1
00:00:46,960 --> 00:00:37,080
I came out here Ito and a lot further

2
00:00:46,970 --> 00:00:56,290
hey babe

3
00:00:56,300 --> 00:01:00,950
I am

4
00:01:06,270 --> 00:01:03,660
welcome to this edition of NASA images

5
00:01:08,190 --> 00:01:06,280
this is Lynn Bondurant during this show

6
00:01:10,710 --> 00:01:08,200
were focusing on historic NASA

7
00:01:12,750 --> 00:01:10,720
documentary footage showing some of the

8
00:01:16,590 --> 00:01:12,760
discoveries about the solar system and

9
00:01:19,340 --> 00:01:16,600
stars made by unmanned probes in 1979

10
00:01:22,770 --> 00:01:19,350
and later our first film clip is from

11
00:01:24,960 --> 00:01:22,780
1979 and shows some of the results of

12
00:01:27,780 --> 00:01:24,970
the Voyager spacecraft encounters with

13
00:01:30,870 --> 00:01:27,790

Jupiter and the Pioneer spacecraft flyby

14
00:01:33,270 --> 00:01:30,880
of Saturn Jupiter largest of the sun's

15
00:01:36,390 --> 00:01:33,280
nine planets was photographed close-up

16
00:01:38,310 --> 00:01:36,400
by the voyagers 1 & 2 spacecraft what

17
00:01:40,650 --> 00:01:38,320
their camera eyes recorded as they

18
00:01:43,140 --> 00:01:40,660
passed by the giant planets churning

19
00:01:46,350 --> 00:01:43,150
clouds were ribbon like streaks of red

20
00:01:48,540 --> 00:01:46,360
and brown and yellow the wealth of data

21
00:01:50,880 --> 00:01:48,550
and photographs left behind by the

22
00:01:52,950 --> 00:01:50,890
voyagers are providing scientists a

23
00:01:55,469 --> 00:01:52,960
valuable source of raw material to be

24
00:01:58,920 --> 00:01:55,479
studied from Jupiter's newly discovered

25
00:02:01,920 --> 00:01:58,930
ring to the active volcanoes of IO one

26
00:02:03,780 --> 00:02:01,930
of its 14 surrounding moans the voyager

27
00:02:06,990 --> 00:02:03,790
discoveries have surprised and delighted

28
00:02:09,210 --> 00:02:07,000
nasa scientists information that may one

29
00:02:12,479 --> 00:02:09,220
day help us better understand our own

30
00:02:15,150 --> 00:02:12,489
earth and the voyagers mission did not

31
00:02:16,860 --> 00:02:15,160
end at Jupiter the two spacecraft are

32
00:02:21,660 --> 00:02:16,870
now speeding toward a rendezvous with

33
00:02:24,690 --> 00:02:21,670
Saturn in 1980 and 1981 acting as

34
00:02:27,930 --> 00:02:24,700
Pathfinder for the voyagers Pioneer 11

35
00:02:30,420 --> 00:02:27,940
the 570 pound spacecraft climaxed

36
00:02:33,390 --> 00:02:30,430
six-and-a-half years and a two billion

37
00:02:38,240 --> 00:02:33,400
mile voyage in deep space as it swept by

38
00:02:41,009 --> 00:02:38,250

Saturn at 70 1,200 miles per hour

39
00:02:43,340 --> 00:02:41,019
scientists watched anxiously as pioneer

40
00:02:46,320 --> 00:02:43,350
made its - our passage of Saturn's rings

41
00:02:48,690 --> 00:02:46,330
four times the spacecraft was hit by

42
00:02:52,020 --> 00:02:48,700
small pieces of debris but emerged

43
00:02:54,180 --> 00:02:52,030
safely despite the collisions pioneer

44
00:02:56,340 --> 00:02:54,190
had a closer look at Saturn that all the

45
00:03:00,930 --> 00:02:56,350
observations that have been made in the

46
00:03:03,090 --> 00:03:00,940
last 400 years photographs show what

47
00:03:06,300 --> 00:03:03,100
appeared to be jet streams swirling

48
00:03:08,260 --> 00:03:06,310
around Saturn at 300 miles an hour a new

49
00:03:10,570 --> 00:03:08,270
ring circling the planets equator

50
00:03:12,700 --> 00:03:10,580
and radiation belts that are more like

51
00:03:16,690 --> 00:03:12,710
Earth's in their intensity and energy

52
00:03:19,300 --> 00:03:16,700
levels the Pioneer 11 spacecraft dwarfed

53
00:03:21,460 --> 00:03:19,310
by the objects it was sent to observe is

54
00:03:23,860 --> 00:03:21,470
speeding out of the solar system in an

55
00:03:27,040 --> 00:03:23,870
endless journey just before Voyager 1

56
00:03:33,030 --> 00:03:27,050
was to fly by Saturn nASA released this

57
00:03:38,410 --> 00:03:35,080
we have looked beyond our atmosphere

58
00:03:40,930 --> 00:03:38,420
many times but never have we seen what

59
00:03:42,490 --> 00:03:40,940
we were about to see two Voyager

60
00:03:45,700 --> 00:03:42,500
spacecraft are now approaching the

61
00:03:47,590 --> 00:03:45,710
planet Saturn ring spectacle of gas and

62
00:03:50,590 --> 00:03:47,600
ice and the second largest of our

63
00:03:51,910 --> 00:03:50,600

planets there are special cameras aboard

64
00:03:53,830 --> 00:03:51,920
the voyagers though which will

65
00:03:56,700 --> 00:03:53,840
revolutionize our knowledge about Saturn

66
00:04:00,160 --> 00:03:56,710
it's curious rings and it's 10 minutes

67
00:04:02,110 --> 00:04:00,170
launched from Cape Canaveral in 1977 the

68
00:04:05,320 --> 00:04:02,120
voyagers completed their tour of Jupiter

69
00:04:06,780 --> 00:04:05,330
in 1979 when they returned 33,000

70
00:04:08,729 --> 00:04:06,790
pictures to earth

71
00:04:10,850 --> 00:04:08,739
because of photography uncovered some

72
00:04:13,700 --> 00:04:10,860
remarkable findings

73
00:04:16,009 --> 00:04:13,710
there's rumors like Saturn and 116

74
00:04:20,949 --> 00:04:16,019
settle of experience has volcanic

75
00:04:25,250 --> 00:04:23,600
the Voyager encounters with Saturn will

76
00:04:27,950 --> 00:04:25,260
sharpen our impressions of the outer

77
00:04:28,430 --> 00:04:27,960
reaches of our solar system it's cold

78
00:04:31,219 --> 00:04:28,440
out there

79
00:04:33,710 --> 00:04:31,229
nearly a billion miles from the Sun and

80
00:04:35,870 --> 00:04:33,720
yet one of Saturn's moons the giant

81
00:04:38,689 --> 00:04:35,880
Titan may have an atmosphere that could

82
00:04:41,330 --> 00:04:38,699
support organic life an exploratory

83
00:04:42,830 --> 00:04:41,340
spacecraft pioneer 11 journey past

84
00:04:45,500 --> 00:04:42,840
Saturday year ago with less

85
00:04:46,909 --> 00:04:45,510
sophisticated cameras pioneers

86
00:04:48,920 --> 00:04:46,919
successfully passing through the

87
00:04:51,170 --> 00:04:48,930
dangerous ranges and discovered a fifth

88
00:04:54,890 --> 00:04:51,180

one which the voyagers should verify

89
00:05:01,050 --> 00:04:57,950
well we can expect very good quality

90
00:05:03,180 --> 00:05:01,060
photographs of Saturn one of the things

91
00:05:04,860 --> 00:05:03,190
that made the the Jupiter pictures so

92
00:05:06,810 --> 00:05:04,870
interesting with the surprises that were

93
00:05:10,470 --> 00:05:06,820
that were seen in these in these

94
00:05:13,320 --> 00:05:10,480
pictures now we know even less about the

95
00:05:16,020 --> 00:05:13,330
about the Saturn system and so we might

96
00:05:20,250 --> 00:05:16,030
expect more surprises than we had even

97
00:05:22,800 --> 00:05:20,260
interpreting these computer-generated

98
00:05:24,600 --> 00:05:22,810
pictures show what larger one will see

99
00:05:27,510 --> 00:05:24,610
traveling toward its closest encounter

100
00:05:29,340 --> 00:05:27,520
on November 12th it should reveal some

101
00:05:31,920 --> 00:05:29,350
exciting discoveries about Saturn which

102
00:05:34,530 --> 00:05:31,930
have been beyond our grasp on that date

103
00:05:36,120 --> 00:05:34,540
Voyager 1 will dip near the clouds have

104
00:05:38,940 --> 00:05:36,130
tightened to look for potential life

105
00:05:41,250 --> 00:05:38,950
there then if we pass behind Saturn's

106
00:05:44,610 --> 00:05:41,260
rings to study the planets mixture of

107
00:05:46,290 --> 00:05:44,620
water and ice scientists think the rains

108
00:05:48,480 --> 00:05:46,300
might have been formed from a shattered

109
00:05:51,300 --> 00:05:48,490
satellite or some other body that was

110
00:05:53,640 --> 00:05:51,310
pulled into Saturn's orbit by gravity to

111
00:05:55,620 --> 00:05:53,650
us they seemed sleek and smooth but the

112
00:05:57,930 --> 00:05:55,630
Rings are composed of huge chunks of ice

113
00:06:00,290 --> 00:05:57,940

at close range they appear as an

114
00:06:02,150 --> 00:06:00,300
asteroid snowstorm

115
00:06:04,190 --> 00:06:02,160
Saturn's composition has been a

116
00:06:07,490 --> 00:06:04,200
scientific puzzle because of the dense

117
00:06:10,760 --> 00:06:07,500
clouds that extend 37,000 miles from the

118
00:06:12,650 --> 00:06:10,770
planets rocky core we don't really even

119
00:06:15,710 --> 00:06:12,660
know exactly how large many of the

120
00:06:19,190 --> 00:06:15,720
Saturnian moons are because they're so

121
00:06:20,900 --> 00:06:19,200
hard to measure from the earth and in

122
00:06:23,990 --> 00:06:20,910
fact one of the major experiments that

123
00:06:25,940 --> 00:06:24,000
we're conducting with all of the

124
00:06:27,740 --> 00:06:25,950
instruments onboard the Voyager

125
00:06:29,360 --> 00:06:27,750
spacecraft is a comparison of the

126
00:06:32,360 --> 00:06:29,370
Jupiter system with the Saturnian system

127
00:06:35,510 --> 00:06:32,370
to see how they differ and why they

128
00:06:37,430 --> 00:06:35,520
differ the voyagers were planned to

129
00:06:39,290 --> 00:06:37,440
affirm our beliefs about Saturn and

130
00:06:42,170 --> 00:06:39,300
Jupiter but they've been so successful

131
00:06:45,800 --> 00:06:42,180
that NASA is sending Voyager 2 on to

132
00:06:47,870 --> 00:06:45,810
Uranus after it tours Saturn next August

133
00:06:50,900 --> 00:06:47,880
Voyager 2 will travel at an average

134
00:06:54,830 --> 00:06:50,910
speed of 60,000 miles per hour reaching

135
00:06:57,020 --> 00:06:54,840
the seventh planet Uranus by 1986 after

136
00:07:00,040 --> 00:06:57,030
that the spacecraft may venture even

137
00:07:02,050 --> 00:07:00,050
farther to Neptune

138
00:07:04,210 --> 00:07:02,060

when the voyagers finished their mission

139
00:07:07,900 --> 00:07:04,220
they will lose contact with earth and

140
00:07:10,240 --> 00:07:07,910
tumble and enslave into new galaxies but

141
00:07:13,450 --> 00:07:10,250
then they will observe their members for

142
00:07:16,420 --> 00:07:13,460
what was Fantasia and speculation in our

143
00:07:23,710 --> 00:07:16,430
minds has become factual knowledge about

144
00:07:25,390 --> 00:07:23,720
space one of the last frontiers when

145
00:07:27,100 --> 00:07:25,400
Voyager one dead speed through the

146
00:07:30,159 --> 00:07:27,110
Saturn system there were some surprises

147
00:07:32,140 --> 00:07:30,169
as we'll see next and we'll also see a

148
00:07:36,249 --> 00:07:32,150
short report on how the solar max

149
00:07:39,279 --> 00:07:36,259
satellite looked at the Sun these people

150
00:07:42,580 --> 00:07:39,289
here in Mission Control were responsible

151
00:07:45,999 --> 00:07:42,590
for guiding NASA's 1,800 pound unmanned

152
00:07:51,189 --> 00:07:46,009
Voyager 1 spacecraft some billion miles

153
00:07:52,360 --> 00:07:51,199
through space on November 12th after a

154
00:07:54,580 --> 00:07:52,370
three-year journey

155
00:08:00,249 --> 00:07:54,590
Voyager 1 made its closest encounter

156
00:08:03,540 --> 00:08:00,259
with the planet Saturn Voyager has

157
00:08:05,860 --> 00:08:03,550
returned more than 18,000 photographs

158
00:08:08,050 --> 00:08:05,870
photographs that are giving scientists

159
00:08:10,480 --> 00:08:08,060
excellent close-up views and new

160
00:08:15,459 --> 00:08:10,490
information about the huge planet and

161
00:08:18,070 --> 00:08:15,469
its many moons with the help of computer

162
00:08:24,159 --> 00:08:18,080
animation you can take a ride on Voyager

163
00:08:26,740 --> 00:08:24,169

to Saturn and its major moons voyagers

164
00:08:29,080 --> 00:08:26,750
11 scientific instruments probed deep

165
00:08:30,850 --> 00:08:29,090
into the atmosphere of Saturn and gave

166
00:08:34,209 --> 00:08:30,860
us an unprecedented view of those

167
00:08:36,760 --> 00:08:34,219
incredible rings we now know there are

168
00:08:39,819 --> 00:08:36,770
six major ring systems made up of

169
00:08:42,519 --> 00:08:39,829
possibly as many as a thousand rings the

170
00:08:45,310 --> 00:08:42,529
Rings are Sun reflecting icy objects

171
00:08:47,710 --> 00:08:45,320
ranging from Boulder sized to small

172
00:08:51,639 --> 00:08:47,720
particles that whirl around the planet

173
00:08:54,850 --> 00:08:51,649
at very high speeds and those moons are

174
00:08:57,430 --> 00:08:54,860
satellites like outriders they encircle

175
00:08:59,410 --> 00:08:57,440
Saturn generating as much scientific

176
00:09:00,389 --> 00:08:59,420
interest as the great ringed planet

177
00:09:03,819 --> 00:09:00,399
itself

178
00:09:08,850 --> 00:09:03,829
- Tethys D&E

179
00:09:11,530 --> 00:09:08,860
rheya Titan and a host of smaller ones

180
00:09:12,990 --> 00:09:11,540
more than a thousand journalists were on

181
00:09:15,030 --> 00:09:13,000
hand to witness the India

182
00:09:17,730 --> 00:09:15,040
and attend the science briefings that

183
00:09:19,860 --> 00:09:17,740
follow and these were some of the

184
00:09:22,470 --> 00:09:19,870
storytellers the engineers and

185
00:09:24,570 --> 00:09:22,480
scientists themselves it's always

186
00:09:25,860 --> 00:09:24,580
gratifying to have the results be

187
00:09:28,500 --> 00:09:25,870
something more than what was expected

188
00:09:31,710 --> 00:09:28,510

and Saturn and what we have found was

189
00:09:32,580 --> 00:09:31,720
not expected I suspect even for the next

190
00:09:35,280 --> 00:09:32,590
few years

191
00:09:36,870 --> 00:09:35,290
we will find new discoveries in the data

192
00:09:38,610 --> 00:09:36,880
which we've acquired in the last few

193
00:09:40,620 --> 00:09:38,620
days and as we see more and more

194
00:09:42,000 --> 00:09:40,630
examples of the way the universe can put

195
00:09:43,830 --> 00:09:42,010
planets together we find that our

196
00:09:45,900 --> 00:09:43,840
terrestrial perspective in explaining

197
00:09:48,380 --> 00:09:45,910
our own planet has been rather limited

198
00:09:51,150 --> 00:09:48,390
we get new ideas from this what we

199
00:09:53,670 --> 00:09:51,160
learned about Saturn during that

200
00:09:56,760 --> 00:09:53,680
encounter and during the months that

201
00:10:00,720 --> 00:09:56,770
preceded it have really rewritten the

202
00:10:03,300 --> 00:10:00,730
text books on Saturn next August Voyager

203
00:10:05,100 --> 00:10:03,310
2 will approach Saturn pass by the ring

204
00:10:07,230 --> 00:10:05,110
spectacle of gas and ice from a

205
00:10:11,070 --> 00:10:07,240
different angle and then fly on to

206
00:10:13,530 --> 00:10:11,080
Uranus arriving there in 1986 it may

207
00:10:19,530 --> 00:10:13,540
also travel to Neptune before leaving

208
00:10:23,460 --> 00:10:19,540
our solar system from Earth it appears

209
00:10:27,600 --> 00:10:23,470
as a warm friendly ball an integral part

210
00:10:30,360 --> 00:10:27,610
of everything living but up close it's a

211
00:10:32,220 --> 00:10:30,370
churning solar furnace that spouts solar

212
00:10:35,760 --> 00:10:32,230
flares in an atmosphere that's

213
00:10:38,490 --> 00:10:35,770

constantly changing and explosive little

214
00:10:40,020 --> 00:10:38,500
wonder that our star the Sun has been

215
00:10:43,170 --> 00:10:40,030
the focal point of scientific

216
00:10:45,570 --> 00:10:43,180
investigation for centuries to reel a

217
00:10:48,300 --> 00:10:45,580
sophisticated pictures and data about

218
00:10:52,530 --> 00:10:48,310
the Sun and its energy cycles NASA

219
00:10:57,060 --> 00:10:52,540
launched the solar max in 1980 short for

220
00:10:59,820 --> 00:10:57,070
solar maximum mission being returned are

221
00:11:02,130 --> 00:10:59,830
the first true close-up views of the

222
00:11:05,579 --> 00:11:02,140
mysterious spots and solar flares that

223
00:11:07,920 --> 00:11:05,589
energized the sun's surface all this

224
00:11:10,140 --> 00:11:07,930
part of an effort to learn how we can

225
00:11:13,680 --> 00:11:10,150
channel the Sun into an even more

226
00:11:16,800 --> 00:11:13,690
effective energy source our next clip

227
00:11:21,800 --> 00:11:16,810
from September 1981 shows us some of the

228
00:11:27,540 --> 00:11:24,660
those music like sounds are actually

229
00:11:29,670 --> 00:11:27,550
radio waves picked up by the plasma wave

230
00:11:33,030 --> 00:11:29,680
detector on NASA's Voyager 2 spacecraft

231
00:11:36,060 --> 00:11:33,040
as it approached and swept by the planet

232
00:11:36,660 --> 00:11:36,070
Saturn after a four-year billion mile

233
00:11:40,290 --> 00:11:36,670
journey

234
00:11:42,600 --> 00:11:40,300
Voyager 2 passed within 63,000 miles of

235
00:11:44,490 --> 00:11:42,610
the many-colored planet and transmitted

236
00:11:47,070 --> 00:11:44,500
back thousands of extremely clear

237
00:11:48,510 --> 00:11:47,080
pictures astronomers were surprised at

238
00:11:50,850 --> 00:11:48,520

the complexity of Saturn's rings

239
00:11:53,980 --> 00:11:50,860
including what appeared to be spokes

240
00:11:58,939 --> 00:11:56,660
during one experiment scientists watched

241
00:12:01,579 --> 00:11:58,949
a star come out from behind Saturn and

242
00:12:03,470 --> 00:12:01,589
go behind the Rings they then measured

243
00:12:08,989 --> 00:12:03,480
the amount of starlight a hundred times

244
00:12:11,090 --> 00:12:08,999
a second as it blinked on and off what

245
00:12:13,369 --> 00:12:11,100
they found were many many individual

246
00:12:16,460 --> 00:12:13,379
streams of particles orbiting Saturn

247
00:12:17,600 --> 00:12:16,470
like waves in the ocean Saturn also has

248
00:12:19,850 --> 00:12:17,610
very interesting weather

249
00:12:23,480 --> 00:12:19,860
according to imaging team leader dr.

250
00:12:25,249 --> 00:12:23,490
Bradford a Smith the in fact have found

251
00:12:27,769 --> 00:12:25,259
that there are similarities between the

252
00:12:30,530 --> 00:12:27,779
Saturnian weather and terrestrial

253
00:12:34,879 --> 00:12:30,540
weather so that the analysis which is

254
00:12:36,650 --> 00:12:34,889
still going on in trying to understand

255
00:12:38,960 --> 00:12:36,660
the dynamics of that of that Saturn

256
00:12:40,790 --> 00:12:38,970
system those analyses sooner or later

257
00:12:44,420 --> 00:12:40,800
are going to be helpful in interpreting

258
00:12:46,970 --> 00:12:44,430
our own Earth's meteorology Saturn is

259
00:12:51,799 --> 00:12:46,980
surrounded by signs of collisions small

260
00:12:53,929 --> 00:12:51,809
odd shaped bodies of rock and ice the

261
00:12:56,119 --> 00:12:53,939
Lawrence a soda blossom chief of astro

262
00:12:58,519 --> 00:12:56,129
geologic studies for the US Geological

263
00:13:02,389 --> 00:12:58,529

Survey specializes in the study of

264
00:13:04,879 --> 00:13:02,399
Saturn's moons or satellites what we've

265
00:13:07,400 --> 00:13:04,889
seen from the combined missions now is

266
00:13:10,249 --> 00:13:07,410
that the collection of objects that we

267
00:13:13,040 --> 00:13:10,259
find in the Saturnian satellite system

268
00:13:14,780 --> 00:13:13,050
extremely varied and unanticipated in

269
00:13:17,660 --> 00:13:14,790
terms of the geologic activity and the

270
00:13:20,449 --> 00:13:17,670
degree to which these objects have

271
00:13:23,540 --> 00:13:20,459
remained active and alive Enceladus

272
00:13:26,059 --> 00:13:23,550
whatja to discovered has been active

273
00:13:28,610 --> 00:13:26,069
over most of geologic history this is

274
00:13:30,439 --> 00:13:28,620
extremely puzzling thing to have an

275
00:13:33,049 --> 00:13:30,449
object that has been continually

276
00:13:34,730 --> 00:13:33,059
replacing sections of a surface but

277
00:13:37,819 --> 00:13:34,740
actually has a mass that's something

278
00:13:40,999 --> 00:13:37,829
like one part in a hundred thousand the

279
00:13:42,710 --> 00:13:41,009
mass of the earth the planet-sized moon

280
00:13:45,139 --> 00:13:42,720
Titan has many of the characteristics

281
00:13:47,900 --> 00:13:45,149
that may have existed on earth in its

282
00:13:51,439 --> 00:13:47,910
early geologic history its atmosphere is

283
00:13:54,319 --> 00:13:51,449
dominated by 82% nitrogen gas compared

284
00:13:56,900 --> 00:13:54,329
with 79% on earth but instead of oxygen

285
00:13:59,840 --> 00:13:56,910
it has methane and hydrogen and it's

286
00:14:01,999 --> 00:13:59,850
very cold and smoggy Voyager twos

287
00:14:03,799 --> 00:14:02,009
cameras have been turned off and will

288
00:14:05,570 --> 00:14:03,809

remain off most of the time for the next

289
00:14:07,600 --> 00:14:05,580
four years

290
00:14:10,040 --> 00:14:07,610
even so engineers at NASA's Johnson

291
00:14:11,840 --> 00:14:10,050
laboratory will be watching and guiding

292
00:14:15,140 --> 00:14:11,850
it toward its next rendezvous with the

293
00:14:20,120 --> 00:14:15,150
planet Uranus in 1986 and Neptune in

294
00:14:22,280 --> 00:14:20,130
1989 Voyager project scientist dr. Eadie

295
00:14:25,100 --> 00:14:22,290
stone made these observations about the

296
00:14:28,580 --> 00:14:25,110
importance of this type research well I

297
00:14:31,340 --> 00:14:28,590
think we all want to understand where we

298
00:14:34,820 --> 00:14:31,350
live and it's interesting that we now

299
00:14:36,680 --> 00:14:34,830
have the capability to include in where

300
00:14:39,110 --> 00:14:36,690
we live the solar system in which we

301
00:14:41,630 --> 00:14:39,120
live now that is interesting because

302
00:14:43,220 --> 00:14:41,640
we're very curious people and where we

303
00:14:45,470 --> 00:14:43,230
live on one of the planets the solar

304
00:14:47,270 --> 00:14:45,480
system which has obviously evolved to

305
00:14:50,030 --> 00:14:47,280
where it is today and which is

306
00:14:52,370 --> 00:14:50,040
continuing to evolve it's very difficult

307
00:14:54,950 --> 00:14:52,380
when you're looking at something now to

308
00:14:57,590 --> 00:14:54,960
be able to accurately go back in time

309
00:14:59,360 --> 00:14:57,600
and or to go forward in time but by

310
00:15:01,670 --> 00:14:59,370
looking at a number of examples of

311
00:15:03,920 --> 00:15:01,680
things as they exist now in the solar

312
00:15:06,080 --> 00:15:03,930
system I think we have a better idea of

313
00:15:07,910 --> 00:15:06,090

both how to look backward in time to the

314
00:15:10,310 --> 00:15:07,920
beginning and possibly how to look

315
00:15:16,160 --> 00:15:10,320
forward in time to how things will

316
00:15:18,770 --> 00:15:16,170
evolve now let's turn to the inner solar

317
00:15:24,980 --> 00:15:18,780
system to learn more about Venus from

318
00:15:27,230 --> 00:15:24,990
this 1982 report stop the Earth's

319
00:15:29,870 --> 00:15:27,240
rotation remove its friendly

320
00:15:32,960 --> 00:15:29,880
neighborhood moon push it just slightly

321
00:15:35,150 --> 00:15:32,970
closer to the Sun and scientists believe

322
00:15:38,750 --> 00:15:35,160
the earth would become like this planet

323
00:15:40,850 --> 00:15:38,760
Venus recent findings indicate that the

324
00:15:43,790 --> 00:15:40,860
earth and Venus are identical in many

325
00:15:46,160 --> 00:15:43,800
ways at one point in Venus history it

326
00:15:48,440 --> 00:15:46,170
might even if at oceans similar to ours

327
00:15:50,420 --> 00:15:48,450
these are some of the new discoveries

328
00:15:52,790 --> 00:15:50,430
resulting from an International Venus

329
00:15:54,380 --> 00:15:52,800
science conference many of the new

330
00:15:56,960 --> 00:15:54,390
findings have come from the several

331
00:15:59,510 --> 00:15:56,970
pioneer Venus spacecraft sent there by

332
00:16:02,720 --> 00:15:59,520
NASA to study the cloud shrouded planet

333
00:16:04,940 --> 00:16:02,730
at close range know that Venus has got

334
00:16:06,620 --> 00:16:04,950
dense sulfuric acid clouds that would

335
00:16:09,050 --> 00:16:06,630
seem to us to be something like a smog

336
00:16:11,000 --> 00:16:09,060
or a heavy fog which would burn your

337
00:16:13,220 --> 00:16:11,010
skin if you were exposed to these clouds

338
00:16:15,530 --> 00:16:13,230

the bottom of the clouds is about 30

339
00:16:16,879 --> 00:16:15,540
miles above the surface and below that

340
00:16:19,309 --> 00:16:16,889
the atmosphere is

341
00:16:20,629 --> 00:16:19,319
you can see for great distances as you

342
00:16:23,030 --> 00:16:20,639
go deeper and deeper into the atmosphere

343
00:16:24,979 --> 00:16:23,040
it gets hotter and hotter and eventually

344
00:16:27,439 --> 00:16:24,989
when you get to the surface it's about

345
00:16:29,629 --> 00:16:27,449
800 degrees Fahrenheit uns like being

346
00:16:31,639 --> 00:16:29,639
inside of a self-cleaning oven the

347
00:16:34,009 --> 00:16:31,649
temperatures are so hot that it would

348
00:16:36,049 --> 00:16:34,019
kill anyone who was exposed to them and

349
00:16:38,030 --> 00:16:36,059
the pressures are equivalent to being

350
00:16:40,400 --> 00:16:38,040
3,000 feet deep in the ocean so the

351
00:16:42,470 --> 00:16:40,410
pressures would be crushing the light

352
00:16:44,629 --> 00:16:42,480
levels are so dim at the surface during

353
00:16:46,849 --> 00:16:44,639
the day that it's sort of like the

354
00:16:51,379 --> 00:16:46,859
cloudiest day that we ever experience on

355
00:16:54,679 --> 00:16:51,389
the earth so it's a dim hot crushing

356
00:16:56,749 --> 00:16:54,689
place during the early years of the

357
00:16:58,759 --> 00:16:56,759
solar system's history conditions may

358
00:17:01,309 --> 00:16:58,769
have been right for life to exist on

359
00:17:03,439 --> 00:17:01,319
Venus one of the key elements was water

360
00:17:06,620 --> 00:17:03,449
according to geologist dr. Harold

361
00:17:09,980 --> 00:17:06,630
Mazursky well we think that there was a

362
00:17:12,590 --> 00:17:09,990
lot of water in Venus like there is on

363
00:17:14,779 --> 00:17:12,600

the earth but it's not there now it's

364
00:17:18,110 --> 00:17:14,789
way too hot there's water vapor in the

365
00:17:20,149 --> 00:17:18,120
atmosphere so the big question is early

366
00:17:22,909 --> 00:17:20,159
in its history did it have condensed

367
00:17:25,159 --> 00:17:22,919
water on the surface and we can look for

368
00:17:27,169 --> 00:17:25,169
that in high-resolution radar pictures

369
00:17:30,860 --> 00:17:27,179
and the way we do it is you look for

370
00:17:32,690 --> 00:17:30,870
shorelines because there are dried lakes

371
00:17:34,370 --> 00:17:32,700
now in the western United States that

372
00:17:36,350 --> 00:17:34,380
were full of water during the Ice Age

373
00:17:39,080 --> 00:17:36,360
and we can see that evidence clearly

374
00:17:41,060 --> 00:17:39,090
there are short bars that were made when

375
00:17:43,430 --> 00:17:41,070
there was water so we can look for those

376
00:17:45,740 --> 00:17:43,440
kinds of things that may have been there

377
00:17:47,779 --> 00:17:45,750
in the past on Venus surface we were

378
00:17:49,610 --> 00:17:47,789
utterly surprised on Mars by

379
00:17:51,769 --> 00:17:49,620
understanding that the history was

380
00:17:54,560 --> 00:17:51,779
different early and the same thing is

381
00:17:56,690 --> 00:17:54,570
true the earth so it would be strange if

382
00:17:58,149 --> 00:17:56,700
Venus had always been the same as it is

383
00:18:02,389 --> 00:17:58,159
now

384
00:18:04,610 --> 00:18:02,399
lightning active volcanoes upside-down

385
00:18:08,480 --> 00:18:04,620
clouds that caused a drizzle of sulfuric

386
00:18:10,399 --> 00:18:08,490
acid and a super hot surface slowly but

387
00:18:12,529 --> 00:18:10,409
surely Venus is giving up some of its

388
00:18:14,629 --> 00:18:12,539

secrets new information that will help

389
00:18:19,490 --> 00:18:14,639
us better understand our own planet both

390
00:18:22,070 --> 00:18:19,500
past and future by May 1983 when the

391
00:18:24,200 --> 00:18:22,080
next clip was released the Pioneer 10

392
00:18:26,419 --> 00:18:24,210
spacecraft was about to become the first

393
00:18:31,730 --> 00:18:26,429
man-made object to leave the solar

394
00:18:38,789 --> 00:18:36,060
launched in 1972 NASA's pioneer 10

395
00:18:41,039 --> 00:18:38,799
spacecraft has accomplished many firsts

396
00:18:43,950 --> 00:18:41,049
over the course of its 11 years Space

397
00:18:46,529 --> 00:18:43,960
Odyssey 1 was a successful passage

398
00:18:48,269 --> 00:18:46,539
through the rocky asteroid belt a feat

399
00:18:50,580 --> 00:18:48,279
which greatly alleviated the fears of

400
00:18:53,639 --> 00:18:50,590
scientists concerned about damage too

401
00:18:55,049 --> 00:18:53,649
far traveling spacecraft having safely

402
00:18:57,720 --> 00:18:55,059
journeyed the some two and a half

403
00:18:59,220 --> 00:18:57,730
billion miles to Jupiter pioneer 10

404
00:19:02,190 --> 00:18:59,230
transmitted valuable scientific

405
00:19:03,869 --> 00:19:02,200
information back to earth information

406
00:19:06,560 --> 00:19:03,879
shedding new light on the composition

407
00:19:11,039 --> 00:19:06,570
and evolution of Jupiter and its moons

408
00:19:13,590 --> 00:19:11,049
On June 13th of this year pioneer 10

409
00:19:16,110 --> 00:19:13,600
will travel beyond all the known planets

410
00:19:19,470 --> 00:19:16,120
and become the first man-made object to

411
00:19:21,539 --> 00:19:19,480
leave the solar system as NASA's Deep

412
00:19:23,730 --> 00:19:21,549
Space Network continues to track the

413
00:19:26,190 --> 00:19:23,740

spacecraft out to around five billion

414
00:19:28,110 --> 00:19:26,200
miles researchers hope to learn more

415
00:19:31,850 --> 00:19:28,120
about the boundary between the sun's

416
00:19:34,919 --> 00:19:31,860
atmosphere and true interstellar space

417
00:19:37,110 --> 00:19:34,929
pioneer 10 a spacecraft that has

418
00:19:40,080 --> 00:19:37,120
journeyed further than any other to the

419
00:19:43,680 --> 00:19:40,090
outer planets and now beyond our solar

420
00:19:45,889 --> 00:19:43,690
system a man-made object which will from

421
00:19:52,500 --> 00:19:45,899
a new vantage point in Whitman's words

422
00:19:58,830 --> 00:19:56,010
as pioneer ten is speeding out towards

423
00:20:01,350 --> 00:19:58,840
the stars astronomers are using radio

424
00:20:08,730 --> 00:20:01,360
telescopes to examine planets and stars

425
00:20:10,140 --> 00:20:08,740
as this 1983 report shows astronomers

426
00:20:13,320 --> 00:20:10,150
calculate that there are approximately

427
00:20:16,380 --> 00:20:13,330
100 billion other stars in the Milky Way

428
00:20:18,360 --> 00:20:16,390
an infinite number of these stars could

429
00:20:21,470 --> 00:20:18,370
conceivably have planets orbiting them

430
00:20:24,080 --> 00:20:21,480
possibly supporting some sort of life

431
00:20:26,210 --> 00:20:24,090
a scientific approach to the search for

432
00:20:28,430 --> 00:20:26,220
extraterrestrial intelligence has become

433
00:20:30,230 --> 00:20:28,440
possible in recent years thanks to the

434
00:20:33,020 --> 00:20:30,240
extraordinary development of new and

435
00:20:34,669 --> 00:20:33,030
more sophisticated instrumentation radio

436
00:20:36,380 --> 00:20:34,679
telescopes such as the Deep Space

437
00:20:39,230 --> 00:20:36,390
Network at NASA's Jet Propulsion

438
00:20:41,690 --> 00:20:39,240

Laboratory in California are being used

439
00:20:45,230 --> 00:20:41,700
by scientists as part of a five-year

440
00:20:48,380 --> 00:20:45,240
research program but the Big Ear on the

441
00:20:51,370 --> 00:20:48,390
universe is the Arecibo Observatory the

442
00:20:53,750 --> 00:20:51,380
world's largest radio radar telescope

443
00:20:55,820 --> 00:20:53,760
flying deep within the mountains of

444
00:20:57,830 --> 00:20:55,830
northern border Rico in a natural

445
00:21:00,530 --> 00:20:57,840
depression formed by the collapse of

446
00:21:02,840 --> 00:21:00,540
huge limestone caves the instruments

447
00:21:04,789 --> 00:21:02,850
collecting area is larger than all the

448
00:21:07,850 --> 00:21:04,799
combined collecting areas of all

449
00:21:09,950 --> 00:21:07,860
telescopes ever built as a radio

450
00:21:11,990 --> 00:21:09,960
receiver the 1,000 foot structure

451
00:21:15,620 --> 00:21:12,000
listens for signals coming from other

452
00:21:17,810 --> 00:21:15,630
stars in our galaxy as a radar the

453
00:21:20,419 --> 00:21:17,820
telescope sends out the strongest signal

454
00:21:22,610 --> 00:21:20,429
now leaving earth a signal which may be

455
00:21:27,830 --> 00:21:22,620
detected by similar instruments anywhere

456
00:21:30,230 --> 00:21:27,840
in our galaxy operated by Cornell

457
00:21:32,240 --> 00:21:30,240
University the observatory was initially

458
00:21:35,000 --> 00:21:32,250
conceived to study the composition of

459
00:21:36,830 --> 00:21:35,010
the Earth's upper atmosphere later NASA

460
00:21:39,140 --> 00:21:36,840
supported the installation of a large

461
00:21:41,900 --> 00:21:39,150
transmitter so it could be used to study

462
00:21:44,210 --> 00:21:41,910
other planets in our solar system the

463
00:21:49,090 --> 00:21:44,220

surface roughness of Mars was examined

464
00:21:54,230 --> 00:21:51,320
high-resolution studies were also done

465
00:21:56,659 --> 00:21:54,240
on Venus director of the Arecibo

466
00:21:59,990 --> 00:21:56,669
telescope is dr. Don Campbell NASA

467
00:22:03,110 --> 00:22:00,000
realized the utility of the improved

468
00:22:04,850 --> 00:22:03,120
Arecibo telescope which would be

469
00:22:07,850 --> 00:22:04,860
powerful enough to study the surface of

470
00:22:09,770 --> 00:22:07,860
Venus it would also allow us to look

471
00:22:12,260 --> 00:22:09,780
more with more detail at the surface and

472
00:22:17,539 --> 00:22:12,270
mercury surfaces and Mars and laser

473
00:22:19,460 --> 00:22:17,549
altitudes to complement the photography

474
00:22:22,130 --> 00:22:19,470
that was done from the Viking orbiters

475
00:22:24,200 --> 00:22:22,140
and also to look at the outer planets

476
00:22:27,260 --> 00:22:24,210
the satellites of Jupiter the rings of

477
00:22:32,510 --> 00:22:27,270
Saturn and numerous asteroids and comets

478
00:22:34,880 --> 00:22:32,520
that might come by the very large

479
00:22:35,270 --> 00:22:34,890
collecting area captures radio waves

480
00:22:37,760 --> 00:22:35,280
come

481
00:22:39,950 --> 00:22:37,770
from stars and galaxies giving

482
00:22:42,590 --> 00:22:39,960
scientists a clue to the distribution of

483
00:22:45,080 --> 00:22:42,600
mass throughout the universe other

484
00:22:48,860 --> 00:22:45,090
interesting cosmic radio sources are

485
00:22:53,390 --> 00:22:48,870
pulsars dying stars which emit pulsating

486
00:22:54,860 --> 00:22:53,400
radio signals as they spin in space one

487
00:22:58,250 --> 00:22:54,870
of these fascinating stars was

488
00:23:00,950 --> 00:22:58,260

discovered at Arecibo in 1982 director

489
00:23:05,090 --> 00:23:00,960
of radio astronomy at Arecibo is dr.

490
00:23:06,670 --> 00:23:05,100
Mike Davis this new pulsar that has been

491
00:23:12,110 --> 00:23:06,680
discovered recently at the observatory

492
00:23:15,620 --> 00:23:12,120
is rotating 642 times per second that's

493
00:23:17,180 --> 00:23:15,630
more than 20 times as fast as the next

494
00:23:19,880 --> 00:23:17,190
fastest pulsar the one in the Crab

495
00:23:21,560 --> 00:23:19,890
Nebula and these neutron stars as

496
00:23:24,590 --> 00:23:21,570
they're called were predicted as long

497
00:23:27,410 --> 00:23:24,600
ago as 1934 but nobody knew that they

498
00:23:30,740 --> 00:23:27,420
would come with a rotating flashlight

499
00:23:33,650 --> 00:23:30,750
beacon like a lighthouse shining out to

500
00:23:35,860 --> 00:23:33,660
sea every time this beacon flashes past

501
00:23:38,390 --> 00:23:35,870
the observatory we pick up a pulse

502
00:23:40,610 --> 00:23:38,400
astronomers have also detected quasars

503
00:23:42,890 --> 00:23:40,620
emitting enormous quantities of radio

504
00:23:45,140 --> 00:23:42,900
energy which traveling at the speed of

505
00:23:51,560 --> 00:23:45,150
light have taken as long as 10 billion

506
00:23:53,840 --> 00:23:51,570
years to reach Earth Arecibo listening

507
00:23:56,030 --> 00:23:53,850
for signals from space in an attempt to

508
00:24:01,160 --> 00:23:56,040
solve some of the mysteries of our

509
00:24:03,410 --> 00:24:01,170
universe our final report shows how an

510
00:24:06,590 --> 00:24:03,420
international group of probes was to

511
00:24:10,160 --> 00:24:06,600
study comet Halley and how Voyager 2 was

512
00:24:12,710 --> 00:24:10,170
approaching the planet Uranus comet

513
00:24:15,290 --> 00:24:12,720

Halley is making its regular 76 year

514
00:24:18,140 --> 00:24:15,300
pilgrimage around our Sun as it has been

515
00:24:19,790 --> 00:24:18,150
doing for countless centuries the comet

516
00:24:22,370 --> 00:24:19,800
is the target of study for five

517
00:24:23,780 --> 00:24:22,380
exploratory spacecraft from Europe Japan

518
00:24:26,330 --> 00:24:23,790
and the Soviet Union

519
00:24:29,180 --> 00:24:26,340
each whizzing by the giant snowball of

520
00:24:32,300 --> 00:24:29,190
ice gas and dust from different vantage

521
00:24:34,340 --> 00:24:32,310
points the European Space Agency's

522
00:24:36,590 --> 00:24:34,350
Giotto spacecraft will be the most

523
00:24:39,230 --> 00:24:36,600
daring probe by taking a flight path

524
00:24:41,870 --> 00:24:39,240
just 300 miles in front of the Comets

525
00:24:43,280 --> 00:24:41,880
head Giotto hopes to photograph the

526
00:24:46,260 --> 00:24:43,290
comet's nucleus

527
00:24:49,110 --> 00:24:46,270
two other highly instrumented Soviet

528
00:24:51,060 --> 00:24:49,120
spacecraft Vega 1 and Vega 2 are

529
00:24:53,520 --> 00:24:51,070
scheduled to fly by the comet at a

530
00:24:55,710 --> 00:24:53,530
distance of six thousand miles hoping

531
00:24:59,280 --> 00:24:55,720
also to obtain images of the comet's

532
00:25:01,920 --> 00:24:59,290
nucleus lastly two japanese spacecraft

533
00:25:03,630 --> 00:25:01,930
studying halle our planet a which

534
00:25:06,240 --> 00:25:03,640
approaches the Sun would side of Halle

535
00:25:09,360 --> 00:25:06,250
at a distance of 120 thousand miles and

536
00:25:12,570 --> 00:25:09,370
Sakigake which will pass about 4 million

537
00:25:14,370 --> 00:25:12,580
miles from the comet in order to get the

538
00:25:16,380 --> 00:25:14,380

best use out of all the research being

539
00:25:19,200 --> 00:25:16,390
done on the comet the International

540
00:25:20,970 --> 00:25:19,210
Halle watch was organized thousands of

541
00:25:23,880 --> 00:25:20,980
scientists and amateur and professional

542
00:25:26,850 --> 00:25:23,890
astronomers from 47 different countries

543
00:25:29,400 --> 00:25:26,860
have joined forces the Halle encounter

544
00:25:31,440 --> 00:25:29,410
is a once-in-a-lifetime chance to study

545
00:25:35,520 --> 00:25:31,450
one of the most primitive objects in our

546
00:25:37,050 --> 00:25:35,530
solar system a program dedicated to

547
00:25:39,420 --> 00:25:37,060
visiting some of the planets in our

548
00:25:41,940 --> 00:25:39,430
solar system with two unmanned probes

549
00:25:45,510 --> 00:25:41,950
has had a history of success ever since

550
00:25:47,970 --> 00:25:45,520
its beginning in 1977 Voyager 1 and

551
00:25:50,880 --> 00:25:47,980
Voyager 2 were both launched on their

552
00:25:53,250 --> 00:25:50,890
way to Jupiter and Saturn now having

553
00:25:56,670 --> 00:25:53,260
logged nearly 2 billion miles in space

554
00:25:58,950 --> 00:25:56,680
since 1977 Voyager 2 will point its

555
00:26:01,520 --> 00:25:58,960
sensors and TV cameras at a planet we

556
00:26:04,110 --> 00:26:01,530
have never seen up close Uranus

557
00:26:06,210 --> 00:26:04,120
Voyager project scientist dr. Edward

558
00:26:08,970 --> 00:26:06,220
stone NASA's Jet Propulsion Laboratory

559
00:26:10,650 --> 00:26:08,980
in Pasadena California well there are

560
00:26:12,210 --> 00:26:10,660
several unique things about Uranus first

561
00:26:13,680 --> 00:26:12,220
of all it's the most remote planet that

562
00:26:16,290 --> 00:26:13,690
we will we will have visited in the

563
00:26:18,270 --> 00:26:16,300

Solar System it formed in a much colder

564
00:26:19,710 --> 00:26:18,280
region of the solar nebula and therefore

565
00:26:22,020 --> 00:26:19,720
is made of different materials than

566
00:26:23,790 --> 00:26:22,030
either Jupiter or Saturn so we will be

567
00:26:26,070 --> 00:26:23,800
studying the different properties of

568
00:26:27,720 --> 00:26:26,080
Uranus and its satellites the other

569
00:26:29,310 --> 00:26:27,730
interesting thing about Uranus is that

570
00:26:31,320 --> 00:26:29,320
it's tipped over on its side with its

571
00:26:33,210 --> 00:26:31,330
spin axis at this time basically

572
00:26:34,530 --> 00:26:33,220
pointing at the Sun so it's it has a

573
00:26:36,159 --> 00:26:34,540
much different orientation with respect

574
00:26:38,229 --> 00:26:36,169
to the Sun

575
00:26:40,840 --> 00:26:38,239
many questions will be answered during

576
00:26:43,149 --> 00:26:40,850
the encounter before the tiny one-ton

577
00:26:45,159 --> 00:26:43,159
spacecraft ventures even further into

578
00:26:49,389 --> 00:26:45,169
our solar system to visit the eighth

579
00:26:52,019 --> 00:26:49,399
planet from the Sun Neptune Voyager to

580
00:26:56,019 --> 00:26:52,029
successfully examine Uranus in early

581
00:26:58,960 --> 00:26:56,029
1986 comet Halley was also studied by an

582
00:27:01,359 --> 00:26:58,970
armada of spacecraft during an X program

583
00:27:04,060 --> 00:27:01,369
we'll see comet Halley and Uranus

584
00:27:06,849 --> 00:27:04,070
results that's all we have for this

585
00:27:09,340 --> 00:27:06,859
edition of NASA images but before we go

586
00:27:11,619 --> 00:27:09,350
let me remind you that you're cordially

587
00:27:13,690 --> 00:27:11,629
invited to see the displays at the

588
00:27:16,090 --> 00:27:13,700

visitor center here at the NASA Lewis

589
00:27:17,919 --> 00:27:16,100
Research Center we're located near the

590
00:27:21,279 --> 00:27:17,929
Hopkins International Airport in

591
00:27:23,440 --> 00:27:21,289
Cleveland admission is free until next