National Aeronautics and
Space Administration

1
00:00:06,470 --> 00:00:03,429
the story of nasa's langley research

2
00:00:07,829 --> 00:00:06,480
center is the story of taking what seems

3
00:00:10,310 --> 00:00:07,839
impossible

4
00:00:12,549 --> 00:00:10,320
and making it reality

5
00:00:14,709 --> 00:00:12,559
it began just 14 years after the wright

6
00:00:17,590 --> 00:00:14,719
brothers achieved the elusive

7
00:00:18,550 --> 00:00:17,600
some said preposterous goal of powered

8
00:00:21,830 --> 00:00:18,560
flight

9
00:00:24,230 --> 00:00:21,840
a goal chased by humankind for millennia

10
00:00:27,189 --> 00:00:24,240
their 120-foot journey at kitty hawk

11
00:00:30,150 --> 00:00:27,199
north carolina in 1903

12
00:00:32,470 --> 00:00:30,160
broke the impossibility barrier setting

13
00:00:34,470 --> 00:00:32,480

the course for the next century

14
00:00:36,950 --> 00:00:34,480
and beyond

15
00:00:38,709 --> 00:00:36,960
the united states invented the first

16
00:00:41,190 --> 00:00:38,719
successful airplane

17
00:00:42,869 --> 00:00:41,200
but european countries brought aviation

18
00:00:44,630 --> 00:00:42,879
to new heights

19
00:00:47,910 --> 00:00:44,640
from the start a number of european

20
00:00:50,630 --> 00:00:47,920
governments funded aeronautics research

21
00:00:53,189 --> 00:00:50,640
which paid off when world war one broke

22
00:00:55,590 --> 00:00:53,199
out in 1914

23
00:00:58,470 --> 00:00:55,600
even before the war aviation leaders

24
00:01:00,389 --> 00:00:58,480
realized the us was falling behind and

25
00:01:01,349 --> 00:01:00,399
pressed washington to do something about

26
00:01:03,270 --> 00:01:01,359
it

27
00:01:05,590 --> 00:01:03,280
so in 1915

28
00:01:08,950 --> 00:01:05,600
congress authorized five thousand

29
00:01:14,550 --> 00:01:08,960
dollars to create the national advisory

30
00:01:17,190 --> 00:01:14,560
committee for aeronautics the naca

31
00:01:21,270 --> 00:01:17,200
this little seed planted in the fertile

32
00:01:23,910 --> 00:01:21,280
farmland of hampton virginia in 1917

33
00:01:26,789 --> 00:01:23,920
grew to become nasa langley

34
00:01:30,630 --> 00:01:26,799
america's first civilian aeronautics

35
00:01:32,230 --> 00:01:30,640
research lab and nasa's first center

36
00:01:33,749 --> 00:01:32,240
and it's been reaching for the

37
00:01:37,220 --> 00:01:33,759
impossible

38
00:01:48,860 --> 00:01:46,630

[Music]

39
00:01:56,389 --> 00:01:48,870
but because

40
00:01:56,399 --> 00:02:02,580
roger

41
00:02:02,590 --> 00:02:52,949
[Music]

42
00:02:56,390 --> 00:02:54,550
the national advisory committee for

43
00:02:58,390 --> 00:02:56,400
aeronautics facility began as

44
00:03:00,390 --> 00:02:58,400
administrative offices and a wind tunnel

45
00:03:02,550 --> 00:03:00,400
building on rural land that the u.s air

46
00:03:04,630 --> 00:03:02,560
service wasn't using

47
00:03:06,949 --> 00:03:04,640
the naca broke ground for the langley

48
00:03:09,750 --> 00:03:06,959
memorial aeronautical laboratory on july

49
00:03:11,910 --> 00:03:09,760
17 1917.

50
00:03:13,930 --> 00:03:11,920
topographically it was a swamp

51
00:03:15,110 --> 00:03:13,940
but geographically it was ideal

52
00:03:18,070 --> 00:03:15,120
[Music]

53
00:03:21,270 --> 00:03:18,080
hampton was really the perfect area for

54
00:03:23,830 --> 00:03:21,280
a facility like langley the us army air

55
00:03:25,830 --> 00:03:23,840
service was already there so there was

56
00:03:27,670 --> 00:03:25,840
already flying going on

57
00:03:29,750 --> 00:03:27,680
and what the engineers liked was the

58
00:03:32,390 --> 00:03:29,760
fact that it was a pretty good distance

59
00:03:34,390 --> 00:03:32,400
from washington so the suits were up

60
00:03:36,309 --> 00:03:34,400
there and the engineers had langley to

61
00:03:38,149 --> 00:03:36,319
themselves

62
00:03:41,030 --> 00:03:38,159
world war one had shown aircraft's need

63
00:03:42,949 --> 00:03:41,040

for more speed power and agility

64
00:03:45,030 --> 00:03:42,959
not just in wartime but for untapped

65
00:03:46,630 --> 00:03:45,040
commercial possibilities

66
00:03:49,430 --> 00:03:46,640
it was for that reason langley was

67
00:03:52,550 --> 00:03:49,440
conceived as a truly national laboratory

68
00:03:54,789 --> 00:03:52,560
to benefit aeronautical exploration

69
00:03:56,390 --> 00:03:54,799
from the start plainly dedicated itself

70
00:03:57,830 --> 00:03:56,400
to building the tools

71
00:03:59,270 --> 00:03:57,840
setting the rules

72
00:04:01,990 --> 00:03:59,280
and solving the problems that kept

73
00:04:04,309 --> 00:04:02,000
flight from reaching its potential

74
00:04:07,429 --> 00:04:04,319
at the time langley was established the

75
00:04:09,670 --> 00:04:07,439
potential for aeronautics was as big as

76
00:04:12,869 --> 00:04:09,680
the sky there was no place to go

77
00:04:16,150 --> 00:04:12,879
literally but up the united states was

78
00:04:18,870 --> 00:04:16,160
really far behind europe in terms of

79
00:04:21,509 --> 00:04:18,880
aeronautical research and progress

80
00:04:24,230 --> 00:04:21,519
the europeans after all had been driven

81
00:04:26,310 --> 00:04:24,240
by the fear of war and then an actual

82
00:04:27,670 --> 00:04:26,320
war lots of money going into the

83
00:04:30,390 --> 00:04:27,680
technology

84
00:04:31,270 --> 00:04:30,400
in this country not so much

85
00:04:34,390 --> 00:04:31,280
and

86
00:04:36,950 --> 00:04:34,400
the founders of the naca recognized just

87
00:04:40,870 --> 00:04:36,960
how important those european labs had

88
00:04:42,710 --> 00:04:40,880

been in pushing european aeronautics

89
00:04:44,710 --> 00:04:42,720
langley came online as america's first

90
00:04:48,150 --> 00:04:44,720
civilian aeronautical research lab in

91
00:04:49,749 --> 00:04:48,160
1920. the naca's first atmospheric wind

92
00:04:53,030 --> 00:04:49,759
tunnel was already at work testing

93
00:04:54,710 --> 00:04:53,040
aerodynamic forces that affect aircraft

94
00:04:57,270 --> 00:04:54,720
it was a good beginning but by no means

95
00:04:59,270 --> 00:04:57,280
state of the art the aerodynamicists

96
00:05:00,390 --> 00:04:59,280
knew they needed to do better a lot

97
00:05:03,749 --> 00:05:00,400
better

98
00:05:05,670 --> 00:05:03,759
and they did two years later in 1922

99
00:05:07,189 --> 00:05:05,680
they powered up a new device no one had

100
00:05:09,270 --> 00:05:07,199
ever seen before

101
00:05:12,629 --> 00:05:09,280
the world's first pressurized wind

102
00:05:14,710 --> 00:05:12,639
tunnel the variable density tunnel

103
00:05:15,590 --> 00:05:14,720
one of the things they did with it early

104
00:05:18,550 --> 00:05:15,600
on

105
00:05:20,390 --> 00:05:18,560
was to run a whole spring of airfoil

106
00:05:23,189 --> 00:05:20,400
tests just

107
00:05:25,990 --> 00:05:23,199
all kinds of airfoil shapes and they

108
00:05:28,469 --> 00:05:26,000
published the data in kind of a catalog

109
00:05:31,749 --> 00:05:28,479
that was really of revolutionary

110
00:05:34,710 --> 00:05:31,759
importance for airplane designers you

111
00:05:36,469 --> 00:05:34,720
could go to the naca catalog you could

112
00:05:39,189 --> 00:05:36,479
pick out an airfoil that had the

113
00:05:40,230 --> 00:05:39,199

characteristics you wanted and there you

114
00:05:42,390 --> 00:05:40,240
go

115
00:05:44,550 --> 00:05:42,400
these reports still used by aircraft

116
00:05:46,390 --> 00:05:44,560
designers today kicked off langley's

117
00:05:47,830 --> 00:05:46,400
reputation as a preeminent research

118
00:05:49,670 --> 00:05:47,840
facility

119
00:05:50,710 --> 00:05:49,680
the value of langley's wind tunnels came

120
00:05:53,909 --> 00:05:50,720
early

121
00:05:55,830 --> 00:05:53,919
in 1928 langley engineer fred weick used

122
00:05:58,469 --> 00:05:55,840
the propeller research tunnel to design

123
00:06:01,189 --> 00:05:58,479
a cowling or cover for propeller engines

124
00:06:03,830 --> 00:06:01,199
that reduced drag cooled the engine and

125
00:06:06,150 --> 00:06:03,840
increased an aircraft's flight speed

126
00:06:08,309 --> 00:06:06,160
it was those sorts of improvements

127
00:06:11,830 --> 00:06:08,319
coming out of the naca

128
00:06:14,309 --> 00:06:11,840
that really laid the foundation for

129
00:06:17,590 --> 00:06:14,319
the advance of both military and

130
00:06:19,590 --> 00:06:17,600
commercial aviation in this country

131
00:06:21,430 --> 00:06:19,600
success followed success

132
00:06:22,870 --> 00:06:21,440
encouraged by the propeller research

133
00:06:25,670 --> 00:06:22,880
tunnel which was big enough for a

134
00:06:27,909 --> 00:06:25,680
full-size aircraft minus the wings

135
00:06:30,469 --> 00:06:27,919
langley built a tunnel to test entire

136
00:06:33,430 --> 00:06:30,479
planes wings and all

137
00:06:35,309 --> 00:06:33,440
in 1931 langley opened the full-scale

138
00:06:38,150 --> 00:06:35,319

tunnel which could test at speeds up to

139
00:06:40,629 --> 00:06:38,160
118 miles per hour

140
00:06:43,590 --> 00:06:40,639
you really can't talk about the history

141
00:06:47,029 --> 00:06:43,600
of aeronautical research at langley

142
00:06:50,390 --> 00:06:47,039
without talking about those wind tunnels

143
00:06:52,710 --> 00:06:50,400
as you get into the mid and late 1930s

144
00:06:54,710 --> 00:06:52,720
langley on the basis of the airfoil

145
00:06:56,550 --> 00:06:54,720
research the cowling

146
00:06:58,870 --> 00:06:56,560
and all of the other work they were

147
00:07:01,909 --> 00:06:58,880
doing had established itself the

148
00:07:04,469 --> 00:07:01,919
engineers had established themselves as

149
00:07:07,270 --> 00:07:04,479
a match for anybody else in the world

150
00:07:09,670 --> 00:07:07,280
the germans the english langley was

151
00:07:13,909 --> 00:07:09,680
right there contributing to the body of

152
00:07:19,189 --> 00:07:16,469
and when the winds of war began to blow

153
00:07:20,629 --> 00:07:19,199
langley's tunnels were ready to serve

154
00:07:23,350 --> 00:07:20,639
many believed we would never beat

155
00:07:24,790 --> 00:07:23,360
germany's superior air power

156
00:07:26,790 --> 00:07:24,800
and based on how things looked at the

157
00:07:29,510 --> 00:07:26,800
end of world war one that would be a

158
00:07:35,029 --> 00:07:29,520
reasonable assumption

159
00:07:40,950 --> 00:07:37,670
during the war i think the lights never

160
00:07:43,189 --> 00:07:40,960
went out at langley research center

161
00:07:46,070 --> 00:07:43,199
the full-scale tunnel i mean you could

162
00:07:47,270 --> 00:07:46,080
put a full-scale fighter with a 40-foot

163
00:07:49,430 --> 00:07:47,280

wingspan

164
00:07:52,550 --> 00:07:49,440
in that tunnel and do

165
00:07:54,070 --> 00:07:52,560
really important tests with it

166
00:07:55,350 --> 00:07:54,080
those tests were possible in part

167
00:07:57,189 --> 00:07:55,360
because of women

168
00:07:58,469 --> 00:07:57,199
who filled critically important jobs in

169
00:08:00,469 --> 00:07:58,479
machine shops

170
00:08:02,230 --> 00:08:00,479
laboratories and offices

171
00:08:04,390 --> 00:08:02,240
while men were at war

172
00:08:07,029 --> 00:08:04,400
the langley research center

173
00:08:09,189 --> 00:08:07,039
just played an incredibly important role

174
00:08:11,670 --> 00:08:09,199
during world war ii as it had in the

175
00:08:13,670 --> 00:08:11,680
years leading up to the war

176
00:08:15,990 --> 00:08:13,680
after the war the innovations kept

177
00:08:18,390 --> 00:08:16,000
coming to increase structural integrity

178
00:08:21,110 --> 00:08:18,400
safety and speed

179
00:08:22,230 --> 00:08:21,120
but how fast could we go

180
00:08:25,670 --> 00:08:22,240
speed

181
00:08:29,350 --> 00:08:25,680
was at that time one of the things that

182
00:08:32,469 --> 00:08:29,360
aeronautics was all about after all

183
00:08:35,430 --> 00:08:32,479
and langley from the days of the nac

184
00:08:39,190 --> 00:08:35,440
cowling and the other advancements had

185
00:08:42,870 --> 00:08:39,200
certainly done its part to build speed

186
00:08:45,269 --> 00:08:42,880
by the late 1930s and during the war it

187
00:08:48,870 --> 00:08:45,279
became clear to engineers though there

188
00:08:51,509 --> 00:08:48,880

was a real problem on the horizon

189
00:08:53,829 --> 00:08:51,519
that problem was the sound barrier

190
00:08:55,829 --> 00:08:53,839
during world war ii pilots noted that in

191
00:08:57,990 --> 00:08:55,839
steep dives as aircraft approached the

192
00:08:59,350 --> 00:08:58,000
speed of sound mach 1

193
00:09:01,190 --> 00:08:59,360
they would behave differently than at

194
00:09:02,870 --> 00:09:01,200
slower speeds

195
00:09:04,949 --> 00:09:02,880
langley's tunnels would again be needed

196
00:09:07,190 --> 00:09:04,959
to solve that problem but first the

197
00:09:09,509 --> 00:09:07,200
tunnels themselves had to change

198
00:09:11,910 --> 00:09:09,519
the eight foot high-speed wind tunnel

199
00:09:14,710 --> 00:09:11,920
could handle speeds of up to 500 miles

200
00:09:16,630 --> 00:09:14,720
an hour when you get air much faster

201
00:09:20,070 --> 00:09:16,640
than that flowing through a normal

202
00:09:22,790 --> 00:09:20,080
tunnel it began to create

203
00:09:24,870 --> 00:09:22,800
all sorts of problems with the reaction

204
00:09:27,829 --> 00:09:24,880
of the air to the wall of the tunnel and

205
00:09:30,150 --> 00:09:27,839
you weren't getting good data anymore

206
00:09:31,990 --> 00:09:30,160
in the late 1940s langley's ray wright

207
00:09:33,030 --> 00:09:32,000
with the support of division chief john

208
00:09:34,949 --> 00:09:33,040
stack

209
00:09:36,710 --> 00:09:34,959
experimented with ways to relieve these

210
00:09:39,110 --> 00:09:36,720
effects so that testing at transonic

211
00:09:40,389 --> 00:09:39,120
speeds could be done

212
00:09:42,949 --> 00:09:40,399
they developed what they called the

213
00:09:44,790 --> 00:09:42,959

slotted throat wind tunnel

214
00:09:47,030 --> 00:09:44,800
you'd always been able to test at

215
00:09:50,150 --> 00:09:47,040
supersonic speeds and of course at

216
00:09:52,790 --> 00:09:50,160
subsonic speeds but it was in the

217
00:09:53,829 --> 00:09:52,800
transonic area where the tunnels had a

218
00:09:54,790 --> 00:09:53,839
problem

219
00:09:57,750 --> 00:09:54,800
until

220
00:10:00,230 --> 00:09:57,760
langley engineers saw

221
00:10:02,150 --> 00:10:00,240
this was the dawn of the supersonic age

222
00:10:03,670 --> 00:10:02,160
where research would push flight beyond

223
00:10:05,430 --> 00:10:03,680
the speed of sound

224
00:10:06,870 --> 00:10:05,440
it was time to take some of the testing

225
00:10:08,870 --> 00:10:06,880
out of the tunnels

226
00:10:11,030 --> 00:10:08,880
the u.s army air force teamed up with

227
00:10:12,949 --> 00:10:11,040
langley and bell aircraft to develop an

228
00:10:15,910 --> 00:10:12,959
experimental rocket engine powered

229
00:10:17,590 --> 00:10:15,920
aircraft the x1

230
00:10:19,110 --> 00:10:17,600
one solution

231
00:10:21,509 --> 00:10:19,120
was to

232
00:10:24,949 --> 00:10:21,519
design an airplane to go out and gather

233
00:10:28,550 --> 00:10:24,959
the data and that's what the x1 was

234
00:10:31,750 --> 00:10:28,560
on october 14 1947 test pilot chuck

235
00:10:33,829 --> 00:10:31,760
yeager took the x1 on its 50th flight

236
00:10:36,069 --> 00:10:33,839
and became the first person to break the

237
00:10:39,110 --> 00:10:36,079
sound barrier

238
00:10:41,430 --> 00:10:39,120

mach 1 was not only reachable but thanks

239
00:10:42,550 --> 00:10:41,440
to langley and others research just the

240
00:10:44,470 --> 00:10:42,560
beginning

241
00:10:46,790 --> 00:10:44,480
the future was suddenly coming at us

242
00:10:48,550 --> 00:10:46,800
faster than sound and langley was up for

243
00:10:49,910 --> 00:10:48,560
the challenge of the new high-speed

244
00:10:51,190 --> 00:10:49,920
frontier

245
00:10:55,030 --> 00:10:51,200
at the time

246
00:10:57,990 --> 00:10:55,040
the x1 flew through the sound barrier

247
00:10:59,670 --> 00:10:58,000
it meant a couple of things for langley

248
00:11:01,670 --> 00:10:59,680
while the wind tunnels were still

249
00:11:03,910 --> 00:11:01,680
incredibly important and engineers were

250
00:11:07,030 --> 00:11:03,920
still doing that work now there were

251
00:11:09,269 --> 00:11:07,040
these new tools research airplanes

252
00:11:12,150 --> 00:11:09,279
and so suddenly

253
00:11:14,790 --> 00:11:12,160
the mission of the naca and langley

254
00:11:16,630 --> 00:11:14,800
began to change a little bit

255
00:11:18,550 --> 00:11:16,640
one of the most brilliant innovations

256
00:11:19,829 --> 00:11:18,560
sprang from the mind of engineer richard

257
00:11:22,949 --> 00:11:19,839
whitcomb

258
00:11:24,710 --> 00:11:22,959
it's called the area rule

259
00:11:25,990 --> 00:11:24,720
the design concept

260
00:11:28,470 --> 00:11:26,000
provides

261
00:11:31,670 --> 00:11:28,480
for a indentation

262
00:11:34,870 --> 00:11:31,680
in the fuselage near the wing

263
00:11:37,670 --> 00:11:34,880

this indentation reduces the drag at

264
00:11:40,870 --> 00:11:37,680
transonic speeds and thus allows the

265
00:11:44,710 --> 00:11:40,880
airplane to fly faster and farther

266
00:11:49,590 --> 00:11:47,350
by the mid 50s the supersonic age gave

267
00:11:52,949 --> 00:11:49,600
way to the hypersonic era and the race

268
00:11:54,629 --> 00:11:52,959
to achieve speed above mach 5.

269
00:11:58,150 --> 00:11:54,639
langley's researchers worked with the

270
00:12:00,550 --> 00:11:58,160
other naca centers the navy army air

271
00:12:03,110 --> 00:12:00,560
force and north american aviation to

272
00:12:05,670 --> 00:12:03,120
design build and test the experimental

273
00:12:07,750 --> 00:12:05,680
hypersonic x-15

274
00:12:10,230 --> 00:12:07,760
the world's first hypersonic research

275
00:12:13,269 --> 00:12:10,240
aircraft made its maiden voyage on june

276
00:12:16,310 --> 00:12:13,279
8 1959

277
00:12:19,750 --> 00:12:16,320
mark 5 is hypersonic

278
00:12:21,350 --> 00:12:19,760
and of course the most famous hypersonic

279
00:12:23,350 --> 00:12:21,360
manned vehicle

280
00:12:26,310 --> 00:12:23,360
was the x-15

281
00:12:28,310 --> 00:12:26,320
and again langley's involved in helping

282
00:12:29,910 --> 00:12:28,320
to think about the aerodynamics of that

283
00:12:33,030 --> 00:12:29,920
vehicle and

284
00:12:35,190 --> 00:12:33,040
in testing it i mean it was an naca

285
00:12:37,590 --> 00:12:35,200
nasa program

286
00:12:39,590 --> 00:12:37,600
that really did bridge

287
00:12:40,949 --> 00:12:39,600
from the age of the air to the age of

288
00:12:43,590 --> 00:12:40,959

space

289
00:12:45,750 --> 00:12:43,600
the sky was no longer the limit

290
00:12:47,110 --> 00:12:45,760
and whether or not anyone realized it at

291
00:13:00,550 --> 00:12:47,120
the time

292
00:13:04,629 --> 00:13:02,710
as the early x-planes began to scrape

293
00:13:07,269 --> 00:13:04,639
the edge of space langley

294
00:13:09,509 --> 00:13:07,279
aerodynamicists looked even further the

295
00:13:11,750 --> 00:13:09,519
u.s had much to learn about rockets and

296
00:13:14,310 --> 00:13:11,760
to learn it langley turned to one of its

297
00:13:16,389 --> 00:13:14,320
up-and-coming engineers

298
00:13:18,629 --> 00:13:16,399
well robert gilbreth was an engineer an

299
00:13:21,030 --> 00:13:18,639
aerodynamicist who went to work at the

300
00:13:23,110 --> 00:13:21,040
langley memorial aeronautical laboratory

301
00:13:25,030 --> 00:13:23,120
just before world war ii

302
00:13:27,110 --> 00:13:25,040
at the end of world war ii he was

303
00:13:29,670 --> 00:13:27,120
instrumental in creating the pilotless

304
00:13:32,310 --> 00:13:29,680
aircraft research division now during

305
00:13:35,509 --> 00:13:32,320
those early years they were exploring

306
00:13:37,670 --> 00:13:35,519
the flight regime around transonics

307
00:13:40,949 --> 00:13:37,680
into supersonic and ultimately

308
00:13:44,389 --> 00:13:40,959
hypersonic flight so it was very much a

309
00:13:46,150 --> 00:13:44,399
rocket development organization

310
00:13:48,790 --> 00:13:46,160
the team's launching of test rockets

311
00:13:51,110 --> 00:13:48,800
from wallops island a remote former navy

312
00:13:53,670 --> 00:13:51,120
base on virginia's eastern shore

313
00:13:59,590 --> 00:13:53,680

was mostly pure research

314
00:14:06,470 --> 00:14:02,870
in october 1957 the soviets launched the

315
00:14:08,949 --> 00:14:06,480
sputnik spacecraft and stunned the world

316
00:14:12,470 --> 00:14:08,959
the next july president eisenhower

317
00:14:16,629 --> 00:14:12,480
signed an act to create a space agency

318
00:14:18,790 --> 00:14:16,639
on october 1 1958 the four naca research

319
00:14:21,269 --> 00:14:18,800
labs including the newly named langley

320
00:14:23,189 --> 00:14:21,279
research center formed the nucleus of

321
00:14:26,550 --> 00:14:23,199
the national aeronautics and space

322
00:14:31,910 --> 00:14:29,990
nasa now included a human space program

323
00:14:33,829 --> 00:14:31,920
langley was its birthplace

324
00:14:35,590 --> 00:14:33,839
and became home to america's first

325
00:14:36,930 --> 00:14:35,600
astronauts

326
00:14:39,030 --> 00:14:36,940
the mercury seven

327
00:14:40,870 --> 00:14:39,040
[Music]

328
00:14:43,509 --> 00:14:40,880
the pilotless aircraft research division

329
00:14:45,750 --> 00:14:43,519
is assigned responsibility as it is

330
00:14:48,790 --> 00:14:45,760
transitioned into something called the

331
00:14:50,629 --> 00:14:48,800
space task group for project mercury the

332
00:14:53,509 --> 00:14:50,639
first human spaceflight activity so

333
00:14:55,430 --> 00:14:53,519
langley becomes the centerpiece of the

334
00:14:57,509 --> 00:14:55,440
human space flight program for the

335
00:15:00,710 --> 00:14:57,519
united states the astronauts are

336
00:15:02,389 --> 00:15:00,720
selected they are unveiled they are

337
00:15:05,110 --> 00:15:02,399
operating at langley for the first

338
00:15:05,990 --> 00:15:05,120

period of the program

339
00:15:09,350 --> 00:15:06,000
they

340
00:15:12,790 --> 00:15:09,360
work on the design and research

341
00:15:14,629 --> 00:15:12,800
necessary to build the mercury capsule

342
00:15:16,310 --> 00:15:14,639
gill ruth group worked through a host of

343
00:15:18,069 --> 00:15:16,320
technical issues

344
00:15:19,990 --> 00:15:18,079
like establishing ways to protect

345
00:15:22,150 --> 00:15:20,000
astronauts during re-entry and

346
00:15:23,990 --> 00:15:22,160
developing simulators to train humans

347
00:15:26,150 --> 00:15:24,000
how to work in space

348
00:15:27,910 --> 00:15:26,160
it also created a global communication

349
00:15:29,749 --> 00:15:27,920
system to maintain contact with

350
00:15:32,069 --> 00:15:29,759
spacecraft

351
00:15:34,069 --> 00:15:32,079
and to streamline operations nasa's

352
00:15:36,310 --> 00:15:34,079
first flight director langley's chris

353
00:15:39,110 --> 00:15:36,320
craft applied the concept as something

354
00:15:41,269 --> 00:15:39,120
now synonymous with space flight

355
00:15:43,509 --> 00:15:41,279
mission control

356
00:15:46,150 --> 00:15:43,519
that was an idea that goes back to

357
00:15:48,389 --> 00:15:46,160
the world wars in which flight control

358
00:15:50,949 --> 00:15:48,399
is a centerpiece

359
00:15:53,509 --> 00:15:50,959
you have to understand the logistics of

360
00:15:56,230 --> 00:15:53,519
movement and how things are going to be

361
00:15:58,389 --> 00:15:56,240
operating all of that can be done from a

362
00:16:00,310 --> 00:15:58,399
room if you will with

363
00:16:03,030 --> 00:16:00,320

communication systems coming in and

364
00:16:04,230 --> 00:16:03,040
going out and data coming in and going

365
00:16:07,030 --> 00:16:04,240
out

366
00:16:09,910 --> 00:16:07,040
and they modified those ideas from the

367
00:16:11,509 --> 00:16:09,920
military and created the modern mission

368
00:16:13,430 --> 00:16:11,519
control

369
00:16:15,829 --> 00:16:13,440
all of these technological advances

370
00:16:17,829 --> 00:16:15,839
required mathematical experts

371
00:16:20,230 --> 00:16:17,839
one of the most well-known was langley's

372
00:16:22,150 --> 00:16:20,240
catherine johnson

373
00:16:24,230 --> 00:16:22,160
for years langley had hired women to

374
00:16:26,629 --> 00:16:24,240
operate primitive mechanical calculating

375
00:16:28,550 --> 00:16:26,639
machines

376
00:16:31,110 --> 00:16:28,560
later those human computers included

377
00:16:33,110 --> 00:16:31,120
african-americans like johnson

378
00:16:35,430 --> 00:16:33,120
who went on to calculate the trajectory

379
00:16:37,110 --> 00:16:35,440
analysis for the first american in space

380
00:16:39,269 --> 00:16:37,120
alan shepard

381
00:16:40,629 --> 00:16:39,279
she also verified computer calculations

382
00:16:43,509 --> 00:16:40,639
for john glenn

383
00:16:45,509 --> 00:16:43,519
the first american to orbit the earth

384
00:16:47,430 --> 00:16:45,519
her contributions were so great that she

385
00:16:50,949 --> 00:16:47,440
was later awarded the presidential medal

386
00:16:56,629 --> 00:16:53,910
in the 1960s the space age born at

387
00:16:58,389 --> 00:16:56,639
langley took its next giant step

388
00:16:59,910 --> 00:16:58,399

with a little nudge from president john

389
00:17:01,829 --> 00:16:59,920
f kennedy

390
00:17:05,270 --> 00:17:01,839
just 20 days after alan shepard's

391
00:17:08,949 --> 00:17:05,280
historic 1961 flight the president gives

392
00:17:11,270 --> 00:17:08,959
his decision to go to the moon speech

393
00:17:13,750 --> 00:17:11,280
we choose to go to the moon in this

394
00:17:16,150 --> 00:17:13,760
decade and do the other things not

395
00:17:17,429 --> 00:17:16,160
because they are easy but because they

396
00:17:19,429 --> 00:17:17,439
are hard

397
00:17:21,829 --> 00:17:19,439
because that goal

398
00:17:22,789 --> 00:17:21,839
will serve to organize and measure the

399
00:17:24,870 --> 00:17:22,799
best

400
00:17:27,189 --> 00:17:24,880
of our energies and skills

401
00:17:28,870 --> 00:17:27,199
because that challenge is one that we're

402
00:17:31,590 --> 00:17:28,880
willing to accept

403
00:17:34,230 --> 00:17:31,600
one we are unwilling to postpone

404
00:17:36,310 --> 00:17:34,240
and one we intend to win and the others

405
00:17:38,710 --> 00:17:36,320
do

406
00:17:40,470 --> 00:17:38,720
it's a technological miracle in many

407
00:17:43,110 --> 00:17:40,480
ways no one's ever even tried this

408
00:17:44,950 --> 00:17:43,120
before in terms of reaching the moon

409
00:17:46,630 --> 00:17:44,960
there were three options that anyone

410
00:17:48,950 --> 00:17:46,640
could think of the first option was

411
00:17:50,549 --> 00:17:48,960
let's build a really big rocket let's

412
00:17:52,390 --> 00:17:50,559
fly it to the moon

413
00:17:54,870 --> 00:17:52,400

and then let's land

414
00:17:55,750 --> 00:17:54,880
a piece of it on the surface

415
00:17:58,870 --> 00:17:55,760
and

416
00:18:00,630 --> 00:17:58,880
that sort of direct ascent option was

417
00:18:02,390 --> 00:18:00,640
very quickly put off the table because

418
00:18:03,590 --> 00:18:02,400
it was just too expensive and difficult

419
00:18:05,909 --> 00:18:03,600
to do

420
00:18:07,669 --> 00:18:05,919
the second option was called earth orbit

421
00:18:10,310 --> 00:18:07,679
rendezvous

422
00:18:15,110 --> 00:18:10,320
you send up multiple spacecraft into

423
00:18:17,510 --> 00:18:15,120
earth orbit you convene a armada if you

424
00:18:19,590 --> 00:18:17,520
will in earth orbit they assemble a set

425
00:18:20,950 --> 00:18:19,600
of vehicles to go to the moon they go to

426
00:18:22,230 --> 00:18:20,960
the moon they do their mission and they

427
00:18:24,150 --> 00:18:22,240
come back

428
00:18:26,549 --> 00:18:24,160
but then a less expensive dark horse

429
00:18:28,950 --> 00:18:26,559
candidate arrived on the scene

430
00:18:31,270 --> 00:18:28,960
lunar orbit rendezvous

431
00:18:33,029 --> 00:18:31,280
in fact it did not have a very strong

432
00:18:35,990 --> 00:18:33,039
following in the senior leadership at

433
00:18:36,870 --> 00:18:36,000
nasa in the early 1960s

434
00:18:39,190 --> 00:18:36,880
and

435
00:18:40,710 --> 00:18:39,200
a langley engineer by the name of john

436
00:18:43,029 --> 00:18:40,720
hobolt

437
00:18:44,150 --> 00:18:43,039
did the math on this worked out how it

438
00:18:47,430 --> 00:18:44,160

could be

439
00:18:50,230 --> 00:18:47,440
undertaken successfully and more easily

440
00:18:53,110 --> 00:18:50,240
than earth orbit rendezvous

441
00:18:55,190 --> 00:18:53,120
hobolt envisioned a modular spacecraft

442
00:18:57,990 --> 00:18:55,200
launched as one unit

443
00:18:59,830 --> 00:18:58,000
as the main capsule orbits the moon

444
00:19:03,750 --> 00:18:59,840
a lander with two thirds of the crew

445
00:19:06,950 --> 00:19:03,760
would detach and go to the lunar surface

446
00:19:08,310 --> 00:19:06,960
hobalt's idea won out

447
00:19:09,750 --> 00:19:08,320
and this is an important decision

448
00:19:11,430 --> 00:19:09,760
because this would drive all the

449
00:19:13,270 --> 00:19:11,440
technology that would be developed to

450
00:19:16,390 --> 00:19:13,280
accomplish the moon program

451
00:19:19,990 --> 00:19:16,400
the apollo spacecraft the lunar module

452
00:19:21,830 --> 00:19:20,000
landing craft the big saturn v rocket

453
00:19:22,830 --> 00:19:21,840
were all predicated

454
00:19:25,750 --> 00:19:22,840
on that

455
00:19:28,070 --> 00:19:25,760
decision a couple of years later langley

456
00:19:30,390 --> 00:19:28,080
trained gemini and apollo astronauts how

457
00:19:32,070 --> 00:19:30,400
to rendezvous and dock two spacecraft

458
00:19:33,830 --> 00:19:32,080
while in orbit

459
00:19:35,350 --> 00:19:33,840
setting the stage for the apollo moon

460
00:19:36,950 --> 00:19:35,360
landing

461
00:19:39,909 --> 00:19:36,960
but before anything could land on the

462
00:19:42,070 --> 00:19:39,919
moon we had to know its surface

463
00:19:44,070 --> 00:19:42,080

five lunar orbiters took images and

464
00:19:45,750 --> 00:19:44,080
beamed them back to langley

465
00:19:47,590 --> 00:19:45,760
well lunar orbiter was an interesting

466
00:19:50,630 --> 00:19:47,600
program how do we get

467
00:19:51,510 --> 00:19:50,640
the best imagery that we can possibly

468
00:19:53,990 --> 00:19:51,520
get

469
00:19:56,230 --> 00:19:54,000
from the lunar surface with a spacecraft

470
00:19:58,710 --> 00:19:56,240
that's in lunar orbit

471
00:20:01,510 --> 00:19:58,720
with the intention of first and foremost

472
00:20:04,470 --> 00:20:01,520
finding good landing sites ones that are

473
00:20:07,029 --> 00:20:04,480
safe to land on but also geologically

474
00:20:09,510 --> 00:20:07,039
interesting so that astronauts can get

475
00:20:11,350 --> 00:20:09,520
out of the spacecraft collect samples

476
00:20:13,430 --> 00:20:11,360
take imagery and do all of the things

477
00:20:15,590 --> 00:20:13,440
that they're supposed to do

478
00:20:18,390 --> 00:20:15,600
the astronauts also had to be trained to

479
00:20:20,470 --> 00:20:18,400
fly the last 150 feet to the lunar

480
00:20:22,149 --> 00:20:20,480
surface and then move safely and

481
00:20:24,230 --> 00:20:22,159
comfortably in the moon's reduced

482
00:20:26,470 --> 00:20:24,240
gravity

483
00:20:28,310 --> 00:20:26,480
two dozen apollo astronauts including

484
00:20:30,630 --> 00:20:28,320
the first person on the moon neil

485
00:20:32,470 --> 00:20:30,640
armstrong trained for their missions at

486
00:20:34,950 --> 00:20:32,480
langley

487
00:20:37,029 --> 00:20:34,960
landing on the moon is not an easy task

488
00:20:40,070 --> 00:20:37,039

it's virtually impossible to simulate it

489
00:20:42,230 --> 00:20:40,080
here on earth they built a huge gantry

490
00:20:44,470 --> 00:20:42,240
at langley research center the lunar

491
00:20:45,430 --> 00:20:44,480
landing research facility

492
00:20:47,430 --> 00:20:45,440
which

493
00:20:49,430 --> 00:20:47,440
had cables and hooks and all kinds of

494
00:20:52,310 --> 00:20:49,440
things and you could put a vehicle that

495
00:20:54,950 --> 00:20:52,320
was a model of the lunar module

496
00:20:57,190 --> 00:20:54,960
suspended from this thing

497
00:20:59,669 --> 00:20:57,200
having conquered the moon langley turned

498
00:21:02,870 --> 00:20:59,679
to the next great challenge

499
00:21:04,710 --> 00:21:02,880
the viking program to mars

500
00:21:06,789 --> 00:21:04,720
a mission to investigate the planet's

501
00:21:09,110 --> 00:21:06,799
atmosphere and surface and to look for

502
00:21:11,510 --> 00:21:09,120
signs of life

503
00:21:13,190 --> 00:21:11,520
nasa langley managed the viking project

504
00:21:14,549 --> 00:21:13,200
and was responsible for the viking

505
00:21:17,029 --> 00:21:14,559
lander system

506
00:21:18,710 --> 00:21:17,039
and mission operations

507
00:21:21,029 --> 00:21:18,720
the history that it had with lunar

508
00:21:23,909 --> 00:21:21,039
orbiter in which it was very successful

509
00:21:26,310 --> 00:21:23,919
sort of gets transferred into the viking

510
00:21:28,230 --> 00:21:26,320
landing program

511
00:21:30,710 --> 00:21:28,240
a mission to mars is infinitely more

512
00:21:33,270 --> 00:21:30,720
complex than landing on the moon

513
00:21:35,510 --> 00:21:33,280

the viking 1 and viking 2 spacecraft

514
00:21:37,110 --> 00:21:35,520
each with its own orbiter and lander

515
00:21:39,430 --> 00:21:37,120
would take months to make the half

516
00:21:41,520 --> 00:21:39,440
billion mile journey to a rocky cratered

517
00:21:42,789 --> 00:21:41,530
planet that has very little atmosphere

518
00:21:44,470 --> 00:21:42,799
[Music]

519
00:21:48,310 --> 00:21:44,480
when viking one touched down on the

520
00:21:50,230 --> 00:21:48,320
martian surface on july 20th 1976

521
00:21:52,070 --> 00:21:50,240
it became the first spacecraft to land

522
00:21:55,810 --> 00:21:52,080
safely on the red planet and keep

523
00:21:59,190 --> 00:21:57,430
[Music]

524
00:22:01,510 --> 00:21:59,200
within seconds it started taking

525
00:22:04,870 --> 00:22:01,520
pictures of mars and itself

526
00:22:07,029 --> 00:22:04,880
what some call the first martian selfie

527
00:22:09,909 --> 00:22:07,039
viking was safe on mars gathering

528
00:22:11,830 --> 00:22:09,919
tantalizing data from another world

529
00:22:13,350 --> 00:22:11,840
the langley developed technologies that

530
00:22:15,110 --> 00:22:13,360
made it possible

531
00:22:18,549 --> 00:22:15,120
have continued to shape the robotic

532
00:22:22,710 --> 00:22:18,559
exploration of mars ever since

533
00:22:24,950 --> 00:22:22,720
it was a very significant coming of age

534
00:22:26,549 --> 00:22:24,960
for both nasa and langley research

535
00:22:28,310 --> 00:22:26,559
center langley

536
00:22:30,149 --> 00:22:28,320
was assigned this task and did it

537
00:22:33,830 --> 00:22:30,159
beautifully

538
00:22:36,470 --> 00:22:33,840

by the time viking 1 blinked out in 1982

539
00:22:38,390 --> 00:22:36,480
the world's first reusable spacecraft

540
00:22:40,950 --> 00:22:38,400
the space shuttle columbia was starting

541
00:22:42,789 --> 00:22:40,960
its fifth mission

542
00:22:45,990 --> 00:22:42,799
it launched on a rocket and returned to

543
00:22:50,549 --> 00:22:48,470
reusable spacecraft goes back to buck

544
00:22:53,830 --> 00:22:50,559
rogers in the first part of the 20th

545
00:22:57,510 --> 00:22:53,840
century the cartoon strips the movie

546
00:23:00,070 --> 00:22:57,520
serials the feature films they all use

547
00:23:01,669 --> 00:23:00,080
reusable spacecraft

548
00:23:03,510 --> 00:23:01,679
langley's researchers knew about

549
00:23:07,190 --> 00:23:03,520
reusable spacecraft from their work in

550
00:23:09,029 --> 00:23:07,200
hypersonic gliders and space planes

551
00:23:11,350 --> 00:23:09,039
beyond testing the preliminary shuttle

552
00:23:13,270 --> 00:23:11,360
designs and capturing tens of thousands

553
00:23:15,110 --> 00:23:13,280
of hours of wind tunnel data

554
00:23:17,270 --> 00:23:15,120
langley's engineers also conducted

555
00:23:19,110 --> 00:23:17,280
structures and materials tests

556
00:23:21,190 --> 00:23:19,120
evaluated shuttle tire and braking

557
00:23:22,160 --> 00:23:21,200
systems and improved its thermal

558
00:23:23,909 --> 00:23:22,170
protection system

559
00:23:27,430 --> 00:23:23,919
[Music]

560
00:23:32,310 --> 00:23:27,440
from 1981 through 2011 nasa's five

561
00:23:36,390 --> 00:23:34,710
its crew transported large cargo to low

562
00:23:37,909 --> 00:23:36,400
earth orbit

563
00:23:39,510 --> 00:23:37,919

launched repaired and recovered

564
00:23:41,190 --> 00:23:39,520
satellites

565
00:23:42,010 --> 00:23:41,200
and helped build the international space

566
00:23:43,750 --> 00:23:42,020
station

567
00:23:45,510 --> 00:23:43,760
[Music]

568
00:23:48,230 --> 00:23:45,520
with astronauts living and working in

569
00:23:50,149 --> 00:23:48,240
space since the year 2000

570
00:23:52,710 --> 00:23:50,159
and commercial companies now conducting

571
00:23:55,330 --> 00:23:52,720
supply missions to the space station

572
00:23:57,669 --> 00:23:55,340
nasa could focus on deep space travel

573
00:23:59,750 --> 00:23:57,679
[Music]

574
00:24:01,430 --> 00:23:59,760
with the red planet again in our sights

575
00:24:04,230 --> 00:24:01,440
langley and other nasa centers are

576
00:24:06,390 --> 00:24:04,240
working on the orion crew capsule and

577
00:24:08,780 --> 00:24:06,400
heavy lift rocket the space launch

578
00:24:11,029 --> 00:24:08,790
system or sls

579
00:24:12,870 --> 00:24:11,039
[Music]

580
00:24:14,789 --> 00:24:12,880
mars is sort of the big enchilada of

581
00:24:17,269 --> 00:24:14,799
places we'd like to go

582
00:24:19,590 --> 00:24:17,279
and i don't think there's anybody in the

583
00:24:21,510 --> 00:24:19,600
space community and probably a whole lot

584
00:24:23,269 --> 00:24:21,520
of people outside the space community

585
00:24:26,710 --> 00:24:23,279
who would like nothing more than to see

586
00:24:28,149 --> 00:24:26,720
astronauts set foot on on the red planet

587
00:24:30,710 --> 00:24:28,159
it's hard to do

588
00:24:32,789 --> 00:24:30,720

there's radiation hazards there's the

589
00:24:35,430 --> 00:24:32,799
microgravity environment that has to be

590
00:24:37,510 --> 00:24:35,440
dealt with all of those are challenges

591
00:24:39,909 --> 00:24:37,520
that need to be overcome to undertake a

592
00:24:41,590 --> 00:24:39,919
human mission to mars

593
00:24:43,909 --> 00:24:41,600
langley research is tackling these

594
00:24:45,830 --> 00:24:43,919
challenges and many more

595
00:24:47,669 --> 00:24:45,840
just like the testing of the saturn v

596
00:24:49,909 --> 00:24:47,679
and shuttle designs

597
00:24:51,590 --> 00:24:49,919
sls models are being tested in langley's

598
00:24:52,250 --> 00:24:51,600
tunnels and with langley computer

599
00:24:53,990 --> 00:24:52,260
know-how

600
00:24:55,909 --> 00:24:54,000
[Music]

601
00:24:58,230 --> 00:24:55,919
and langley engineers have led efforts

602
00:25:00,149 --> 00:24:58,240
to build a launch abort system designed

603
00:25:04,149 --> 00:25:00,159
to carry the crew away in the event of

604
00:25:08,070 --> 00:25:05,990
versions of the orion capsule have gone

605
00:25:11,750 --> 00:25:08,080
through testing at the same gantry used

606
00:25:14,230 --> 00:25:11,760
to train the apollo astronauts

607
00:25:16,149 --> 00:25:14,240
splash tests of orion mockups outfitted

608
00:25:18,630 --> 00:25:16,159
with sensors and some equipped with

609
00:25:20,470 --> 00:25:18,640
crash test dummies will help us better

610
00:25:22,470 --> 00:25:20,480
understand what the spacecraft and

611
00:25:25,510 --> 00:25:22,480
astronauts may experience when returning

612
00:25:27,510 --> 00:25:25,520
home after deep space missions

613
00:25:30,390 --> 00:25:27,520

one of the things that you have to do is

614
00:25:33,350 --> 00:25:30,400
come down in some sort of target area

615
00:25:35,590 --> 00:25:33,360
that is within the bounds of the ships

616
00:25:39,110 --> 00:25:35,600
that you've got at sea that are going to

617
00:25:40,789 --> 00:25:39,120
recover this vehicle you do not want to

618
00:25:43,269 --> 00:25:40,799
leave the astronauts bobbing in the

619
00:25:45,269 --> 00:25:43,279
water for too long

620
00:25:47,110 --> 00:25:45,279
langley researchers are using all their

621
00:25:55,220 --> 00:25:47,120
tools to make sure everything is on

622
00:26:02,950 --> 00:26:00,789
[Music]

623
00:26:04,549 --> 00:26:02,960
even as nasa and nasa langley turned

624
00:26:06,950 --> 00:26:04,559
their attention toward other parts of

625
00:26:08,870 --> 00:26:06,960
the solar system scientists never lost

626
00:26:11,110 --> 00:26:08,880
sight of planet earth

627
00:26:13,909 --> 00:26:11,120
atmospheric science work at nasa langley

628
00:26:16,230 --> 00:26:13,919
began in the early 1970s as an offshoot

629
00:26:18,630 --> 00:26:16,240
of its aeronautics research

630
00:26:20,549 --> 00:26:18,640
langley applied its expertise in tools

631
00:26:22,789 --> 00:26:20,559
methods and testing toward a science

632
00:26:24,950 --> 00:26:22,799
program that would study the impacts of

633
00:26:27,110 --> 00:26:24,960
supersonic flight

634
00:26:29,590 --> 00:26:27,120
to understand changes in the atmosphere

635
00:26:31,110 --> 00:26:29,600
scientists first need to measure it

636
00:26:33,510 --> 00:26:31,120
at langley some of the earliest

637
00:26:35,510 --> 00:26:33,520
measurements started with the 1975

638
00:26:37,750 --> 00:26:35,520

apollo soyuz mission

639
00:26:40,070 --> 00:26:37,760
when astronaut deke slayton operated the

640
00:26:41,990 --> 00:26:40,080
stratospheric aerosol measurement or

641
00:26:43,909 --> 00:26:42,000
sam's sensor

642
00:26:45,909 --> 00:26:43,919
aerosols are suspended particles or

643
00:26:48,789 --> 00:26:45,919
liquid droplets in the atmosphere things

644
00:26:50,950 --> 00:26:48,799
like soot dust black carbon pollen those

645
00:26:52,390 --> 00:26:50,960
are all examples of aerosols and though

646
00:26:54,710 --> 00:26:52,400
they're really small

647
00:26:57,350 --> 00:26:54,720
they have a big or large uncertainty in

648
00:26:58,789 --> 00:26:57,360
the earth's climate system nasa langley

649
00:27:00,950 --> 00:26:58,799
has been instrumental in studying

650
00:27:02,870 --> 00:27:00,960
aerosols and the processes related to

651
00:27:04,390 --> 00:27:02,880
them and understanding their role in the

652
00:27:06,230 --> 00:27:04,400
climate system

653
00:27:07,990 --> 00:27:06,240
the sam experiment marked the beginning

654
00:27:11,269 --> 00:27:08,000
of langley's space-based studies of

655
00:27:13,350 --> 00:27:11,279
aerosols in earth's atmosphere

656
00:27:15,350 --> 00:27:13,360
later more langley-developed instruments

657
00:27:17,350 --> 00:27:15,360
were sent into space

658
00:27:19,750 --> 00:27:17,360
many were on satellites like the first

659
00:27:23,590 --> 00:27:19,760
stratospheric aerosol and gas experiment

660
00:27:25,590 --> 00:27:23,600
or sage launched in 1979

661
00:27:28,630 --> 00:27:25,600
part of the family tree of instruments

662
00:27:30,789 --> 00:27:28,640
that grew out of the sam experiment

663
00:27:32,389 --> 00:27:30,799

the vantage point of space allows us to

664
00:27:33,909 --> 00:27:32,399
look at the earth's atmosphere its

665
00:27:35,750 --> 00:27:33,919
weather and its climate to look at

666
00:27:38,070 --> 00:27:35,760
various processes ranging from

667
00:27:40,230 --> 00:27:38,080
diagnosing our climate long-range

668
00:27:42,389 --> 00:27:40,240
transport or even improving prediction

669
00:27:44,789 --> 00:27:42,399
from our climate models

670
00:27:46,549 --> 00:27:44,799
beginning in the 1980s the space shuttle

671
00:27:48,870 --> 00:27:46,559
served as another tool in the langley

672
00:27:50,710 --> 00:27:48,880
atmospheric science toolbox

673
00:27:52,630 --> 00:27:50,720
nasa's first science payload on a

674
00:27:53,830 --> 00:27:52,640
shuttle launched on columbia's second

675
00:27:55,750 --> 00:27:53,840
mission

676
00:27:57,909 --> 00:27:55,760
the langley-developed measurement of air

677
00:27:59,669 --> 00:27:57,919
pollution from space instrument helps

678
00:28:02,549 --> 00:27:59,679
scientists build a database of

679
00:28:04,310 --> 00:28:02,559
atmospheric carbon monoxide levels these

680
00:28:06,310 --> 00:28:04,320
measurements gave scientists a better

681
00:28:09,029 --> 00:28:06,320
understanding of pollution and how far

682
00:28:13,110 --> 00:28:10,789
the atmosphere is composed of both

683
00:28:15,430 --> 00:28:13,120
natural and anthrogenic pollutants we

684
00:28:17,430 --> 00:28:15,440
talk about aerosols and trace gas

685
00:28:19,510 --> 00:28:17,440
pollution these are critical and we're

686
00:28:21,190 --> 00:28:19,520
seeing increases in places like asia

687
00:28:22,470 --> 00:28:21,200
meanwhile we're seeing decreases in

688
00:28:23,830 --> 00:28:22,480

other places around the world so

689
00:28:25,430 --> 00:28:23,840
transport and understanding that

690
00:28:26,870 --> 00:28:25,440
transport is important to understand the

691
00:28:28,310 --> 00:28:26,880
overall climate system and the

692
00:28:30,070 --> 00:28:28,320
composition of these pollutants and

693
00:28:31,750 --> 00:28:30,080
gases

694
00:28:33,750 --> 00:28:31,760
the shuttle also carried a langley

695
00:28:36,630 --> 00:28:33,760
satellite based experiment that measured

696
00:28:39,909 --> 00:28:36,640
the planet's overall warming and cooling

697
00:28:41,430 --> 00:28:39,919
in 1984 sally ride the first american

698
00:28:43,510 --> 00:28:41,440
woman in space

699
00:28:45,110 --> 00:28:43,520
deployed the earth radiation budget

700
00:28:46,549 --> 00:28:45,120
satellite from the space shuttle

701
00:28:47,909 --> 00:28:46,559
challenger

702
00:28:49,669 --> 00:28:47,919
it's important to study the earth's

703
00:28:51,750 --> 00:28:49,679
radiation budget because it has a

704
00:28:52,710 --> 00:28:51,760
critical impact on understanding climate

705
00:28:54,230 --> 00:28:52,720
change

706
00:28:56,470 --> 00:28:54,240
the sun's energy comes into the

707
00:28:58,870 --> 00:28:56,480
atmosphere it can be absorbed by

708
00:29:01,190 --> 00:28:58,880
greenhouse gases some of that energy can

709
00:29:03,669 --> 00:29:01,200
be reflected if we end up with an

710
00:29:05,430 --> 00:29:03,679
imbalance in our energy budget we can

711
00:29:06,870 --> 00:29:05,440
see warming in our climate system and

712
00:29:08,470 --> 00:29:06,880
that's why the work that's being done at

713
00:29:11,110 --> 00:29:08,480

nasa langley is critical particularly

714
00:29:13,350 --> 00:29:11,120
some of the satellite-based observations

715
00:29:14,870 --> 00:29:13,360
the earth radiation budget satellite was

716
00:29:17,669 --> 00:29:14,880
also carrying an instrument that would

717
00:29:19,909 --> 00:29:17,679
take a closer look at the ozone layer

718
00:29:21,590 --> 00:29:19,919
sage 2 another in the family of

719
00:29:23,430 --> 00:29:21,600
instruments that grew out of the sam

720
00:29:25,029 --> 00:29:23,440
experiment

721
00:29:27,190 --> 00:29:25,039
the ozone layer which is a part of the

722
00:29:29,510 --> 00:29:27,200
stratosphere is critical for life on our

723
00:29:32,470 --> 00:29:29,520
planet the ozone layer protects us from

724
00:29:34,310 --> 00:29:32,480
harmful uv radiation now in the past we

725
00:29:36,230 --> 00:29:34,320
use ground-based observations and

726
00:29:37,830 --> 00:29:36,240
perhaps balloon measurements but it

727
00:29:39,110 --> 00:29:37,840
really gave us point measurements it's

728
00:29:40,950 --> 00:29:39,120
kind of like seeing a tree but not

729
00:29:42,710 --> 00:29:40,960
necessarily seeing the forest

730
00:29:45,830 --> 00:29:42,720
satellites allowed us to see the true

731
00:29:47,590 --> 00:29:45,840
expansiveness of the ozone hole

732
00:29:49,350 --> 00:29:47,600
information from langley satellite

733
00:29:53,029 --> 00:29:49,360
instruments provided the most widely

734
00:29:55,110 --> 00:29:53,039
used ozone data sets in the 1990s

735
00:29:56,950 --> 00:29:55,120
helping scientists better understand the

736
00:29:58,710 --> 00:29:56,960
whole and how to work across borders to

737
00:30:02,470 --> 00:29:58,720
repair it

738
00:30:04,389 --> 00:30:02,480

and in february 2017 langley extended

739
00:30:06,630 --> 00:30:04,399
that ozone monitoring legacy with the

740
00:30:08,870 --> 00:30:06,640
launch of sage iii to the international

741
00:30:10,789 --> 00:30:08,880
space station

742
00:30:12,710 --> 00:30:10,799
another of langley's tools for looking

743
00:30:15,269 --> 00:30:12,720
at the atmosphere is active remote

744
00:30:17,190 --> 00:30:15,279
sensing lidar technology

745
00:30:20,470 --> 00:30:17,200
much like radar uses sound waves to take

746
00:30:23,830 --> 00:30:20,480
measurements lidar uses lasers

747
00:30:25,830 --> 00:30:23,840
launched in 2006 the calypso satellite a

748
00:30:27,269 --> 00:30:25,840
partnership with the french space agency

749
00:30:29,510 --> 00:30:27,279
canes

750
00:30:32,149 --> 00:30:29,520
uses lidar to provide new insight into

751
00:30:34,389 --> 00:30:32,159
the role clouds and atmospheric aerosols

752
00:30:37,190 --> 00:30:34,399
play in regulating earth's weather

753
00:30:38,870 --> 00:30:37,200
climate and air quality

754
00:30:40,710 --> 00:30:38,880
two of the biggest uncertainties in

755
00:30:43,190 --> 00:30:40,720
climate model projections are aerosols

756
00:30:44,870 --> 00:30:43,200
and clouds clouds can be a net warmer or

757
00:30:46,630 --> 00:30:44,880
a net cooler in our climate system

758
00:30:47,990 --> 00:30:46,640
depending on where they're located in

759
00:30:50,470 --> 00:30:48,000
the atmosphere

760
00:30:52,789 --> 00:30:50,480
another key point with clouds is that

761
00:30:54,789 --> 00:30:52,799
clouds form on aerosols

762
00:30:56,789 --> 00:30:54,799
understanding clouds their formation and

763
00:30:58,389 --> 00:30:56,799

their distribution will take us a long

764
00:31:00,389 --> 00:30:58,399
way in closing the uncertainty in those

765
00:31:02,789 --> 00:31:00,399
model projections

766
00:31:04,950 --> 00:31:02,799
langley scientists have also used lidar

767
00:31:07,190 --> 00:31:04,960
instruments on board airplanes

768
00:31:10,070 --> 00:31:07,200
it's part of an airborne science legacy

769
00:31:12,389 --> 00:31:10,080
langley pioneered in the 1980s

770
00:31:13,990 --> 00:31:12,399
when scientists first used instrumented

771
00:31:16,630 --> 00:31:14,000
planes to better understand the

772
00:31:18,710 --> 00:31:16,640
troposphere the air we breathe

773
00:31:20,230 --> 00:31:18,720
the troposphere is the lowest layer of

774
00:31:22,230 --> 00:31:20,240
our atmosphere it's the layer that we

775
00:31:25,269 --> 00:31:22,240
live in and we'll never leave unless we

776
00:31:27,350 --> 00:31:25,279
are an astronaut or become an astronaut

777
00:31:29,269 --> 00:31:27,360
aircraft and the instruments they carry

778
00:31:30,950 --> 00:31:29,279
continue to be important to langley

779
00:31:32,630 --> 00:31:30,960
earth science

780
00:31:33,990 --> 00:31:32,640
whether it's to measure and track air

781
00:31:36,310 --> 00:31:34,000
pollution

782
00:31:38,070 --> 00:31:36,320
help assess arctic sea ice

783
00:31:39,509 --> 00:31:38,080
or study the movement of greenhouse

784
00:31:41,590 --> 00:31:39,519
gases

785
00:31:44,070 --> 00:31:41,600
even as langley's earth monitoring

786
00:31:46,149 --> 00:31:44,080
instruments fly around the skies

787
00:31:48,470 --> 00:31:46,159
new langley satellite instruments are in

788
00:31:49,830 --> 00:31:48,480

the works including a new version of

789
00:31:51,830 --> 00:31:49,840
series

790
00:31:53,029 --> 00:31:51,840
the clouds and earth's radiant energy

791
00:31:55,590 --> 00:31:53,039
system

792
00:31:57,909 --> 00:31:55,600
dating back to the late 90s ceres and

793
00:32:00,190 --> 00:31:57,919
its follow-on instruments are devoted to

794
00:32:01,750 --> 00:32:00,200
understanding earth's radiation budget

795
00:32:03,990 --> 00:32:01,760
[Music]

796
00:32:06,230 --> 00:32:04,000
langley is also managing the development

797
00:32:07,909 --> 00:32:06,240
of tempo the first space-based

798
00:32:10,470 --> 00:32:07,919
instrument to monitor major air

799
00:32:13,430 --> 00:32:10,480
pollutants across north america hourly

800
00:32:17,430 --> 00:32:15,269
nasa langley is critical for studying

801
00:32:19,750 --> 00:32:17,440
the earth's atmosphere given its

802
00:32:21,830 --> 00:32:19,760
observations and capabilities related to

803
00:32:23,590 --> 00:32:21,840
things like atmospheric chemistry

804
00:32:26,149 --> 00:32:23,600
aerosols clouds and the earth's

805
00:32:28,389 --> 00:32:26,159
radiation budget it also hosts the

806
00:32:30,389 --> 00:32:28,399
atmospheric sciences data center the

807
00:32:32,230 --> 00:32:30,399
data from these satellites aircraft

808
00:32:33,830 --> 00:32:32,240
missions and otherwise will be critical

809
00:32:36,310 --> 00:32:33,840
for closing the uncertainty in our

810
00:32:38,070 --> 00:32:36,320
climate model projections

811
00:32:39,830 --> 00:32:38,080
learning as much as we can about where

812
00:32:41,340 --> 00:32:39,840
we are today will tell us where we're

813
00:32:43,110 --> 00:32:41,350

heading tomorrow

814
00:32:45,430 --> 00:32:43,120
[Music]

815
00:32:47,990 --> 00:32:45,440
of course sometimes emergencies arise

816
00:32:49,909 --> 00:32:48,000
that no one could have predicted

817
00:32:51,909 --> 00:32:49,919
and in many of those cases

818
00:32:53,750 --> 00:32:51,919
the researchers at nasa langley have

819
00:32:58,540 --> 00:32:53,760
risen to the challenge with timely

820
00:32:58,550 --> 00:33:08,389
[Music]

821
00:33:11,509 --> 00:33:10,070
wartime is the ultimate national

822
00:33:13,509 --> 00:33:11,519
emergency

823
00:33:16,310 --> 00:33:13,519
and in world war ii langley earned its

824
00:33:18,389 --> 00:33:16,320
wings once again

825
00:33:19,750 --> 00:33:18,399
by methodically examining individual

826
00:33:21,750 --> 00:33:19,760
warplanes

827
00:33:25,110 --> 00:33:21,760
engineers learned how to squeeze maximum

828
00:33:29,430 --> 00:33:25,120
aeronautic efficiency out of each one

829
00:33:32,230 --> 00:33:31,190
the magic happened in the full-scale

830
00:33:33,669 --> 00:33:32,240
tunnel

831
00:33:38,549 --> 00:33:33,679
starting with the navy's brewster

832
00:33:43,669 --> 00:33:41,590
this brewster buffalo is the classic

833
00:33:45,990 --> 00:33:43,679
example they they bring in a plane

834
00:33:49,590 --> 00:33:46,000
that's not working the way it's supposed

835
00:33:52,230 --> 00:33:49,600
to it's not performing the way the

836
00:33:56,310 --> 00:33:52,240
engineers designed it wasn't going to

837
00:33:58,789 --> 00:33:56,320
meet the basic contract requirements

838
00:34:01,909 --> 00:33:58,799

the real achievement of the drag cleanup

839
00:34:03,350 --> 00:34:01,919
study was this invention of a new

840
00:34:06,470 --> 00:34:03,360
process for

841
00:34:09,909 --> 00:34:06,480
quickly evaluating the performance of a

842
00:34:12,550 --> 00:34:09,919
particular aircraft design

843
00:34:14,790 --> 00:34:12,560
by the war's end more than 30 varieties

844
00:34:17,589 --> 00:34:14,800
of military aircraft flew faster because

845
00:34:20,550 --> 00:34:17,599
of drag cleanup

846
00:34:22,230 --> 00:34:20,560
and you cannot overstate how important

847
00:34:25,510 --> 00:34:22,240
that was

848
00:34:28,069 --> 00:34:25,520
to the performance of these vehicles

849
00:34:32,389 --> 00:34:28,079
throughout the second world war and

850
00:34:35,990 --> 00:34:32,399
really helped give the allies an edge in

851
00:34:41,030 --> 00:34:37,669
langley's engineering also made a

852
00:34:43,190 --> 00:34:41,040
difference in civil aviation

853
00:34:46,149 --> 00:34:43,200
it benefited the nation

854
00:34:48,550 --> 00:34:46,159
and the industry by producing amazing

855
00:34:50,790 --> 00:34:48,560
aircraft right after the second world

856
00:34:52,470 --> 00:34:50,800
war airplanes that could fly faster and

857
00:34:55,589 --> 00:34:52,480
farther and higher than anything that

858
00:34:57,829 --> 00:34:55,599
had ever been designed in human history

859
00:34:59,990 --> 00:34:57,839
those new advancements

860
00:35:02,310 --> 00:35:00,000
came at a cost

861
00:35:04,630 --> 00:35:02,320
vibrations that are inconsequential at

862
00:35:06,950 --> 00:35:04,640
lower speeds can be catastrophic as

863
00:35:09,589 --> 00:35:06,960

planes flew faster

864
00:35:14,150 --> 00:35:09,599
the vibrations called flutter

865
00:35:19,510 --> 00:35:17,430
and then suddenly in 1959 an electra

866
00:35:21,829 --> 00:35:19,520
fell out of the sky and another one fell

867
00:35:24,470 --> 00:35:21,839
out of the sky and

868
00:35:29,030 --> 00:35:24,480
people lost their lives and this was a

869
00:35:31,109 --> 00:35:29,040
profound crisis for the airline industry

870
00:35:34,230 --> 00:35:31,119
the federal aviation administration

871
00:35:36,310 --> 00:35:34,240
ordered tess to find solutions

872
00:35:39,030 --> 00:35:36,320
industry turned to nasa langley and its

873
00:35:40,870 --> 00:35:39,040
new transonic dynamics tunnel

874
00:35:42,710 --> 00:35:40,880
designed to study the effects of wind

875
00:35:44,950 --> 00:35:42,720
gusts and structural vibration on

876
00:35:46,790 --> 00:35:44,960
aircraft

877
00:35:49,750 --> 00:35:46,800
it was a

878
00:35:52,790 --> 00:35:49,760
blockbuster test for that tunnel

879
00:35:55,990 --> 00:35:52,800
but what they did in this work was

880
00:35:59,589 --> 00:35:56,000
discover the root of the problems what

881
00:36:02,470 --> 00:35:59,599
caused this vibrations what caused the

882
00:36:04,550 --> 00:36:02,480
flutter to occur and more importantly

883
00:36:06,150 --> 00:36:04,560
how to fix it

884
00:36:07,910 --> 00:36:06,160
the langley testing did more than

885
00:36:10,550 --> 00:36:07,920
prevent further accidents and save

886
00:36:13,109 --> 00:36:10,560
countless lives it also set the pace for

887
00:36:15,829 --> 00:36:13,119
the aircraft industry

888
00:36:18,950 --> 00:36:15,839

i think one of the really important

889
00:36:22,550 --> 00:36:18,960
contributions that langley made in this

890
00:36:23,910 --> 00:36:22,560
particular moment was that it taught

891
00:36:26,950 --> 00:36:23,920
industry

892
00:36:29,829 --> 00:36:26,960
how to work together productively how to

893
00:36:33,190 --> 00:36:29,839
identify a research problem how to solve

894
00:36:36,390 --> 00:36:33,200
it and more importantly it's set up a

895
00:36:38,470 --> 00:36:36,400
research agenda for decades to come

896
00:36:41,430 --> 00:36:38,480
langley's problem-solving expertise was

897
00:36:43,589 --> 00:36:41,440
called on again after the 1985 crash of

898
00:36:47,430 --> 00:36:43,599
a delta airliner at dallas-fort worth

899
00:36:48,950 --> 00:36:47,440
airport that killed 136 people

900
00:36:50,870 --> 00:36:48,960
it went down trying to land in the

901
00:36:53,430 --> 00:36:50,880
thunderstorm doomed by a windshear

902
00:36:55,349 --> 00:36:53,440
downdraft the second such crash in three

903
00:36:57,750 --> 00:36:55,359
years

904
00:36:59,510 --> 00:36:57,760
the faa tapped nasa langley to lead

905
00:37:02,069 --> 00:36:59,520
airborne windshear and microburst

906
00:37:05,270 --> 00:37:02,079
detection research

907
00:37:07,270 --> 00:37:05,280
microburst is kind of a mini tornado but

908
00:37:10,310 --> 00:37:07,280
in reverse

909
00:37:13,829 --> 00:37:10,320
and wind shear is when those wind

910
00:37:16,710 --> 00:37:13,839
currents suddenly shift unexpectedly

911
00:37:19,430 --> 00:37:16,720
because of these sudden changes it makes

912
00:37:21,589 --> 00:37:19,440
it extremely hazardous for pilots if

913
00:37:23,510 --> 00:37:21,599

they're at the point of a flight when

914
00:37:27,750 --> 00:37:23,520
they're trying to land the plane this is

915
00:37:29,589 --> 00:37:27,760
when a number of accidents occurred

916
00:37:31,910 --> 00:37:29,599
langley developed a system to better

917
00:37:34,470 --> 00:37:31,920
understand and analyze these unusual

918
00:37:36,950 --> 00:37:34,480
weather conditions

919
00:37:39,349 --> 00:37:36,960
langley researchers come up with a

920
00:37:40,710 --> 00:37:39,359
numerical scale they call the f factor

921
00:37:42,870 --> 00:37:40,720
to help

922
00:37:43,829 --> 00:37:42,880
pilots understand the severity of wind

923
00:37:46,630 --> 00:37:43,839
shear

924
00:37:49,829 --> 00:37:46,640
that number this f factor if you will is

925
00:37:52,230 --> 00:37:49,839
incorporated into faa regulations today

926
00:37:54,790 --> 00:37:52,240
but it's a great example how

927
00:37:55,829 --> 00:37:54,800
one piece of research can have national

928
00:37:57,829 --> 00:37:55,839
impact

929
00:38:00,069 --> 00:37:57,839
because of nasa langley research into

930
00:38:02,470 --> 00:38:00,079
sensors that warn pilots a microburst is

931
00:38:05,510 --> 00:38:02,480
ahead wind shear accidents in the u.s

932
00:38:07,349 --> 00:38:05,520
have been virtually eliminated

933
00:38:10,710 --> 00:38:07,359
but it's not just outside agencies that

934
00:38:14,310 --> 00:38:10,720
rely on nasa langley's expertise

935
00:38:16,069 --> 00:38:14,320
after challenger exploded in 1986

936
00:38:19,270 --> 00:38:16,079
langley engineers tested the solid

937
00:38:21,030 --> 00:38:19,280
rocket boosters failed o-rings

938
00:38:22,790 --> 00:38:21,040

other langley researchers focused on the

939
00:38:25,589 --> 00:38:22,800
booster joints and came up with a whole

940
00:38:29,190 --> 00:38:27,589
after columbia was lost during re-entry

941
00:38:31,030 --> 00:38:29,200
in 2003

942
00:38:33,349 --> 00:38:31,040
langley wind tunnel and computer-based

943
00:38:37,030 --> 00:38:33,359
studies of shuttle aero heating helped

944
00:38:40,310 --> 00:38:38,790
langley then focused its technical

945
00:38:43,349 --> 00:38:40,320
strengths on shuttle's thermal

946
00:38:45,910 --> 00:38:43,359
protection system what made it fail how

947
00:38:47,750 --> 00:38:45,920
to inspect it how to repair it in orbit

948
00:38:50,470 --> 00:38:47,760
and determine when it was safe to fly

949
00:38:53,030 --> 00:38:50,480
even with minor damage

950
00:38:55,910 --> 00:38:53,040
so after the shuttle accidents one in

951
00:38:59,109 --> 00:38:55,920
the mid 1980s the other in the early

952
00:39:00,870 --> 00:38:59,119
2000s nasa langley engineers worked

953
00:39:03,750 --> 00:39:00,880
together to

954
00:39:05,670 --> 00:39:03,760
find solutions to incredibly complicated

955
00:39:07,750 --> 00:39:05,680
technological problems

956
00:39:10,390 --> 00:39:07,760
they even developed a camera that could

957
00:39:12,870 --> 00:39:10,400
inspect the shuttle while it's in orbit

958
00:39:15,030 --> 00:39:12,880
but the most important contribution they

959
00:39:17,270 --> 00:39:15,040
made was helping the united states

960
00:39:19,750 --> 00:39:17,280
return to space

961
00:39:21,910 --> 00:39:19,760
and during the shuttle's final missions

962
00:39:24,310 --> 00:39:21,920
langley researchers took images unlike

963
00:39:26,550 --> 00:39:24,320

those ever seen of the shuttle

964
00:39:30,230 --> 00:39:26,560
thermal snapshots at mach 20 that may

965
00:39:32,310 --> 00:39:30,240
someday be used to create new spacecraft

966
00:39:35,030 --> 00:39:32,320
over the past century nasa langley has

967
00:39:37,829 --> 00:39:35,040
gained an outstanding reputation for its

968
00:39:39,270 --> 00:39:37,839
responsiveness to national emergencies

969
00:39:40,710 --> 00:39:39,280
i think the reason it's been so

970
00:39:42,390 --> 00:39:40,720
effective

971
00:39:44,790 --> 00:39:42,400
is it's people

972
00:39:46,230 --> 00:39:44,800
they're resourceful they're imaginative

973
00:39:48,310 --> 00:39:46,240
they're creative

974
00:39:50,310 --> 00:39:48,320
and above all else they have the

975
00:39:51,349 --> 00:39:50,320
remarkable capacity to reinvent

976
00:39:53,430 --> 00:39:51,359
themselves

977
00:39:55,670 --> 00:39:53,440
it's those qualities that make langley

978
00:39:58,070 --> 00:39:55,680
such a national treasure it's what

979
00:40:04,150 --> 00:39:58,080
augurs well for the future

980
00:40:09,430 --> 00:40:06,230
from the beginning nasa langley has been

981
00:40:11,910 --> 00:40:09,440
in the business of shaping the future

982
00:40:14,150 --> 00:40:11,920
first we conquered the air

983
00:40:16,550 --> 00:40:14,160
then the sound barrier

984
00:40:17,910 --> 00:40:16,560
after that the moon

985
00:40:20,710 --> 00:40:17,920
next step

986
00:40:22,230 --> 00:40:20,720
mars and beyond

987
00:40:24,230 --> 00:40:22,240
while we've celebrated successful

988
00:40:26,630 --> 00:40:24,240

martian landings starting with nasa

989
00:40:28,870 --> 00:40:26,640
langley's vikings in the 70s and more

990
00:40:31,589 --> 00:40:28,880
recently rovers like spirit

991
00:40:33,510 --> 00:40:31,599
opportunity and curiosity

992
00:40:34,550 --> 00:40:33,520
future missions will require larger

993
00:40:36,790 --> 00:40:34,560
craft

994
00:40:39,030 --> 00:40:36,800
bigger payloads and eventually human

995
00:40:41,270 --> 00:40:39,040
explorers

996
00:40:44,150 --> 00:40:41,280
that will demand improved entry descent

997
00:40:46,870 --> 00:40:44,160
and landing edl technologies that must

998
00:40:48,309 --> 00:40:46,880
slow a martian lander from 16 000 miles

999
00:40:51,430 --> 00:40:48,319
per hour

1000
00:40:53,589 --> 00:40:51,440
for a safe and precise landing

1001
00:40:55,750 --> 00:40:53,599
langley's edl experts developed and

1002
00:40:57,829 --> 00:40:55,760
built a heat shield sensor that flew to

1003
00:41:00,710 --> 00:40:57,839
mars and will help researchers design

1004
00:41:02,710 --> 00:41:00,720
future spacecraft

1005
00:41:05,030 --> 00:41:02,720
other game-changing langley inventions

1006
00:41:07,190 --> 00:41:05,040
for planetary exploration include

1007
00:41:08,550 --> 00:41:07,200
lightweight inflatable spacecraft heat

1008
00:41:10,710 --> 00:41:08,560
shields

1009
00:41:12,630 --> 00:41:10,720
inflatable habitats

1010
00:41:15,270 --> 00:41:12,640
and next generation rovers that will

1011
00:41:17,510 --> 00:41:15,280
allow humans to live and work on other

1012
00:41:19,270 --> 00:41:17,520
worlds

1013
00:41:21,510 --> 00:41:19,280

langley research center has already

1014
00:41:24,230 --> 00:41:21,520
started building the future using robots

1015
00:41:26,150 --> 00:41:24,240
to help create new structures

1016
00:41:28,309 --> 00:41:26,160
langley chemists are also developing the

1017
00:41:30,630 --> 00:41:28,319
next generation of materials

1018
00:41:32,390 --> 00:41:30,640
incredibly strong and lightweight that

1019
00:41:36,710 --> 00:41:32,400
could have wide ranging uses in

1020
00:41:40,470 --> 00:41:38,550
but langley has not forgotten its

1021
00:41:42,550 --> 00:41:40,480
aeronautic roots or its commitment to

1022
00:41:44,950 --> 00:41:42,560
x-planes

1023
00:41:46,710 --> 00:41:44,960
almost 70 years after chuck yeager broke

1024
00:41:48,630 --> 00:41:46,720
the sound barrier

1025
00:41:50,790 --> 00:41:48,640
langley is working with industry on a

1026
00:41:53,349 --> 00:41:50,800
supersonic passenger jet

1027
00:41:57,589 --> 00:41:53,359
that would transform the sonic boom into

1028
00:42:01,910 --> 00:41:59,430
today's and tomorrow's x-planes have

1029
00:42:04,790 --> 00:42:01,920
progressed to numbers like 43 the

1030
00:42:07,829 --> 00:42:04,800
fastest air breathing aircraft

1031
00:42:10,790 --> 00:42:07,839
the x-48 a new aircraft concept designed

1032
00:42:13,589 --> 00:42:10,800
to be greener and more fuel efficient

1033
00:42:15,349 --> 00:42:13,599
and the x-57 the first all-electric

1034
00:42:17,349 --> 00:42:15,359
aircraft

1035
00:42:19,270 --> 00:42:17,359
all are being tested or developed at

1036
00:42:21,270 --> 00:42:19,280
nasa langley

1037
00:42:23,190 --> 00:42:21,280
on a smaller but perhaps even more

1038
00:42:24,950 --> 00:42:23,200

ambitious scale

1039
00:42:27,430 --> 00:42:24,960
langley engineers are looking at

1040
00:42:28,790 --> 00:42:27,440
concepts like personal air vehicles and

1041
00:42:30,550 --> 00:42:28,800
drones

1042
00:42:33,190 --> 00:42:30,560
that require the development of

1043
00:42:35,589 --> 00:42:33,200
intelligent autonomous systems

1044
00:42:37,910 --> 00:42:35,599
that can allow machines to learn and act

1045
00:42:39,750 --> 00:42:37,920
independently

1046
00:42:41,750 --> 00:42:39,760
other langley visionary research will

1047
00:42:43,829 --> 00:42:41,760
explore new ways to better understand

1048
00:42:45,510 --> 00:42:43,839
our home planet

1049
00:42:48,150 --> 00:42:45,520
langley scientists are developing

1050
00:42:49,910 --> 00:42:48,160
low-cost small satellite technologies to

1051
00:42:51,750 --> 00:42:49,920
observe the climate and air that we

1052
00:42:54,230 --> 00:42:51,760
breathe

1053
00:42:56,790 --> 00:42:54,240
sensors and instruments on spacecraft

1054
00:42:59,190 --> 00:42:56,800
aircraft and on the ground combined with

1055
00:43:01,349 --> 00:42:59,200
computer modeling will help us better

1056
00:43:03,109 --> 00:43:01,359
predict and understand conditions here

1057
00:43:04,870 --> 00:43:03,119
on earth

1058
00:43:07,349 --> 00:43:04,880
and will continue to add to our

1059
00:43:12,230 --> 00:43:07,359
long-term climate data records

1060
00:43:17,349 --> 00:43:14,870
one hundred years ago nasa langley rose

1061
00:43:19,270 --> 00:43:17,359
from the farmlands of hampton virginia

1062
00:43:20,790 --> 00:43:19,280
to become an aerospace research

1063
00:43:23,349 --> 00:43:20,800

powerhouse

1064
00:43:25,829 --> 00:43:23,359
the trajectory of langley's mission has

1065
00:43:28,630 --> 00:43:25,839
carried it beyond the sound barrier

1066
00:43:30,230 --> 00:43:28,640
beyond our atmosphere and even beyond

1067
00:43:32,870 --> 00:43:30,240
the moon

1068
00:43:35,750 --> 00:43:32,880
all the while nasa langley's advances in

1069
00:43:38,470 --> 00:43:35,760
materials and atmospheric science are

1070
00:43:41,030 --> 00:43:38,480
improving life right here on earth

1071
00:43:42,630 --> 00:43:41,040
expanding our knowledge and protecting

1072
00:43:45,030 --> 00:43:42,640
the planet

1073
00:43:47,430 --> 00:43:45,040
whether pushing the envelope of science

1074
00:43:49,910 --> 00:43:47,440
and engineering or responding to

1075
00:43:52,710 --> 00:43:49,920
national emergencies the people at

1076
00:43:56,150 --> 00:43:52,720
langley are already hard at work

1077
00:43:58,790 --> 00:43:56,160
shaping its next 100 years

1078
00:44:04,130 --> 00:43:58,800
transforming science fiction