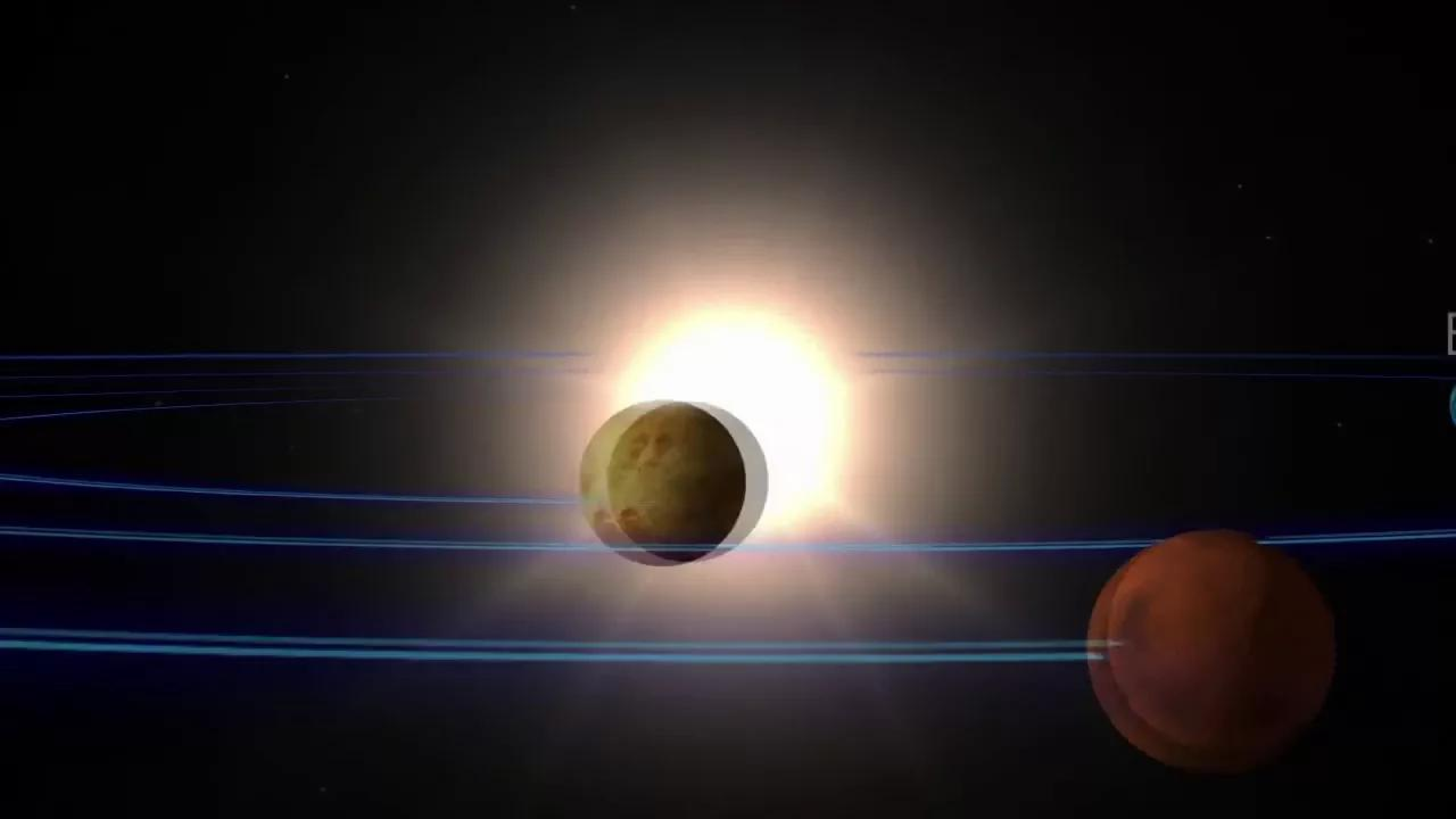

1
00:00:08,140 --> 00:00:04,090
Music and sound effects

2
00:00:08,160 --> 00:00:12,200
Planets begin as dense

3
00:00:12,220 --> 00:00:16,260
knots in a cloud of gas and
dust swirling around a

4
00:00:16,280 --> 00:00:20,290
star. But how do they go from
something like this ....

5
00:00:20,310 --> 00:00:24,320
... to something like this.
With the James

6
00:00:24,340 --> 00:00:28,350
James Webb Space Telescope,
astronomers will be able to
study how planets

7
00:00:28,370 --> 00:00:32,400
come to be and how they change
as get older.

8
00:00:32,420 --> 00:00:36,430
After centuries of searching,
astronomers are finding

9
00:00:36,450 --> 00:00:40,520
exoplanets ... just about
everywhere.

10
00:00:40,540 --> 00:00:44,590
ranging from giant planets with
masses much greater than

11

00:00:44,610 --> 00:00:48,630
Jupiter's ... to worlds only a
few times more massive than
Earth.

12
00:00:48,650 --> 00:00:52,640
But where do the planets we
know

13
00:00:52,660 --> 00:00:56,660
best fit into the menagerie of
worlds astronomers are finding?

14
00:00:56,680 --> 00:01:00,690
How did our solar system come
to be the way it is?

15
00:01:00,710 --> 00:01:04,760
Why is Earth a balmy,
water-rich world -- and are
there

16
00:01:04,780 --> 00:01:08,780
others like it elsewhere in the
galaxy?

17
00:01:08,800 --> 00:01:12,820
These are the kinds of
questions astronomers will
address

18
00:01:12,840 --> 00:01:16,820
with Webb.

19
00:01:16,840 --> 00:01:20,850
For planets that pass directly
in front of their stars,

20
00:01:20,870 --> 00:01:24,890
Webb will search for chemical
"fingerprints," identifying

21
00:01:24,910 --> 00:01:28,890
atmospheric gases like water
vapor, carbon dioxide and

22
00:01:28,910 --> 00:01:32,970
methane that absorb specific
wavelengths of the star's light.

23
00:01:32,990 --> 00:01:36,970
Webb will also study the dusty
disks where new

24
00:01:36,990 --> 00:01:41,030
planets form, revealing how the
chemical compositions of
younger and older

25
00:01:41,050 --> 00:01:45,040
disks change with time and
identifying

26
00:01:45,060 --> 00:01:49,050
how these changes are reflected
in the planets we find.

27
00:01:49,070 --> 00:01:53,120
Such studies will be
revolutionary in their own
right.

28
00:01:53,140 --> 00:01:57,120
And by applying Webb's
capabilities closer to home,
astronomers

29
00:01:57,140 --> 00:02:01,140
will better understand
planetary systems.

30

00:02:01,160 --> 00:02:05,140
For example:

31
00:02:05,160 --> 00:02:09,150
How do our asteroids, comets,
and other small bodies like
Pluto

32
00:02:09,170 --> 00:02:13,160
relate to the objects that
create the dusty disks around
other stars?

33
00:02:17,220 --> 00:02:21,200
The Webb telescope will
determine the chemical and
physical

34
00:02:21,220 --> 00:02:25,290
properties of these bodies with
unprecedented sensitivity in

35
00:02:25,310 --> 00:02:29,350
in wavelengths unavailable to
telescopes on the ground.

36
00:02:29,370 --> 00:02:33,350
By learning more about the
small bodies in our solar
system,

37
00:02:33,370 --> 00:02:37,390
scientists will be able to
address questions about the
solar system's past

38
00:02:37,410 --> 00:02:41,420
and compare it to other
planetary systems we find in
similar

39

00:02:41,440 --> 00:02:45,470
phases of construction. For
example,

40
00:02:45,490 --> 00:02:49,510
did Earth's oceans arrive by
impacts with small icy bodies?

41
00:02:49,530 --> 00:02:53,540
If so, is the same process
happening elsewhere

42
00:02:53,560 --> 00:02:57,540
-- and can we find those
locations?

43
00:03:01,580 --> 00:03:05,630
Webb also will study the outer
planets and their moons.

44
00:03:05,650 --> 00:03:09,640
Of particular interest is
Titan, the largest

45
00:03:09,660 --> 00:03:13,650
moon of Saturn. Now being
explored by NASA's Cassini
spacecraft,

46
00:03:13,670 --> 00:03:17,670
Titan is as big as the planet
Mercury, possesses

47
00:03:17,690 --> 00:03:21,710
an atmosphere half again as
thick as Earth's, and frigid
surface

48
00:03:21,730 --> 00:03:25,800
with lakes of liquid
hydrocarbons. Webb

49
00:03:25,820 --> 00:03:29,820
will map Titan's chemical
makeup with six times Cassini's

50
00:03:29,840 --> 00:03:33,870
resolution and monitor the
moon's seasonal changes over a
decade

51
00:03:33,890 --> 00:03:37,880
or more. Next stop: Uranus.

52
00:03:37,900 --> 00:03:41,890
When Voyager 2 returned this
image in 1986, the

53
00:03:41,910 --> 00:03:45,910
planet's south pole was facing
the sun. Few clouds could be
seen.

54
00:03:45,930 --> 00:03:49,930
But as Uranus neared its
equinox in 2007

55
00:03:49,950 --> 00:03:53,950
brightclouds suddenly
materialized. So far,

56
00:03:53,970 --> 00:03:58,010
scientistsare at a loss to
explain this profound
seasonalchange."

57
00:03:58,030 --> 00:04:02,050
During Voyager's visit, the
northern

58
00:04:02,070 --> 00:04:06,050

hemispheres of Uranus' big
moons were all in shadow.

59
00:04:06,070 --> 00:04:10,120
. But when Webb begins service,
the moons' northern halves

60
00:04:10,140 --> 00:04:14,120
will face the sun and give
astronomers abundant new real
estate

61
00:04:14,140 --> 00:04:18,130
to explore.

62
00:04:18,150 --> 00:04:22,190
Three years later, in 1989,
Voyager 2 passed

63
00:04:22,210 --> 00:04:26,190
Neptune and imaged its strange
dark spot.

64
00:04:26,210 --> 00:04:30,280
Over the following years,
astronomers have seen the dark
spot disappear ...

65
00:04:30,300 --> 00:04:34,320
and then reappear. Voyager
easily picked

66
00:04:34,340 --> 00:04:38,340
out clouds despite Neptune's
greater distance from the sun.

67
00:04:38,360 --> 00:04:42,340
Why is weather on Uranus and
Neptune so different?

68

00:04:42,360 --> 00:04:46,420
Neptune's big moon Triton is
unusual, too.

69
00:04:46,440 --> 00:04:50,470
Nitrogen-spewing volcanoes and
other geological

70
00:04:50,490 --> 00:04:54,490
forces reshape this frozen
surface in ways we're just

71
00:04:54,510 --> 00:04:58,500
beginning to understand.

72
00:04:58,520 --> 00:05:02,510
Comets. Asteroids.

73
00:05:02,530 --> 00:05:06,570
The outer planets and their
moons -- and beyond them, the
icy

74
00:05:06,590 --> 00:05:10,570
the icy bodies of the Kuiper
Belt. These objects provide us
with

75
00:05:10,590 --> 00:05:14,570
the closest and most detailed
look at how our own solar
system evolved.

76
00:05:14,590 --> 00:05:18,590
The James Webb Space Telescope

77
00:05:18,610 --> 00:05:22,610
makes it possible to take that
understanding a step farther

78

00:05:22,630 --> 00:05:26,620
-- to probe the makeup of
nearby planetary systems at
comparable

79
00:05:26,640 --> 00:05:30,660
distances from their stars. Webb

80
00:05:30,680 --> 00:05:34,720
will allow astronomers to
directly compare the chemical
and physical

81
00:05:34,740 --> 00:05:38,800
properties of our outer solar
system with similar zones

82
00:05:38,820 --> 00:05:42,840
around nearby stars.

83
00:05:42,860 --> 00:05:46,920
Music