1
00:00:00,250 --> 00:00:02,252
InSight
Landing on Mars

2
00:00:03,587 --> 00:00:05,472
Rob Manning: Although
we've done it before,

3
00:00:05,472 --> 00:00:07,241
landing on Mars
is hard.

4
00:00:07,241 --> 00:00:09,393
And this mission
is no different.

5
00:00:10,510 --> 00:00:13,096
The process to get from the
top of the atmosphere of Mars

6
00:00:13,096 --> 00:00:17,451
to the surface we call "entry,
descent, and landing" or EDL.

7
00:00:17,684 --> 00:00:19,786
It takes thousands of steps

8
00:00:19,786 --> 00:00:22,422
to go from the top of the
atmosphere to the surface.

9
00:00:22,422 --> 00:00:25,409
And each one of them
has to work perfectly

10
00:00:25,409 --> 00:00:27,311
to be a successful mission.

11
00:00:27,728 --> 00:00:32,165

The process starts well above
the atmosphere of Mars.

12
00:00:32,165 --> 00:00:35,636
The cruise stage faces the Sun.

13
00:00:35,636 --> 00:00:39,539
It also has its radio antenna
which faces Earth.

14
00:00:39,539 --> 00:00:41,675
But now we don't need
the cruise stage.

15
00:00:41,675 --> 00:00:43,710
Its job is done.

16
00:00:43,710 --> 00:00:45,812
The next step, just
7 minutes before

17
00:00:45,812 --> 00:00:48,448
arriving to the top of
the Mars atmosphere,

18
00:00:48,448 --> 00:00:51,184
is to separate the
cruise stage.

19
00:00:51,184 --> 00:00:53,220
Before you hit the top of
the atmosphere though,

20
00:00:53,220 --> 00:00:55,589
the space capsule has
to orient itself

21
00:00:55,589 --> 00:00:56,957
so that the heat shield

22
00:00:56,957 --> 00:01:00,110
is precisely facing
the atmosphere.

23
00:01:00,928 --> 00:01:02,529
Now the fun begins.

24
00:01:02,529 --> 00:01:06,867
The vehicle is moving at nearly
13,000 miles an hour.

25
00:01:06,867 --> 00:01:08,518
But it's hitting the
top of the atmosphere

26
00:01:08,518 --> 00:01:10,203
at a very shallow angle.

27
00:01:10,203 --> 00:01:11,605
12 degrees.

28
00:01:11,605 --> 00:01:14,157
Any steeper, the vehicle
will hit the thicker part

29
00:01:14,157 --> 00:01:16,643
of the atmosphere and
will melt and burn up.

30
00:01:16,643 --> 00:01:19,379
Any shallower, the vehicle
will bounce off

31
00:01:19,379 --> 00:01:20,814
the atmosphere of Mars.

32
00:01:20,814 --> 00:01:22,416
At the very top
of the atmosphere

33
00:01:22,416 --> 00:01:25,769
it's about 70 miles above
the surface of Mars.

34
00:01:25,769 --> 00:01:28,388
And the air is starting to get
thicker and thicker and thicker.

35
00:01:28,388 --> 00:01:30,490
As it does that, the temperature
in the heat shield

36
00:01:30,490 --> 00:01:33,060
gets well over a thousand
degrees centigrade--

37
00:01:33,060 --> 00:01:34,828
enough to melt steel.

38
00:01:34,828 --> 00:01:37,531
Over the next 2 minutes,
the vehicle decelerates

39
00:01:37,531 --> 00:01:40,233
at a back-breaking 12 Earth G's.

40
00:01:40,233 --> 00:01:44,187
From 13,000 miles an hour to
about 1,000 miles an hour.

41
00:01:44,187 --> 00:01:47,257
At about 10 miles above
the surface of Mars

42
00:01:47,257 --> 00:01:49,860
a supersonic parachute
is launched

43

00:01:49,860 --> 00:01:51,478
out of the back of the vehicle.

44
00:01:51,478 --> 00:01:54,064
Fifteen seconds after the
parachute inflates

45
00:01:54,064 --> 00:01:55,916
it's time to get rid
of the heat shield.

46
00:01:55,916 --> 00:01:59,419
Six pyrotechnic devices
fire simultaneously

47
00:01:59,419 --> 00:02:01,655
allowing the heat shield to fall

48
00:02:01,655 --> 00:02:03,523
and tumble away
from the vehicle,

49
00:02:03,523 --> 00:02:06,360
exposing the lander to
the surface of Mars.

50
00:02:06,360 --> 00:02:08,628
Ten seconds after the heat
shield is dropped,

51
00:02:08,628 --> 00:02:11,431
three pyrotechnically
deployed legs

52
00:02:11,431 --> 00:02:14,101
are released and
locked for landing.

53
00:02:14,101 --> 00:02:17,554
About a minute later the

landing radar is turned on,

54
00:02:17,554 --> 00:02:20,574
sending pulses toward
the surface of Mars

55
00:02:20,574 --> 00:02:22,693
as the vehicle starts
to try to measure

56
00:02:22,693 --> 00:02:24,611
how high it is
above the surface

57
00:02:24,611 --> 00:02:26,296
and how fast it's going.

58
00:02:26,463 --> 00:02:29,016
At about a mile above
the surface of Mars

59
00:02:29,016 --> 00:02:31,418
the lander falls away
from the backshell

60
00:02:31,418 --> 00:02:33,053
and lights its engines.

61
00:02:33,053 --> 00:02:36,857
And very quickly the vehicle
must rotate out of the way

62
00:02:36,857 --> 00:02:38,959
so that the parachute
and the backshell

63
00:02:38,959 --> 00:02:40,894
doesn't come down to hit it.

64

00:02:40,894 --> 00:02:42,879
The last thing
that has to happen

65
00:02:42,879 --> 00:02:45,132
is that on the moment of contact

66
00:02:45,132 --> 00:02:48,735
the engines have to
shut down immediately.

67
00:02:48,735 --> 00:02:51,538
If they don't, the
vehicle will tip over.

68
00:02:51,538 --> 00:02:53,607
So if all the steps

69
00:02:53,607 --> 00:02:55,642
of entry, descent, and landing

70
00:02:55,642 --> 00:02:56,927
happen perfectly

71
00:02:56,927 --> 00:02:59,546
and we are safely on
the surface of Mars,

72
00:02:59,546 --> 00:03:03,367
we'll be ready to do some
exciting new science.

73
00:03:04,384 --> 00:03:06,386
InSight mission landing
November 26, 2018

74
00:03:08,855 --> 00:03:12,109
NASA Jet Propulsion Laboratory