1
00:00:09,860 --> 00:00:07,550
of all the mysteries that scientists

2
00:00:12,440 --> 00:00:09,870
investigate the greatest riddle is life

3
00:00:15,650 --> 00:00:12,450
itself what caused a planet like Earth

4
00:00:18,260 --> 00:00:15,660
to form around our Sun what sparked

5
00:00:19,580 --> 00:00:18,270
chemicals to burst forth into life to

6
00:00:21,830 --> 00:00:19,590
help answer these questions

7
00:00:24,140 --> 00:00:21,840
astronomers are studying celestial

8
00:00:32,840 --> 00:00:24,150
fossils from the solar system's earliest

9
00:00:37,860 --> 00:00:35,490
the planets and the Sun were created

10
00:00:44,090 --> 00:00:37,870
four and a half billion years ago from a

11
00:00:49,350 --> 00:00:46,709
heat from the young Sun and the pressure

12
00:00:55,779 --> 00:00:49,360
of the solar wind swept clean nearby

13
00:01:01,369 --> 00:00:58,850

but farther away the cold outer regions

14
00:01:04,399 --> 00:01:01,379
preserve giant gas balls like Jupiter

15
00:01:07,310 --> 00:01:04,409
and Saturn comets were to remain frozen

16
00:01:12,660 --> 00:01:07,320
fossils holding secrets of the chemical

17
00:01:17,969 --> 00:01:15,749
life itself is found only on earth but

18
00:01:20,100 --> 00:01:17,979
clues to its origins may be found in the

19
00:01:23,609 --> 00:01:20,110
distant reaches of giant planets moons

20
00:01:25,710 --> 00:01:23,619
and comets the NASA missions to the

21
00:01:29,160 --> 00:01:25,720
outer solar system are named comic

22
00:01:32,670 --> 00:01:29,170
rendezvous asteroid flyby or craft and

23
00:01:35,730 --> 00:01:32,680
Cassini craft and Cassini are the first

24
00:01:37,920 --> 00:01:35,740
missions in Mariner mark to a new series

25
00:01:41,609 --> 00:01:37,930
of spacecraft being designed to explore

26
00:01:44,300 --> 00:01:41,619
the outer solar system dr. Tobias Owen

27
00:01:46,919 --> 00:01:44,310
of the state university of new york the

28
00:01:49,380 --> 00:01:46,929
inner planets are small they've been

29
00:01:51,660 --> 00:01:49,390
heavily bombarded reworked from within

30
00:01:54,149 --> 00:01:51,670
that early history is more or less gone

31
00:01:56,309 --> 00:01:54,159
it's been very very changed with time

32
00:01:58,710 --> 00:01:56,319
but in the outer solar system the low

33
00:02:01,889 --> 00:01:58,720
temperature out there has preserved the

34
00:02:04,980 --> 00:02:01,899
chemistry in a primitive state from the

35
00:02:08,900 --> 00:02:04,990
time the solar system formed comets took

36
00:02:13,470 --> 00:02:11,220
they are likely composed of the same

37
00:02:15,960 --> 00:02:13,480
primitive chemicals as the ancient

38
00:02:21,090 --> 00:02:15,970

nebula of gas and dust that formed the

39
00:02:23,160 --> 00:02:21,100
Sun and solar system 1986 a fleet of

40
00:02:25,949 --> 00:02:23,170
international spacecraft track Halley's

41
00:02:30,900 --> 00:02:25,959
Comet and reveal a snowball of dust and

42
00:02:33,900 --> 00:02:30,910
ice and the hint of organic compounds in

43
00:02:38,130 --> 00:02:33,910
1995 craft will be launched to a typical

44
00:02:40,289 --> 00:02:38,140
comet named cough on its outward flight

45
00:02:43,890 --> 00:02:40,299
the spacecraft first investigates an

46
00:02:49,750 --> 00:02:47,020
in August 2000 it reaches its

47
00:02:52,240 --> 00:02:49,760
destination as craft travels alongside

48
00:02:53,860 --> 00:02:52,250
the comet it fires a penetrator lander

49
00:03:06,290 --> 00:02:53,870
equipped with a laboratory of

50
00:03:11,250 --> 00:03:09,120
these instruments will directly sample

51
00:03:14,030 --> 00:03:11,260
chemicals that could be relics of an era

52
00:03:16,800 --> 00:03:14,040
billions of years old

53
00:03:19,410 --> 00:03:16,810
comets must have impacted the earth with

54
00:03:22,740 --> 00:03:19,420
considerable frequency shortly after the

55
00:03:25,980 --> 00:03:22,750
planet itself was formed so the Comets

56
00:03:27,570 --> 00:03:25,990
were bringing in this rich mixture of

57
00:03:29,610 --> 00:03:27,580
organic material which would have been

58
00:03:31,470 --> 00:03:29,620
available to give life a sort of

59
00:03:33,870 --> 00:03:31,480
headstart the chemical reactions for

60
00:03:36,030 --> 00:03:33,880
life ahead start as we proceed down the

61
00:03:38,850 --> 00:03:36,040
path towards increasing complexity and

62
00:03:43,470 --> 00:03:38,860
ultimately to life itself so we want to

63
00:03:45,270 --> 00:03:43,480

know what are those compounds what are

64
00:03:48,900 --> 00:03:45,280
the chemical missing links in Earth's

65
00:03:49,530 --> 00:03:48,910
past while crafts studies the comet for

66
00:04:10,180 --> 00:03:49,540
three years

67
00:04:15,080 --> 00:04:12,890
Cassini is an international mission that

68
00:04:19,879 --> 00:04:15,090
teams an orbiter spacecraft built by

69
00:04:21,830 --> 00:04:19,889
NASA's Jet Propulsion Laboratory and a

70
00:04:26,240 --> 00:04:21,840
probe provided by the European Space

71
00:04:28,640 --> 00:04:26,250
Agency ISA Cassini was named for the

72
00:04:33,530 --> 00:04:28,650
17th century astronomer John Dominique

73
00:04:35,690 --> 00:04:33,540
Cassini here in the Paris observatory he

74
00:04:39,440 --> 00:04:35,700
discovered four of Saturn's moons and

75
00:04:41,900 --> 00:04:39,450
the division in Saturn's rings dr.

76
00:04:47,690 --> 00:04:41,910
Danielle Gautier is the chief scientist

77
00:04:50,210 --> 00:04:47,700
for the Titan probe but louis xiv invite

78
00:04:53,600 --> 00:04:50,220
him to come here and he discover all

79
00:04:57,080 --> 00:04:53,610
four satellites of Saturn yeah you can

80
00:05:02,570 --> 00:04:57,090
see the notes by Cassini where he put

81
00:05:04,490 --> 00:05:02,580
discoveries the spacecraft Cassini will

82
00:05:07,190 --> 00:05:04,500
orbit Saturn for at least three years

83
00:05:09,080 --> 00:05:07,200
giving scientists an extended look at

84
00:05:12,080 --> 00:05:09,090
the ringed planet and its elaborate

85
00:05:14,440 --> 00:05:12,090
system of moons the most tantalizing of

86
00:05:16,790 --> 00:05:14,450
those moons is Saturn's largest Titan

87
00:05:18,980 --> 00:05:16,800
Titan is larger than the planet Mercury

88
00:05:23,000 --> 00:05:18,990

and is the only moon with a major

89
00:05:25,250 --> 00:05:23,010
atmosphere in 2002 Cassini will launch

90
00:05:41,940 --> 00:05:25,260
its european-built probe to descend to

91
00:05:48,900 --> 00:05:44,790
the most important I think the most

92
00:05:53,310 --> 00:05:48,910
important project of the title pub will

93
00:05:56,040 --> 00:05:53,320
be the measurement of complex molecules

94
00:05:59,310 --> 00:05:56,050
which are expected to be present in the

95
00:06:02,850 --> 00:05:59,320
upper atmosphere Titan including the

96
00:06:06,180 --> 00:06:02,860
organic molecules which has used to

97
00:06:08,130 --> 00:06:06,190
build life we don't believe that the

98
00:06:10,740 --> 00:06:08,140
life exists on Titan because it's of

99
00:06:13,470 --> 00:06:10,750
course but obviously there is a complex

100
00:06:15,060 --> 00:06:13,480
chemistry detailed measurements will be

101
00:06:17,730 --> 00:06:15,070
made of the thick nitrogen methane

102
00:06:19,950 --> 00:06:17,740
atmosphere believed to contain the

103
00:06:22,620 --> 00:06:19,960
chemical precursors to a life supporting

104
00:06:26,070 --> 00:06:22,630
environment huge lakes of liquid methane

105
00:06:27,810 --> 00:06:26,080
and ethane may exist on Titan the probe

106
00:06:30,390 --> 00:06:27,820
will analyze compounds on the surface

107
00:06:36,690 --> 00:06:30,400
and relay the information back to the

108
00:06:39,710 --> 00:06:36,700
orbiting spacecraft Titan has an

109
00:06:42,570 --> 00:06:39,720
atmosphere that is denser than our own

110
00:06:46,050 --> 00:06:42,580
consisting primarily of nitrogen but

111
00:06:49,140 --> 00:06:46,060
with a lot of carbon rich compounds as

112
00:06:51,690 --> 00:06:49,150
well now what's fascinating about that

113
00:06:54,390 --> 00:06:51,700

atmosphere for us is that it allows us

114
00:06:57,180 --> 00:06:54,400
to do a kind of cosmic time traveled as

115
00:06:59,550 --> 00:06:57,190
if we could go back in time and see what

116
00:07:02,550 --> 00:06:59,560
the earth was like shortly after it

117
00:07:04,980 --> 00:07:02,560
formed because Titan being at such a low

118
00:07:07,620 --> 00:07:04,990
temperature has preserved those original

119
00:07:09,480 --> 00:07:07,630
conditions so the kinds of chemical

120
00:07:12,630 --> 00:07:09,490
reactions taking place in Titan's

121
00:07:14,220 --> 00:07:12,640
atmosphere today we think resemble the

122
00:07:16,530 --> 00:07:14,230
kinds of things that happened on the

123
00:07:19,920 --> 00:07:16,540
very early earth which ultimately led to

124
00:07:22,350 --> 00:07:19,930
the formation of life here raff and

125
00:07:23,550 --> 00:07:22,360
Cassini are a new series of spacecraft

126
00:07:26,820 --> 00:07:23,560
being designed at the Jet Propulsion

127
00:07:30,120 --> 00:07:26,830
Laboratory to explore the outer solar

128
00:07:32,250 --> 00:07:30,130
system the spacecraft to be launched on

129
00:07:36,589 --> 00:07:32,260
expendable rockets streamlined design

130
00:07:39,120 --> 00:07:36,599
and operations to save costs

131
00:07:42,420 --> 00:07:39,130
what we're trying to do with these two

132
00:07:45,059 --> 00:07:42,430
spacecraft is to gain information about

133
00:07:48,180 --> 00:07:45,069
two of the biggest questions that people

134
00:07:50,100 --> 00:07:48,190
have ever asked themselves one is where

135
00:07:51,870 --> 00:07:50,110
did the solar system come from the

136
00:07:56,670 --> 00:07:51,880
second is where did we come from how did

137
00:07:58,980 --> 00:07:56,680
life on earth begin time has obliterated

138
00:08:02,070 --> 00:07:58,990

remnants of the past the celestial past

139
00:08:04,860 --> 00:08:02,080
on our planet by exploring comets

140
00:08:06,390 --> 00:08:04,870
asteroids Saturn and its moons we are

141
00:08:09,029 --> 00:08:06,400
looking backwards in time

142
00:08:11,850 --> 00:08:09,039
the astronomical equivalent of being the

143
00:08:13,890 --> 00:08:11,860
first to open an ancient vault it is an