 --> 00:06:38,720
blood supply

125
00:06:42,950 --> 00:06:41,199
so our heart tries to compensate

126
00:06:45,830 --> 00:06:42,960
first the muscle structure of our heart

127
00:06:47,990 --> 00:06:45,840
stretches so that it can hold more blood

128
00:06:49,749 --> 00:06:48,000
when this happens other body systems

129
00:06:53,110 --> 00:06:49,759
tell our kidneys to eliminate what

130
00:06:55,350 --> 00:06:53,120
appears to be excess fluid

131
00:06:56,710 --> 00:06:55,360
as the fluid level is reduced we believe

132
00:06:58,870 --> 00:06:56,720
our bone marrow shuts down its

133
00:07:01,430 --> 00:06:58,880
production of red blood cells in order

134
00:07:03,189 --> 00:07:01,440
to keep our blood from getting too thick

135
00:07:05,350 --> 00:07:03,199
pretty soon the amount of blood in the

136
00:07:06,870 --> 00:07:05,360
red cells in our body is less than we

137
00:07:08,790 --> 00:07:06,880
have on earth

138
00:07:10,230 --> 00:07:08,800

with less blood to pump our heart

139
00:07:12,150 --> 00:07:10,240
shrinks

140
00:07:12,950 --> 00:07:12,160
back to about the same size it is on

141
00:07:17,270 --> 00:07:12,960
earth

142
00:07:19,430 --> 00:07:17,280
gravity again pulls much of our blood

143
00:07:20,950 --> 00:07:19,440
back to our legs

144
00:07:22,469 --> 00:07:20,960
now there's not enough blood to go

145
00:07:24,790 --> 00:07:22,479
around and some of us will get

146
00:07:26,790 --> 00:07:24,800
light-headed and dizzy for a short time

147
00:07:29,670 --> 00:07:26,800
until our bodies get more fluids and

148
00:07:31,510 --> 00:07:29,680
manufacture more blood

149
00:07:33,430 --> 00:07:31,520
spite of this there's no indication that

150
00:07:35,830 --> 00:07:33,440
space flight causes any permanent

151
00:07:37,350 --> 00:07:35,840
problems for our cardiovascular system

152
00:07:40,550 --> 00:07:37,360
but during this flight we're going to

153
00:07:42,950 --> 00:07:40,560
investigate this matter more closely

154
00:07:45,189 --> 00:07:42,960
before we departed earth i had a long

155
00:07:46,230 --> 00:07:45,199
plastic tube inserted into a vein in my

156
00:07:48,629 --> 00:07:46,240
arm

157
00:07:50,870 --> 00:07:48,639
this tube is called a catheter

158
00:07:53,350 --> 00:07:50,880
the tube was advanced in a vein to a

159
00:07:55,350 --> 00:07:53,360
point just above my heart

160
00:07:57,589 --> 00:07:55,360
during the first few hours of flight

161
00:07:59,670 --> 00:07:57,599
when the fluid shifts occur we're able

162
00:08:01,670 --> 00:07:59,680
to measure the central venous pressure

163
00:08:03,749 --> 00:08:01,680

near my heart

164
00:08:05,670 --> 00:08:03,759
central venous pressure is directly

165
00:08:06,629 --> 00:08:05,680
related to the volume of blood our heart

166
00:08:08,390 --> 00:08:06,639
pumps

167
00:08:10,309 --> 00:08:08,400
once we get back to earth we'll do the

168
00:08:14,309 --> 00:08:10,319
same experiment see if the central

169
00:08:18,070 --> 00:08:16,309
if our suspicions are correct we'll

170
00:08:21,110 --> 00:08:18,080
demonstrate that the fluid shift caused

171
00:08:23,029 --> 00:08:21,120
by weightlessness increases activity and

172
00:08:24,869 --> 00:08:23,039
changes the control mechanisms of the

173
00:08:26,790 --> 00:08:24,879
heart and circulation

174
00:08:29,029 --> 00:08:26,800
information like this will help us to

175
00:08:30,950 --> 00:08:29,039
better understand the changes we go when

176
00:08:33,110 --> 00:08:30,960
we first enter weightlessness and it

177
00:08:35,509 --> 00:08:33,120
will give us insight into the possible

178
00:08:37,269 --> 00:08:35,519
effects of long-term weightlessness

179
00:08:51,030 --> 00:08:37,279
as well as diseases of earthbound

180
00:08:54,750 --> 00:08:53,110
the cardiovascular system works closely

181
00:08:57,430 --> 00:08:54,760
with another body system called the

182
00:08:59,509 --> 00:08:57,440
cardiopulmonary system

183
00:09:01,509 --> 00:08:59,519
cardio refers to the heart and pulmonary

184
00:09:03,190 --> 00:09:01,519
refers to the lungs

185
00:09:05,509 --> 00:09:03,200
this lung heart connection is right in

186
00:09:08,550 --> 00:09:05,519
the middle of the cardiovascular system

187
00:09:09,750 --> 00:09:08,560
but not literally here's what i mean

188
00:09:11,910 --> 00:09:09,760

the heart pumps blood through our

189
00:09:14,150 --> 00:09:11,920
arteries and veins the blood in turn has

190
00:09:15,509 --> 00:09:14,160
an equally important job

191
00:09:17,190 --> 00:09:15,519
when the blood is on its way to our

192
00:09:19,910 --> 00:09:17,200
tissue and organs it is said to be

193
00:09:23,269 --> 00:09:19,920
oxygenated meaning that it is carrying

194
00:09:25,350 --> 00:09:23,279
oxygen to all of the cells in our bodies

195
00:09:27,590 --> 00:09:25,360
when blood is returning from the cells

196
00:09:29,590 --> 00:09:27,600
it is oxygen depleted

197
00:09:33,190 --> 00:09:29,600
meaning that the oxygen has been used up

198
00:09:34,389 --> 00:09:33,200
and in its place is carbon dioxide

199
00:09:36,310 --> 00:09:34,399
looking at a diagram of the

200
00:09:37,990 --> 00:09:36,320
cardiovascular system we see that it's a

201
00:09:39,670 --> 00:09:38,000
closed system

202
00:09:41,509 --> 00:09:39,680
if this is true then how does the blood

203
00:09:43,190 --> 00:09:41,519
get a fresh supply of oxygen to carry

204
00:09:45,269 --> 00:09:43,200
back to the cells

205
00:09:47,350 --> 00:09:45,279
that's where the lungs come in

206
00:09:49,670 --> 00:09:47,360
oxygen depleted blood is pumped from the

207
00:09:52,230 --> 00:09:49,680
heart to the lungs

208
00:09:53,750 --> 00:09:52,240
think of the lungs as two large airbags

209
00:09:55,910 --> 00:09:53,760
filled with thousands of tiny blood

210
00:09:57,430 --> 00:09:55,920
vessels called capillaries

211
00:09:58,949 --> 00:09:57,440
my friend here is going to help me show

212
00:10:00,310 --> 00:09:58,959
what happens when we take a breath of

213
00:10:01,829 --> 00:10:00,320

air

214
00:10:05,590 --> 00:10:01,839
when we breathe

215
00:10:07,350 --> 00:10:05,600
air rich with oxygen enters the lungs

216
00:10:08,870 --> 00:10:07,360
now we've got two lungs full of fresh

217
00:10:10,710 --> 00:10:08,880
air and oxygen

218
00:10:12,550 --> 00:10:10,720
and we have a network of small blood

219
00:10:14,470 --> 00:10:12,560
vessels filled with oxygen depleted

220
00:10:17,030 --> 00:10:14,480
blood

221
00:10:18,870 --> 00:10:17,040
now something quite fascinating happens

222
00:10:20,550 --> 00:10:18,880
the oxygen in the lungs and the carbon

223
00:10:22,230 --> 00:10:20,560
dioxide in the blood are going to trade

224
00:10:25,110 --> 00:10:22,240
places through the thin membranes that

225
00:10:28,150 --> 00:10:25,120
line the lungs this phenomenon is called

226
00:10:33,590 --> 00:10:30,069
now the air in the lungs is optionally

227
00:10:38,150 --> 00:10:33,600
depleted and the blood is oxygenating

228
00:10:38,160 --> 00:10:41,590
thank you

229
00:10:44,870 --> 00:10:43,190
the blood then returns to the heart

230
00:10:47,670 --> 00:10:44,880
where it's pumped out to the body to

231
00:10:50,150 --> 00:10:47,680
nourish the cells and give them oxygen

232
00:10:51,350 --> 00:10:50,160
it then returns back to the to the heart

233
00:10:54,069 --> 00:10:51,360
and then again in the lungs where the

234
00:10:55,750 --> 00:10:54,079
processes again repeated

235
00:10:57,590 --> 00:10:55,760
on earth where gravity tends to pull

236
00:10:59,110 --> 00:10:57,600
blood toward our feet the majority of

237
00:11:01,509 --> 00:10:59,120
the blood in the lung stays near the

238
00:11:03,190 --> 00:11:01,519

bottom and the air stays mostly in the

239
00:11:05,430 --> 00:11:03,200
top

240
00:11:07,430 --> 00:11:05,440
but in space where the fluid in our body

241
00:11:09,030 --> 00:11:07,440
shifts upwards it is felt that there

242
00:11:10,630 --> 00:11:09,040
will be a more even distribution of

243
00:11:12,310 --> 00:11:10,640
blood and air in the lungs

244
00:11:14,150 --> 00:11:12,320
that means that the lungs should

245
00:11:17,190 --> 00:11:14,160
function even more efficiently in space

246
00:11:21,110 --> 00:11:19,030
spacelab's gas analyzer is going to help

247
00:11:22,949 --> 00:11:21,120
us determine if this is true

248
00:11:24,470 --> 00:11:22,959
by breathing into the rebreather device

249
00:11:25,670 --> 00:11:24,480
we'll inhale a mixture of traceable

250
00:11:27,670 --> 00:11:25,680
gases

251
00:11:29,509 --> 00:11:27,680
when we exhale the mixture the gas

252
00:11:31,030 --> 00:11:29,519
analyzer will identify each gas and

253
00:11:33,750 --> 00:11:31,040
determine the quantity that was absorbed

254
00:11:35,509 --> 00:11:33,760
by the bloodstream

255
00:11:37,590 --> 00:11:35,519
investigators back on earth will then be

256
00:11:39,590 --> 00:11:37,600
able to determine if gas exchange in the

257
00:11:40,790 --> 00:11:39,600
lungs is actually more efficient in

258
00:11:42,470 --> 00:11:40,800
space

259
00:11:44,230 --> 00:11:42,480
if that is the case it may help us to

260
00:11:58,550 --> 00:11:44,240
better understand certain respiratory

261
00:12:03,190 --> 00:12:00,230
if you're a healthy young person

262
00:12:06,230 --> 00:12:03,200
weighing about 120 pounds over 60

263
00:12:08,230 --> 00:12:06,240

percent or 72 pounds of your body is

264
00:12:09,990 --> 00:12:08,240
made out of water

265
00:12:12,710 --> 00:12:10,000
that means that water is the most

266
00:12:14,069 --> 00:12:12,720
abundant and the most important fluid in

267
00:12:16,790 --> 00:12:14,079
your body

268
00:12:18,389 --> 00:12:16,800
but how do we keep our body water at a

269
00:12:19,990 --> 00:12:18,399
constant level

270
00:12:21,269 --> 00:12:20,000
every time we perspire go to the

271
00:12:23,350 --> 00:12:21,279
bathroom

272
00:12:27,509 --> 00:12:23,360
we rid our bodies of water and every

273
00:12:32,150 --> 00:12:29,430
we add water back

274
00:12:34,310 --> 00:12:32,160
so how does the body keep the water in

275
00:12:36,949 --> 00:12:34,320
balance

276
00:12:39,590 --> 00:12:36,959
this is done for us automatically by our

277
00:12:42,710 --> 00:12:39,600
renal endocrine system

278
00:12:45,350 --> 00:12:42,720
renal refers to the kidneys

279
00:12:47,670 --> 00:12:45,360
and the endocrine system is a collection

280
00:12:49,350 --> 00:12:47,680
of hormone-secreting glands

281
00:12:51,670 --> 00:12:49,360
that include

282
00:12:53,990 --> 00:12:51,680
the hypothalamus

283
00:12:56,470 --> 00:12:54,000
the pituitary

284
00:12:58,069 --> 00:12:56,480
the thyroid gland

285
00:13:01,509 --> 00:12:58,079
the pancreas

286
00:13:08,069 --> 00:13:04,230
the primary body compounds regulated by

287
00:13:10,550 --> 00:13:08,079
this system are water and electrolytes

288
00:13:14,150 --> 00:13:10,560

when we drink water or other fluids they

289
00:13:16,470 --> 00:13:14,160
go into our gastrointestinal tract

290
00:13:18,470 --> 00:13:16,480
from there water and electrolytes are

291
00:13:25,030 --> 00:13:18,480
absorbed into the bloodstream by a

292
00:13:29,590 --> 00:13:27,509
the cells in our bodies then absorb

293
00:13:35,030 --> 00:13:29,600
whatever water they need from the

294
00:13:43,509 --> 00:13:37,750
the cells also dump water along cellular

295
00:13:46,629 --> 00:13:45,269
as the blood passes through our

296
00:13:48,710 --> 00:13:46,639
endocrine system

297
00:14:02,710 --> 00:13:48,720
it is monitored for different metabolic

298
00:14:07,269 --> 00:14:04,470
two of the endocrine glands the

299
00:14:13,030 --> 00:14:07,279
hypothalamus and the pituitary monitor

300
00:14:18,870 --> 00:14:16,550
too high too high

301
00:14:21,670 --> 00:14:18,880
if the fluid level is not right they

302
00:14:24,230 --> 00:14:21,680
will release a hormone

303
00:14:26,069 --> 00:14:24,240
and that hormone tells the brain there's

304
00:14:28,949 --> 00:14:26,079
a problem

305
00:14:32,790 --> 00:14:28,959
if the fluid level is too low

306
00:14:35,750 --> 00:14:32,800
the brain tells us that we're thirsty

307
00:14:38,310 --> 00:14:35,760
but if the fluid level is high

308
00:14:43,030 --> 00:14:38,320
the brain tells the kidneys to eliminate

309
00:14:48,310 --> 00:14:45,430
through an elaborate filtering process

310
00:14:50,389 --> 00:14:48,320
our kidneys remove the excess fluids and

311
00:14:53,910 --> 00:14:50,399
waste from our blood and store it in our

312
00:14:56,069 --> 00:14:53,920
bladder in the form of urine

313
00:14:57,670 --> 00:14:56,079

when our kidneys are told by our body to

314
00:15:00,470 --> 00:14:57,680
get rid of water

315
00:15:02,870 --> 00:15:00,480
we make more urine in the body

316
00:15:04,230 --> 00:15:02,880
our bladders fill and we get the urge to

317
00:15:05,750 --> 00:15:04,240
urinate

318
00:15:07,829 --> 00:15:05,760
but what does all this mean for the

319
00:15:09,990 --> 00:15:07,839
space traveler

320
00:15:12,470 --> 00:15:10,000
for one it means that when we enter

321
00:15:13,750 --> 00:15:12,480
weightlessness the body fluids shift

322
00:15:15,990 --> 00:15:13,760
upward

323
00:15:18,550 --> 00:15:16,000
and our renal endocrine system will tell

324
00:15:20,949 --> 00:15:18,560
our bodies to eliminate fluid

325
00:15:23,350 --> 00:15:20,959
what we don't know is how weightlessness

326
00:15:26,470 --> 00:15:23,360
affects the production of hormones that

327
00:15:28,949 --> 00:15:26,480
keep our fluid levels balanced here on

328
00:15:31,350 --> 00:15:28,959
sls 1 we're investigating all the

329
00:15:33,430 --> 00:15:31,360
changes that occur during space flight

330
00:15:36,150 --> 00:15:33,440
changes in the hormone production

331
00:15:38,629 --> 00:15:36,160
changes in how the kidney functions

332
00:15:40,790 --> 00:15:38,639
and the circulation

333
00:15:42,470 --> 00:15:40,800
and with this new knowledge we hope to

334
00:15:43,990 --> 00:15:42,480
shed new light

335
00:15:46,150 --> 00:15:44,000
on things like

336
00:15:47,430 --> 00:15:46,160
how and why we deconditioned during

337
00:15:49,670 --> 00:15:47,440
space flight

338
00:16:04,310 --> 00:15:49,680

and on earth problems like orthostatic

339
00:16:07,590 --> 00:16:06,389
all of us know that blood is essential

340
00:16:10,389 --> 00:16:07,600
for life

341
00:16:13,670 --> 00:16:10,399
but do we really know why

342
00:16:16,870 --> 00:16:13,680
blood has two very important jobs first

343
00:16:18,870 --> 00:16:16,880
it transports oxygen and carbon dioxide

344
00:16:19,990 --> 00:16:18,880
to and from the millions of cells in our

345
00:16:22,470 --> 00:16:20,000
bodies

346
00:16:24,470 --> 00:16:22,480
blood is also a defense mechanism that

347
00:16:25,990 --> 00:16:24,480
allows our bodies to fight infection and

348
00:16:28,230 --> 00:16:26,000
disease

349
00:16:30,150 --> 00:16:28,240
blood has three components

350
00:16:31,990 --> 00:16:30,160
red blood cells which do the

351
00:16:33,350 --> 00:16:32,000
transporting of oxygen and carbon

352
00:16:36,230 --> 00:16:33,360
dioxide

353
00:16:39,590 --> 00:16:36,240
white blood cells which fight infections

354
00:16:41,990 --> 00:16:39,600
and a watery fluid called plasma which

355
00:16:44,790 --> 00:16:42,000
makes our blood liquid and allows it to

356
00:16:46,230 --> 00:16:44,800
flow through the blood vessels

357
00:16:51,990 --> 00:16:46,240
let's take a look at each of these

358
00:16:56,550 --> 00:16:53,990
red blood cells could be compared to

359
00:16:58,949 --> 00:16:56,560
millions of taxicabs zooming around in

360
00:17:01,269 --> 00:16:58,959
our bodies

361
00:17:03,910 --> 00:17:01,279
as each red blood cell taxi passes

362
00:17:07,590 --> 00:17:03,920
through our lungs it's flagged down by

363
00:17:12,470 --> 00:17:09,990

the oxygen is wanting to go to one of

364
00:17:15,429 --> 00:17:12,480
the millions of cells that makes up our

365
00:17:19,750 --> 00:17:17,590
so the red blood cell takes off through

366
00:17:21,750 --> 00:17:19,760
the cardiovascular system toward that

367
00:17:24,549 --> 00:17:21,760
destination

368
00:17:26,069 --> 00:17:24,559
once there the oxygen gets out and goes

369
00:17:28,789 --> 00:17:26,079
to the cell

370
00:17:30,710 --> 00:17:28,799
now like any good taxi driver the red

371
00:17:33,029 --> 00:17:30,720
blood cell doesn't want to make a return

372
00:17:35,270 --> 00:17:33,039
trip without a paying customer

373
00:17:37,909 --> 00:17:35,280
so while at the cell he picks up a

374
00:17:39,590 --> 00:17:37,919
carbon dioxide passenger for the return

375
00:17:42,470 --> 00:17:39,600
trip to the lungs

376
00:17:46,310 --> 00:17:42,480
without red blood cells our cells can't

377
00:17:48,150 --> 00:17:46,320
get the oxygen they need to sustain life

378
00:17:50,390 --> 00:17:48,160
white blood cells also perform an

379
00:17:52,789 --> 00:17:50,400
important function they are a major part

380
00:17:55,350 --> 00:17:52,799
of our immune system

381
00:17:56,950 --> 00:17:55,360
from time to time foreign substances

382
00:17:59,590 --> 00:17:56,960
enter our bodies

383
00:18:01,830 --> 00:17:59,600
these substances might be bacteria

384
00:18:03,590 --> 00:18:01,840
viruses or even something like a

385
00:18:05,590 --> 00:18:03,600
splinter

386
00:18:09,830 --> 00:18:05,600
we might compare the white blood cells

387
00:18:19,590 --> 00:18:11,750
when someone or something harmful comes

388
00:18:24,710 --> 00:18:22,390

the white blood cells work the same way

389
00:18:26,549 --> 00:18:24,720
except there are millions of them

390
00:18:29,430 --> 00:18:26,559
when a foreign substance enters our

391
00:18:31,510 --> 00:18:29,440
bodies the white blood cells attack and

392
00:18:33,110 --> 00:18:31,520
repel the intruder

393
00:18:35,270 --> 00:18:33,120
there are several types of white blood

394
00:18:38,230 --> 00:18:35,280
cells but the ones that we're interested

395
00:18:40,230 --> 00:18:38,240
in on this flight are called lymphocytes

396
00:18:41,830 --> 00:18:40,240
the red and white blood cells would have

397
00:18:44,470 --> 00:18:41,840
a difficult time making it through our

398
00:18:46,710 --> 00:18:44,480
blood vessels if it weren't for a liquid

399
00:18:49,270 --> 00:18:46,720
called plasma

400
00:18:52,870 --> 00:18:49,280
in the red fluid we call blood

401
00:18:55,110 --> 00:18:52,880
cells make up about 40 to 45

402
00:18:57,590 --> 00:18:55,120
the rest is plasma

403
00:18:59,750 --> 00:18:57,600
since plasma is a fluid it is really

404
00:19:01,830 --> 00:18:59,760
affected by the upward fluid shift that

405
00:19:03,909 --> 00:19:01,840
takes place in our bodies when we first

406
00:19:06,549 --> 00:19:03,919
encounter weightlessness and that

407
00:19:08,310 --> 00:19:06,559
affects our body's overall blood supply

408
00:19:09,990 --> 00:19:08,320
here's how

409
00:19:11,029 --> 00:19:10,000
when the fluid in our bodies drifts

410
00:19:13,190 --> 00:19:11,039
upward

411
00:19:15,590 --> 00:19:13,200
sensors in the circulatory system and

412
00:19:17,430 --> 00:19:15,600
the endocrine system send a message to

413
00:19:22,310 --> 00:19:17,440

the brain saying that there's too much

414
00:19:26,789 --> 00:19:24,390
the brain then tells the kidneys to

415
00:19:29,029 --> 00:19:26,799
reduce the fluid volume

416
00:19:30,870 --> 00:19:29,039
this is probably accomplished mainly

417
00:19:33,270 --> 00:19:30,880
through urination

418
00:19:36,310 --> 00:19:33,280
once the fluid level has been reduced

419
00:19:37,750 --> 00:19:36,320
blood cells make up more than 45 of the

420
00:19:41,510 --> 00:19:37,760
blood supply

421
00:19:43,350 --> 00:19:41,520
in other words our blood becomes thicker

422
00:19:45,830 --> 00:19:43,360
to compensate for this

423
00:19:48,310 --> 00:19:45,840
we think the bone marrow decreases its

424
00:19:52,310 --> 00:19:48,320
production of red blood cells until the

425
00:19:54,630 --> 00:19:52,320
ratio returns to about 45 percent so

426
00:19:56,710 --> 00:19:54,640
once again our bodies adapt to the

427
00:19:59,110 --> 00:19:56,720
changes of space flight

428
00:20:00,710 --> 00:19:59,120
but when we return to earth we face

429
00:20:02,710 --> 00:20:00,720
another problem

430
00:20:05,350 --> 00:20:02,720
we find that we've lost both blood

431
00:20:07,510 --> 00:20:05,360
volume and red blood cells

432
00:20:10,390 --> 00:20:07,520
the loss of blood volume is a problem

433
00:20:12,870 --> 00:20:10,400
immediately upon returning to earth

434
00:20:15,750 --> 00:20:12,880
because earth gravity is again pooling

435
00:20:17,669 --> 00:20:15,760
blood in our legs the decreased volume

436
00:20:18,830 --> 00:20:17,679
makes it more difficult for blood to be

437
00:20:21,909 --> 00:20:18,840
pumped to our

438
00:20:25,510 --> 00:20:21,919

brain this can lead to lightheadedness

439
00:20:27,909 --> 00:20:25,520
and a woozy feeling right after landing

440
00:20:30,390 --> 00:20:27,919
we begin working to correct this problem

441
00:20:31,830 --> 00:20:30,400
even before we land by drinking lots of

442
00:20:36,710 --> 00:20:31,840
water

443
00:20:38,950 --> 00:20:36,720
the plasma in our blood

444
00:20:41,510 --> 00:20:38,960
but once the plasma level is increased

445
00:20:43,430 --> 00:20:41,520
we face another problem

446
00:20:45,909 --> 00:20:43,440
now we have fewer red blood cells than

447
00:20:48,149 --> 00:20:45,919
we should have this condition is called

448
00:20:49,830 --> 00:20:48,159
space anemia even though it doesn't

449
00:20:51,350 --> 00:20:49,840
actually happen until we're back on

450
00:20:53,990 --> 00:20:51,360
earth

451
00:20:56,630 --> 00:20:54,000
face anemia will continue until the body

452
00:20:59,110 --> 00:20:56,640
manufactures enough red blood cells to

453
00:21:01,510 --> 00:20:59,120
bring the plasma cell ratio back to

454
00:21:03,990 --> 00:21:01,520
about 45 percent

455
00:21:05,909 --> 00:21:04,000
during the sls-1 mission we're studying

456
00:21:09,270 --> 00:21:05,919
several ways in which space flight may

457
00:21:11,510 --> 00:21:09,280
affect the blood and immune system

458
00:21:13,669 --> 00:21:11,520
for example in the past we have found

459
00:21:15,430 --> 00:21:13,679
that astronauts have fewer lymphocytes

460
00:21:17,510 --> 00:21:15,440
after flying in space

461
00:21:19,669 --> 00:21:17,520
and the lymphocytes they did have were

462
00:21:23,190 --> 00:21:19,679
not as effective in fighting infection

463
00:21:25,350 --> 00:21:23,200

as they had been prior to space flight

464
00:21:28,230 --> 00:21:25,360
at various times throughout this mission

465
00:21:30,390 --> 00:21:28,240
we're going to draw blood from the crew

466
00:21:32,870 --> 00:21:30,400
these specimens will be studied later on

467
00:21:35,270 --> 00:21:32,880
earth to determine if the lymphocytes

468
00:21:37,110 --> 00:21:35,280
ability to respond to infection

469
00:21:38,870 --> 00:21:37,120
decreases the longer they remain

470
00:21:40,549 --> 00:21:38,880
weightless

471
00:21:41,510 --> 00:21:40,559
this is an important question to be

472
00:21:43,669 --> 00:21:41,520
answered

473
00:21:45,510 --> 00:21:43,679
without a functioning immune system our

474
00:21:56,630 --> 00:21:45,520
bodies would become easy prey for

475
00:22:01,350 --> 00:21:58,070
most structures are designed with a

476
00:22:03,190 --> 00:22:01,360
specific purpose in mind

477
00:22:06,390 --> 00:22:03,200
the orbiter was designed to function in

478
00:22:08,070 --> 00:22:06,400
the unique conditions of space

479
00:22:13,750 --> 00:22:08,080
our bodies were designed to function on

480
00:22:17,510 --> 00:22:15,990
in fact our body's musculoskeletal

481
00:22:20,149 --> 00:22:17,520
system needs gravity to function

482
00:22:24,549 --> 00:22:21,750
of all the body systems we're studying

483
00:22:26,390 --> 00:22:24,559
during sls-1 the musculoskeletal system

484
00:22:28,470 --> 00:22:26,400
may be the only one that has serious

485
00:22:32,230 --> 00:22:28,480
problems adapting to the changes it

486
00:22:35,669 --> 00:22:33,990
by pulling against our bodies gravity

487
00:22:37,430 --> 00:22:35,679
makes our bones and muscles work and

488
00:22:39,270 --> 00:22:37,440

become stronger

489
00:22:40,789 --> 00:22:39,280
each time we take a step and push our

490
00:22:42,710 --> 00:22:40,799
weight forward we perform a weight

491
00:22:43,830 --> 00:22:42,720
lifting exercise for the muscles in our

492
00:22:45,669 --> 00:22:43,840
legs

493
00:22:47,909 --> 00:22:45,679
activities like climbing stairs make our

494
00:22:50,470 --> 00:22:47,919
muscles work even harder

495
00:22:52,070 --> 00:22:50,480
but in space nothing has weight so our

496
00:22:54,789 --> 00:22:52,080
muscles don't have to work the same as

497
00:22:58,070 --> 00:22:54,799
they do on earth when muscles don't work

498
00:22:59,590 --> 00:22:58,080
in their usual way they become weaker

499
00:23:01,430 --> 00:22:59,600
most of us have known someone who's

500
00:23:03,830 --> 00:23:01,440
broken an arm or leg and had to wear a

501
00:23:05,350 --> 00:23:03,840
cast while the bone healed

502
00:23:07,430 --> 00:23:05,360
while in the cast the muscles of that

503
00:23:09,270 --> 00:23:07,440
arm or leg didn't have to work

504
00:23:11,909 --> 00:23:09,280
and once the cast was removed the muscle

505
00:23:13,590 --> 00:23:11,919
was weak and had lost its bulk

506
00:23:15,669 --> 00:23:13,600
the same is true for people who've been

507
00:23:18,230 --> 00:23:15,679
confined to a bed for a long time and

508
00:23:19,830 --> 00:23:18,240
could not use their muscles

509
00:23:22,310 --> 00:23:19,840
in space we work our muscles on

510
00:23:24,070 --> 00:23:22,320
treadmills and exercise bikes but the

511
00:23:25,990 --> 00:23:24,080
results still aren't the same as they

512
00:23:27,590 --> 00:23:26,000
are on earth

513
00:23:33,669 --> 00:23:27,600

imagine that every day we lift the

514
00:23:37,750 --> 00:23:36,070
then one day we go on a trip it lasts a

515
00:23:43,190 --> 00:23:37,760
month and we only have a 40 pound

516
00:23:46,149 --> 00:23:45,110
even though we lift the 40-pound barbell

517
00:23:47,990 --> 00:23:46,159
every day

518
00:23:49,510 --> 00:23:48,000
the 100-pound barbell is going to be

519
00:23:50,470 --> 00:23:49,520
hard to lift when we return from our

520
00:23:53,909 --> 00:23:50,480
trip

521
00:23:55,909 --> 00:23:53,919
the same is true about space flight

522
00:23:59,590 --> 00:23:55,919
even though we exercise in space we're

523
00:24:02,710 --> 00:24:00,950
depending on how long we've been in

524
00:24:04,149 --> 00:24:02,720
space it may take us weeks or even

525
00:24:06,630 --> 00:24:04,159
months to regain the strength in our

526
00:24:08,310 --> 00:24:06,640
muscles that we've lost

527
00:24:09,750 --> 00:24:08,320
it could be even worse for astronauts

528
00:24:11,909 --> 00:24:09,760
who will someday live on the space

529
00:24:13,590 --> 00:24:11,919
station or at lunar bases

530
00:24:15,350 --> 00:24:13,600
not to mention a trip to mars it could

531
00:24:16,789 --> 00:24:15,360
last a year or more

532
00:24:19,190 --> 00:24:16,799
mussels aren't the only parts of our

533
00:24:21,110 --> 00:24:19,200
bodies that suffer during space flight

534
00:24:23,830 --> 00:24:21,120
weightlessness also causes our bones to

535
00:24:25,510 --> 00:24:23,840
lose the minerals calcium and phosphorus

536
00:24:27,590 --> 00:24:25,520
many of us don't think of our bones as

537
00:24:29,909 --> 00:24:27,600
being alive but they are really very

538
00:24:32,110 --> 00:24:29,919

active

539
00:24:34,710 --> 00:24:32,120
in our bone are two types of cells

540
00:24:35,909 --> 00:24:34,720
osteoclasts which get rid of old bone

541
00:24:41,110 --> 00:24:35,919
matter

542
00:24:44,310 --> 00:24:42,630
because of the activity of these two

543
00:24:45,750 --> 00:24:44,320
types of cells our bones are in a

544
00:24:47,510 --> 00:24:45,760
constant state of tearing down and

545
00:24:49,269 --> 00:24:47,520
rebuilding

546
00:24:50,630 --> 00:24:49,279
the balance of these cells seems to be

547
00:24:52,950 --> 00:24:50,640
tipped slightly in favor of the

548
00:24:55,269 --> 00:24:52,960
osteoblast cells that's why our bones

549
00:24:56,870 --> 00:24:55,279
grow stronger

550
00:24:58,870 --> 00:24:56,880
but what happens in space is still

551
00:25:00,310 --> 00:24:58,880
somewhat of a mystery

552
00:25:02,230 --> 00:25:00,320
since there is no weight to bear in

553
00:25:03,909 --> 00:25:02,240
space then there is no stress on our

554
00:25:05,350 --> 00:25:03,919
bones as they go through the rebuilding

555
00:25:06,950 --> 00:25:05,360
process

556
00:25:08,870 --> 00:25:06,960
this seems to affect the structural

557
00:25:11,430 --> 00:25:08,880
integrity of our bones

558
00:25:14,149 --> 00:25:11,440
bone density recovers but without stress

559
00:25:15,830 --> 00:25:14,159
they may not grow as strong

560
00:25:17,990 --> 00:25:15,840
the only way to prove this theory is to

561
00:25:19,750 --> 00:25:18,000
test some of our bones for strength

562
00:25:20,789 --> 00:25:19,760
and the only way to do that is to remove

563
00:25:24,390 --> 00:25:20,799

the bone

564
00:25:26,630 --> 00:25:24,400
and so far we've had no volunteers

565
00:25:29,269 --> 00:25:26,640
so nasa is working on ways to study bone

566
00:25:31,029 --> 00:25:29,279
strength without removing the bone

567
00:25:32,470 --> 00:25:31,039
finding a way to test bone strength is

568
00:25:34,310 --> 00:25:32,480
going to help us to treat elderly

569
00:25:37,190 --> 00:25:34,320
patients who have a common bone problem

570
00:25:39,590 --> 00:25:37,200
known as osteoporosis

571
00:25:41,830 --> 00:25:39,600
here on sls 1 we're going to measure the

572
00:25:43,750 --> 00:25:41,840
level of calcium producing hormones and

573
00:25:46,070 --> 00:25:43,760
compare them directly to the uptake and

574
00:25:47,590 --> 00:25:46,080
release of calcium in the body

575
00:26:02,390 --> 00:25:47,600
it will be the first time that this has

576
00:26:08,149 --> 00:26:05,430
it's a spectacular view out the window

577
00:26:10,310 --> 00:26:08,159
but most of the time looking outside

578
00:26:12,789 --> 00:26:10,320
doesn't tell us if we're flying the way

579
00:26:14,070 --> 00:26:12,799
we should

580
00:26:16,070 --> 00:26:14,080
since there aren't a lot of visual

581
00:26:18,230 --> 00:26:16,080
references in space

582
00:26:22,470 --> 00:26:18,240
the shuttle has a guidance system that

583
00:26:26,149 --> 00:26:24,310
we have a guidance system in our bodies

584
00:26:28,549 --> 00:26:26,159
too

585
00:26:30,149 --> 00:26:28,559
it's called the neurovestibular system

586
00:26:32,310 --> 00:26:30,159
and it's what keeps our bodies in the

587
00:26:34,230 --> 00:26:32,320
proper orientation on earth

588
00:26:36,230 --> 00:26:34,240

the neurovestibular system is very

589
00:26:39,510 --> 00:26:36,240
sensitive to gravity

590
00:26:41,510 --> 00:26:39,520
in fact it's gravity that makes it work

591
00:26:43,909 --> 00:26:41,520
deep inside our inner ear

592
00:26:47,190 --> 00:26:43,919
in the vestibular organ

593
00:26:49,269 --> 00:26:47,200
are thousands of tiny hairs

594
00:26:52,230 --> 00:26:49,279
resting on top of these hairs are

595
00:26:54,470 --> 00:26:52,240
microscopic clumps of crystals called

596
00:26:58,470 --> 00:26:54,480
otoliths

597
00:27:01,510 --> 00:26:58,480
different directions according to the

598
00:27:03,750 --> 00:27:01,520
type of activity we're doing

599
00:27:05,830 --> 00:27:03,760
this in turn bends the tiny hairs

600
00:27:09,190 --> 00:27:05,840
sending messages that tell the brain

601
00:27:11,669 --> 00:27:09,200
before hanging upside down

602
00:27:13,510 --> 00:27:11,679
accelerating

603
00:27:18,310 --> 00:27:13,520
or any other sensation that has to do

604
00:27:22,630 --> 00:27:20,549
the neural vestibular system also uses

605
00:27:24,870 --> 00:27:22,640
sensors in our muscles to determine

606
00:27:30,310 --> 00:27:24,880
sensations of motion or changes in

607
00:27:34,390 --> 00:27:32,870
but most of all it relies on our eyes

608
00:27:36,870 --> 00:27:34,400
we might even say that the neural

609
00:27:40,710 --> 00:27:36,880
vestibular system's main purpose is to

610
00:27:42,870 --> 00:27:40,720
create a stable platform for our eyes

611
00:27:44,070 --> 00:27:42,880
when our eyes can't lock onto what we're

612
00:27:45,909 --> 00:27:44,080
looking at

613
00:27:47,669 --> 00:27:45,919

we can get a queasy feeling we call

614
00:27:49,510 --> 00:27:47,679
motion sickness

615
00:27:51,190 --> 00:27:49,520
it's the same feeling some people get

616
00:27:53,029 --> 00:27:51,200
when they ride a wild ride at an

617
00:27:55,590 --> 00:27:53,039
amusement park

618
00:27:57,269 --> 00:27:55,600
everything rushes by in a blur

619
00:27:59,029 --> 00:27:57,279
and before long they think they might

620
00:28:01,190 --> 00:27:59,039
get a second look at the hot dog they

621
00:28:03,029 --> 00:28:01,200
just ate

622
00:28:05,750 --> 00:28:03,039
some of us who fly in space get a

623
00:28:07,669 --> 00:28:05,760
similar feeling we call it space motion

624
00:28:09,350 --> 00:28:07,679
sickness

625
00:28:11,350 --> 00:28:09,360
that doesn't mean riding the shuttle is

626
00:28:12,549 --> 00:28:11,360
like climbing aboard a tilt-a-wheel at a

627
00:28:14,549 --> 00:28:12,559
carnival

628
00:28:17,029 --> 00:28:14,559
but it does mean that space flight can

629
00:28:19,350 --> 00:28:17,039
confuse our neurovestibular system and

630
00:28:20,950 --> 00:28:19,360
disorient the visual references we rely

631
00:28:22,950 --> 00:28:20,960
on for stability

632
00:28:25,269 --> 00:28:22,960
there's a reason for this

633
00:28:27,350 --> 00:28:25,279
when we get into space gravity no longer

634
00:28:28,470 --> 00:28:27,360
pulls down on us the way we're used to

635
00:28:30,870 --> 00:28:28,480
on earth

636
00:28:32,950 --> 00:28:30,880
things start to float away and for all

637
00:28:35,669 --> 00:28:32,960
practical purposes

638
00:28:37,350 --> 00:28:35,679

objects become weightless

639
00:28:39,110 --> 00:28:37,360
in this environment the vestibular

640
00:28:41,510 --> 00:28:39,120
system functions differently than it

641
00:28:43,590 --> 00:28:41,520
does on earth and we no longer have a

642
00:28:45,590 --> 00:28:43,600
way to tell our brain what the right

643
00:28:47,110 --> 00:28:45,600
body position is

644
00:28:49,269 --> 00:28:47,120
without the vestibular system

645
00:28:51,269 --> 00:28:49,279
functioning the way we're used to

646
00:28:52,630 --> 00:28:51,279
some of us get confusing signals in our

647
00:28:54,470 --> 00:28:52,640
brain

648
00:28:55,669 --> 00:28:54,480
our eyes tell us that our feet are off

649
00:28:57,830 --> 00:28:55,679
the ground

650
00:29:01,190 --> 00:28:57,840
but our vestibular organ doesn't give us

651
00:29:03,510 --> 00:29:01,200
the sensation of falling that we expect

652
00:29:05,669 --> 00:29:03,520
usually after a few days in flight our

653
00:29:12,230 --> 00:29:05,679
bodies adjust to the weightlessness and

654
00:29:15,750 --> 00:29:14,630
not everyone experiences space motion

655
00:29:17,590 --> 00:29:15,760
sickness

656
00:29:21,029 --> 00:29:17,600
and that's one of the medical mysteries

657
00:29:25,190 --> 00:29:23,110
the reason is quite obvious

658
00:29:27,269 --> 00:29:25,200
imagine getting off a ride at a carnival

659
00:29:30,310 --> 00:29:27,279
and someone hands you an algebra book

660
00:29:32,149 --> 00:29:30,320
and tells you to work a few problems

661
00:29:33,750 --> 00:29:32,159
that's what it's like for an astronaut

662
00:29:35,830 --> 00:29:33,760
who's suffering from space motion

663
00:29:37,830 --> 00:29:35,840

sickness

664
00:29:40,230 --> 00:29:37,840
it's rather difficult to concentrate on

665
00:29:42,630 --> 00:29:40,240
an experiment if all you can think about

666
00:29:44,950 --> 00:29:42,640
is how sick you feel

667
00:29:48,149 --> 00:29:44,960
we want to have as much productive time

668
00:29:49,830 --> 00:29:48,159
as possible when we're in space

669
00:29:52,549 --> 00:29:49,840
so to help us learn more about the

670
00:29:54,549 --> 00:29:52,559
effects of space motion sickness and how

671
00:29:58,070 --> 00:29:54,559
to treat it we're going to do some

672
00:30:00,070 --> 00:29:58,080
experiments here on sls1

673
00:30:02,149 --> 00:30:00,080
one of my favorite experiments involves

674
00:30:04,470 --> 00:30:02,159
this rotating dome

675
00:30:06,830 --> 00:30:04,480
what the dome does is to help us see how

676
00:30:09,830 --> 00:30:06,840
visual cues affect the way our body

677
00:30:11,750 --> 00:30:09,840
responds to do the experiment millie

678
00:30:14,389 --> 00:30:11,760
will put her head in the dome

679
00:30:16,549 --> 00:30:14,399
and look at the dots as they rotate

680
00:30:17,909 --> 00:30:16,559
her eyes naturally want to lock onto the

681
00:30:20,470 --> 00:30:17,919
dots

682
00:30:23,590 --> 00:30:20,480
this causes her body to want to keep up

683
00:30:25,909 --> 00:30:23,600
with her eyes and pretty soon her whole

684
00:30:27,830 --> 00:30:25,919
body will feel like it is turning

685
00:30:29,590 --> 00:30:27,840
but it really isn't

686
00:30:32,630 --> 00:30:29,600
a camera mounted in the dome is

687
00:30:35,750 --> 00:30:32,640
recording her eye reaction

688
00:30:37,909 --> 00:30:35,760

back on earth scientists will study this

689
00:30:39,750 --> 00:30:37,919
and other data we've collected to see if

690
00:30:41,669 --> 00:30:39,760
they can answer some of the questions

691
00:30:44,149 --> 00:30:41,679
about how our neuro vestibular system

692
00:30:45,669 --> 00:30:44,159
works and why we get space motion

693
00:30:47,110 --> 00:30:45,679
sickness

694
00:30:48,070 --> 00:30:47,120
i'll leave you with a small bit of

695
00:30:49,830 --> 00:30:48,080
advice

696
00:30:52,230 --> 00:30:49,840
the next time you're on a roller coaster

697
00:31:01,269 --> 00:30:52,240
ride and you feel yourself getting sick

698
00:31:05,990 --> 00:31:03,430
our body systems are so different from

699
00:31:07,350 --> 00:31:06,000
each other yet they all depend so much

700
00:31:09,830 --> 00:31:07,360
on each other

701
00:31:13,590 --> 00:31:09,840
they perform their jobs each day in a

702
00:31:16,070 --> 00:31:13,600
way that most of us never realize

703
00:31:18,789 --> 00:31:16,080
our goal at nasa is to enable the human

704
00:31:20,710 --> 00:31:18,799
exploration of space but to do that we

705
00:31:21,990 --> 00:31:20,720
have to understand how space affects our

706
00:31:24,070 --> 00:31:22,000
bodies

707
00:31:26,549 --> 00:31:24,080
space lab missions like this one are a

708
00:31:29,269 --> 00:31:26,559
step toward that goal but only a small

709
00:31:33,350 --> 00:31:31,669
orbiting laboratories will allow us even

710
00:31:36,149 --> 00:31:33,360
longer periods to investigate the

711
00:31:38,070 --> 00:31:36,159
mysteries of the human body

712
00:31:40,470 --> 00:31:38,080
hopefully the benefits of all

713
00:31:42,789 --> 00:31:40,480

space-based research may someday help

714
00:31:46,070 --> 00:31:42,799
solve the puzzles of such earthbound

715
00:31:49,350 --> 00:31:46,080
problems as heart disease emphysema

716
00:31:51,830 --> 00:31:49,360
osteoporosis and other disorders

717
00:31:56,470 --> 00:31:51,840
the possibilities are as limitless as

718
00:32:01,110 --> 00:31:59,110
spacecraft life sciences one has been a

719
00:32:03,190 --> 00:32:01,120
valuable learning experience for all of

720
00:32:49,509 --> 00:32:03,200
us we're really glad you could join us