



1
00:00:14,450 --> 00:00:12,589

Mars

2
00:00:17,090 --> 00:00:14,460

commonly referred to as the red planet

3
00:00:19,849 --> 00:00:17,100

is one of our closest neighbors beyond

4
00:00:23,210 --> 00:00:19,859

the moon it has qualities that make it a

5
00:00:25,330 --> 00:00:23,220

potentially habitable outpost before all

6
00:00:29,120 --> 00:00:25,340

Martian exploration ended in November

7
00:00:33,139 --> 00:00:29,130

1982 a handful of probes had made the

8
00:00:35,630 --> 00:00:33,149

year-long journey Viking ones orbiter

9
00:00:39,020 --> 00:00:35,640

completed nearly 1500 picture-taking

10
00:00:40,910 --> 00:00:39,030

trips around the planet while its Lander

11
00:00:43,760 --> 00:00:40,920

studied samples and returned to views

12
00:00:46,819 --> 00:00:43,770

from the surface as a result Mars is

13
00:00:48,709 --> 00:00:46,829

well mapped but many questions remain so

14

00:00:51,319 --> 00:00:48,719

researchers are designing systems to

15

00:00:55,310 --> 00:00:51,329

explore the varied Martian geography in

16

00:00:57,500 --> 00:00:55,320

anticipation of a return mission on calm

17

00:00:59,420 --> 00:00:57,510

sunny mornings Jim Burke can often be

18

00:01:01,700 --> 00:00:59,430

found flying this lightweight solar

19

00:01:03,049 --> 00:01:01,710

balloon in the courtyard at NASA's Jet

20

00:01:06,530 --> 00:01:03,059

Propulsion Laboratory in Pasadena

21

00:01:08,570 --> 00:01:06,540

California mr. Burke views his study as

22

00:01:10,490 --> 00:01:08,580

an important stepping stone to a larger

23

00:01:12,609 --> 00:01:10,500

goal than gathering more precise

24

00:01:15,410 --> 00:01:12,619

information about the red planet

25

00:01:19,550 --> 00:01:15,420

now the Martian atmosphere is carbon

26

00:01:21,920 --> 00:01:19,560

dioxide and if you put a black balloon

27

00:01:24,830 --> 00:01:21,930

that's light enough with a light enough

28

00:01:27,260 --> 00:01:24,840

payload into that atmosphere the sun

29

00:01:29,510 --> 00:01:27,270

shining on the black balloon will warm

30

00:01:32,780 --> 00:01:29,520

it up like the heat inside a parked car

31

00:01:35,090 --> 00:01:32,790

with the windows shut and it gets hot

32

00:01:39,200 --> 00:01:35,100

enough inside to become a hot air

33

00:01:40,540 --> 00:01:39,210

balloon scientists students and

34

00:01:43,270 --> 00:01:40,550

engineers from Jake

35

00:01:45,250 --> 00:01:43,280

California Institute of Technology have

36

00:01:47,590 --> 00:01:45,260

taken the concept a step further by

37

00:01:49,900 --> 00:01:47,600

testing the feasibility his 30 foot

38

00:01:53,470 --> 00:01:49,910

diameter solar balloon that might be

39

00:01:55,510 --> 00:01:53,480

used to study Mars in theory the device

40

00:01:57,670 --> 00:01:55,520

could be blown around by local Martian

41

00:01:59,770 --> 00:01:57,680

winds during the day to collect data and

42

00:02:02,470 --> 00:01:59,780

take pictures at night it would cool

43

00:02:04,360 --> 00:02:02,480

down lose buoyancy and lower itself to

44

00:02:07,630 --> 00:02:04,370

the ground and to survey the planet's

45

00:02:09,310 --> 00:02:07,640

surface the small clear balloon pulls

46

00:02:10,780 --> 00:02:09,320

the larger one off the ground at night

47

00:02:12,910 --> 00:02:10,790

so it won't get damaged

48

00:02:14,890 --> 00:02:12,920

there are many regions of Mars that

49

00:02:18,240 --> 00:02:14,900

could be explored this way according to

50

00:02:21,880 --> 00:02:18,250

Jim Burnie one very interesting

51
00:02:24,160 --> 00:02:21,890
possibility is to flip the balloon in

52
00:02:26,650 --> 00:02:24,170
the atmosphere get it inflated operating

53
00:02:30,370 --> 00:02:26,660
up in the polar regions and let the

54
00:02:34,000 --> 00:02:30,380
circumpolar winds drift it down across

55
00:02:36,340 --> 00:02:34,010
the polar cap over the layered terrain

56
00:02:38,470 --> 00:02:36,350
which is in the canyons that spiral out

57
00:02:42,190 --> 00:02:38,480
from the polar cap then across the

58
00:02:44,590 --> 00:02:42,200
immense dune fields that surround the

59
00:02:47,680 --> 00:02:44,600
floor caps and on downward into

60
00:02:50,140 --> 00:02:47,690
temperate latitudes on Mars to remotely

61
00:02:52,270 --> 00:02:50,150
explore the surface of Mars a number of

62
00:02:54,880 --> 00:02:52,280
devices have been investigated they

63
00:02:57,310 --> 00:02:54,890

include early roving vehicle prototypes

64

00:03:00,550 --> 00:02:57,320

designed to fall or wheel their way

65

00:03:02,800 --> 00:03:00,560

across alien terrain Rovers continue to

66

00:03:06,910 --> 00:03:02,810

be designed today based on some of these

67

00:03:09,220 --> 00:03:06,920

models University of Arizona's lunar and

68

00:03:12,030 --> 00:03:09,230

planetary labs graduate students and

69

00:03:15,869 --> 00:03:12,040

faculty have recently built this

70

00:03:17,130 --> 00:03:15,879

- wheel prototype Mars roll another

71

00:03:19,500 --> 00:03:17,140

vehicle

72

00:03:21,480 --> 00:03:19,510

this robotic six-wheeled version which

73

00:03:23,040 --> 00:03:21,490

is JPL's latest testbed for

74

00:03:25,340 --> 00:03:23,050

understanding the control

75

00:03:28,820 --> 00:03:25,350

vision systems needed for a Mars mission

76

00:03:31,520 --> 00:03:28,830

according to Brian Wilcox

77

00:03:32,770 --> 00:03:31,530

operators research group at JPL sending

78

00:03:34,690 --> 00:03:32,780

commands to a

79

00:03:37,690 --> 00:03:34,700

Mars would be difficult because of the

80

00:03:39,520 --> 00:03:37,700

10 to 40 minute round-trip delay you

81

00:03:42,370 --> 00:03:39,530

can't just sit there and steer in your

82

00:03:44,350 --> 00:03:42,380

armchair from a TV monitor and make the

83

00:03:46,449 --> 00:03:44,360

vehicle do useful things because of this

84

00:03:48,580 --> 00:03:46,459

long speed of light delay so we've

85

00:03:50,949 --> 00:03:48,590

identified several techniques to

86

00:03:53,890 --> 00:03:50,959

maneuver of vehicle on Mars in such a

87

00:03:56,590 --> 00:03:53,900

way that you can go useful distances in

88

00:03:58,720 --> 00:03:56,600

a day in spite of the fact that the

89

00:04:18,909 --> 00:03:58,730

humans are this long speed of light

90

00:04:22,629 --> 00:04:21,640

the rugged vehicle has two TV cameras

91

00:04:24,429 --> 00:04:22,639

for eyes

92

00:04:27,060 --> 00:04:24,439

indisputably of climbing complex

93

00:04:28,710 --> 00:04:27,070

occurred taller than it

94

00:04:31,170 --> 00:04:28,720

the proposed making vehicle would have

95

00:04:39,260 --> 00:04:31,180

robotic arms to make measurements and

96

00:04:44,580 --> 00:04:42,089

using Rovers onboard vision system

97

00:04:46,409 --> 00:04:44,590

scientists can freeze three-dimensional

98

00:04:48,989 --> 00:04:46,419

images from its pair of television

99

00:04:51,330 --> 00:04:48,999

cameras they can then designate the

100

00:04:53,429 --> 00:04:51,340

pathway to follow continually updating

101
00:04:56,869 --> 00:04:53,439
commands from Earth so that the rover is

102
00:04:59,610 --> 00:04:56,879
able to avoid obstacles and hazards as

103
00:05:01,260 --> 00:04:59,620
more sophisticated visual systems are

104
00:05:03,360 --> 00:05:01,270
developed greater artificial

105
00:05:06,089 --> 00:05:03,370
intelligence and help the rover find its

106
00:05:08,369 --> 00:05:06,099
own way if given I res Aleutian imagery

107
00:05:12,700 --> 00:05:08,379
of the Martian surface and the list of

108
00:05:17,260 --> 00:05:15,070
the hope is to someday send a manned

109
00:05:19,270 --> 00:05:17,270
mission to Mars but a more detailed

110
00:05:21,700 --> 00:05:19,280
study of the planet is necessary first

111
00:05:24,370 --> 00:05:21,710
and these pioneering steps can be made

112
00:05:27,460 --> 00:05:24,380
by roving vehicles and balloons again

113
00:05:29,650 --> 00:05:27,470

Brian Wilcox if you imagine an

114

00:05:32,409 --> 00:05:29,660

expedition Lewis and Clark trying to

115

00:05:34,840 --> 00:05:32,419

survey the Louisiana Purchase they

116

00:05:36,760 --> 00:05:34,850

basically made one track across a very

117

00:05:40,060 --> 00:05:36,770

small fraction of the land surface of

118

00:05:43,060 --> 00:05:40,070

the earth took them years to do it and

119

00:05:44,980 --> 00:05:43,070

yet they found incredible things all

120

00:05:48,810 --> 00:05:44,990

along the way we could certainly have a

121

00:05:52,540 --> 00:05:48,820

dozen Rover missions which yielded

122

00:05:55,270 --> 00:05:52,550

equally interesting results the