



1
00:00:03,189 --> 00:00:01,829
nothing can be taken for granted when

2
00:00:04,309 --> 00:00:03,199
you get to mars there's a lot of things

3
00:00:06,789 --> 00:00:04,319
we just don't know

4
00:00:08,710 --> 00:00:06,799
space always has a way of throwing us

5
00:00:10,230 --> 00:00:08,720
curveballs and surprising us

6
00:00:12,150 --> 00:00:10,240
i mean until we get the data that says

7
00:00:16,790 --> 00:00:12,160
we're on the ground safely i'm gonna be

8
00:00:18,870 --> 00:00:16,800
worried that we're not gonna make it

9
00:00:20,790 --> 00:00:18,880
entry descent and landing is often

10
00:00:21,990 --> 00:00:20,800
referred to as the seven minutes of

11
00:00:24,150 --> 00:00:22,000
terror

12
00:00:26,710 --> 00:00:24,160
because it takes about seven minutes to

13
00:00:27,269 --> 00:00:26,720

get from the top of the atmosphere of

14

00:00:30,630 --> 00:00:27,279

mars

15

00:00:31,589 --> 00:00:30,640

to the ground safely the spacecraft has

16

00:00:34,950 --> 00:00:31,599

to do all of this

17

00:00:36,630 --> 00:00:34,960

by itself there are many things that

18

00:00:38,869 --> 00:00:36,640

have to go right to get

19

00:00:40,229 --> 00:00:38,879

perseverance onto the ground safely

20

00:00:42,069 --> 00:00:40,239

there's a lot counting on this this is

21

00:00:45,110 --> 00:00:42,079

the first leg of our sample return relay

22

00:00:46,950 --> 00:00:45,120

race there's a lot of work on the line

23

00:00:48,549 --> 00:00:46,960

starting about 10 minutes before

24

00:00:50,950 --> 00:00:48,559

atmospheric entry we

25

00:00:52,790 --> 00:00:50,960

get rid of really the spacecraft part of

26
00:00:55,510 --> 00:00:52,800
of the rover that's been supporting us

27
00:00:56,389 --> 00:00:55,520
we come screaming in to the martian

28
00:00:59,830 --> 00:00:56,399
atmosphere

29
00:01:02,310 --> 00:00:59,840
at 12 to 13 000 miles per hour

30
00:01:04,710 --> 00:01:02,320
and the heat shield is what dissipates

31
00:01:06,070 --> 00:01:04,720
all that initial energy through friction

32
00:01:07,429 --> 00:01:06,080
the vehicle will continue actually

33
00:01:08,870 --> 00:01:07,439
flying itself through the atmosphere

34
00:01:10,070 --> 00:01:08,880
it's sort of like a transforming

35
00:01:11,350 --> 00:01:10,080
vehicle that went from spacecraft and

36
00:01:12,710 --> 00:01:11,360
now it's kind of like an aircraft

37
00:01:15,109 --> 00:01:12,720
actively guiding itself

38
00:01:18,070 --> 00:01:15,119

when we're going slow enough we deploy a

39

00:01:21,590 --> 00:01:19,670

the biggest supersonic parachute we've

40

00:01:22,950 --> 00:01:21,600

ever sent to another planet

41

00:01:24,630 --> 00:01:22,960

it's critical for slowing down the

42

00:01:27,030 --> 00:01:24,640

vehicle

43

00:01:28,630 --> 00:01:27,040

perseverance entry descent and landing

44

00:01:31,429 --> 00:01:28,640

borrowed heavily from that

45

00:01:32,550 --> 00:01:31,439

of curiosity but fundamentally

46

00:01:35,109 --> 00:01:32,560

perseverance is a

47

00:01:36,310 --> 00:01:35,119

different rover she's bigger she has

48

00:01:37,590 --> 00:01:36,320

different instruments

49

00:01:39,510 --> 00:01:37,600

we've added a lot of smarts on the

50

00:01:40,710 --> 00:01:39,520

inside to make it more capable

51
00:01:42,469 --> 00:01:40,720
so that it can deal with the landing

52
00:01:44,550 --> 00:01:42,479
site that we've given the science team

53
00:01:46,230 --> 00:01:44,560
identified jezreel crater as

54
00:01:48,389 --> 00:01:46,240
basically an ancient lake bed and one of

55
00:01:50,149 --> 00:01:48,399
the most promising places to look for

56
00:01:52,069 --> 00:01:50,159
evidence of ancient microbial life and

57
00:01:53,030 --> 00:01:52,079
to collect samples for future return to

58
00:01:54,469 --> 00:01:53,040
earth

59
00:01:56,469 --> 00:01:54,479
the problem is it's a much more

60
00:01:58,310 --> 00:01:56,479
hazardous place to land

61
00:01:59,990 --> 00:01:58,320
you look at jezreel all you see is

62
00:02:01,510 --> 00:02:00,000
danger how do we go to a site

63
00:02:03,749 --> 00:02:01,520

that we never thought was safe enough to

64

00:02:04,870 --> 00:02:03,759

go to before so the heat shield which

65

00:02:06,389 --> 00:02:04,880

has protected us all the way through

66

00:02:08,070 --> 00:02:06,399

entry is no longer necessary we need to

67

00:02:08,790 --> 00:02:08,080

get that off so that we can actually see

68

00:02:12,229 --> 00:02:08,800

the ground

69

00:02:13,910 --> 00:02:12,239

different ways perseverance will be

70

00:02:15,510 --> 00:02:13,920

the first mission to use terrain

71

00:02:17,270 --> 00:02:15,520

relative navigation

72

00:02:19,270 --> 00:02:17,280

so while it's descending on the

73

00:02:22,070 --> 00:02:19,280

parachute it will actually be taking

74

00:02:22,790 --> 00:02:22,080

images of the surface of mars and

75

00:02:25,270 --> 00:02:22,800

determining

76

00:02:27,510 --> 00:02:25,280

where to go based on what it sees this

77

00:02:28,390 --> 00:02:27,520

is finally like landing with your eyes

78

00:02:30,710 --> 00:02:28,400

open

79

00:02:31,670 --> 00:02:30,720

having this new technology really allows

80

00:02:34,550 --> 00:02:31,680

perseverance

81

00:02:35,990 --> 00:02:34,560

to land in much more challenging terrain

82

00:02:37,910 --> 00:02:36,000

than curiosity

83

00:02:40,470 --> 00:02:37,920

or any previous mars mission could

84

00:02:41,430 --> 00:02:40,480

amongst the rocks and the craters and

85

00:02:45,190 --> 00:02:41,440

the cliffs

86

00:02:46,550 --> 00:02:45,200

these things are hazardous to the rover

87

00:02:48,630 --> 00:02:46,560

but these are the things that are

88

00:02:50,229 --> 00:02:48,640

interesting to the scientists

89

00:02:52,309 --> 00:02:50,239

once perseverance has figured out where

90

00:02:53,910 --> 00:02:52,319

she is we jettison the back shell and

91

00:02:57,270 --> 00:02:53,920

parachute

92

00:03:01,030 --> 00:02:59,190

those rockets help us steer to a safe

93

00:03:03,030 --> 00:03:01,040

landing spot that's nearby

94

00:03:05,509 --> 00:03:03,040

that descent stage takes us all the way

95

00:03:06,710 --> 00:03:05,519

down to about 20 meters off the ground

96

00:03:07,420 --> 00:03:06,720

that's when we start the skycrane

97

00:03:11,350 --> 00:03:07,430

maneuver

98

00:03:13,270 --> 00:03:11,360

[Music]

99

00:03:14,790 --> 00:03:13,280

once the rover has hit the ground the

100

00:03:17,589 --> 00:03:14,800

descent stage will cut loose from the

101

00:03:19,830 --> 00:03:17,599

rover and fly away to a safe distance

102

00:03:21,910 --> 00:03:19,840

surviving that seven minutes is really

103

00:03:23,509 --> 00:03:21,920

just the beginning for perseverance

104

00:03:25,430 --> 00:03:23,519

its job right being the first leg of

105

00:03:27,430 --> 00:03:25,440

sample return to go look for those signs

106

00:03:27,990 --> 00:03:27,440

of past life on mars all that can't

107

00:03:29,990 --> 00:03:28,000

start

108

00:03:31,910 --> 00:03:30,000

until we get perseverant safely to the