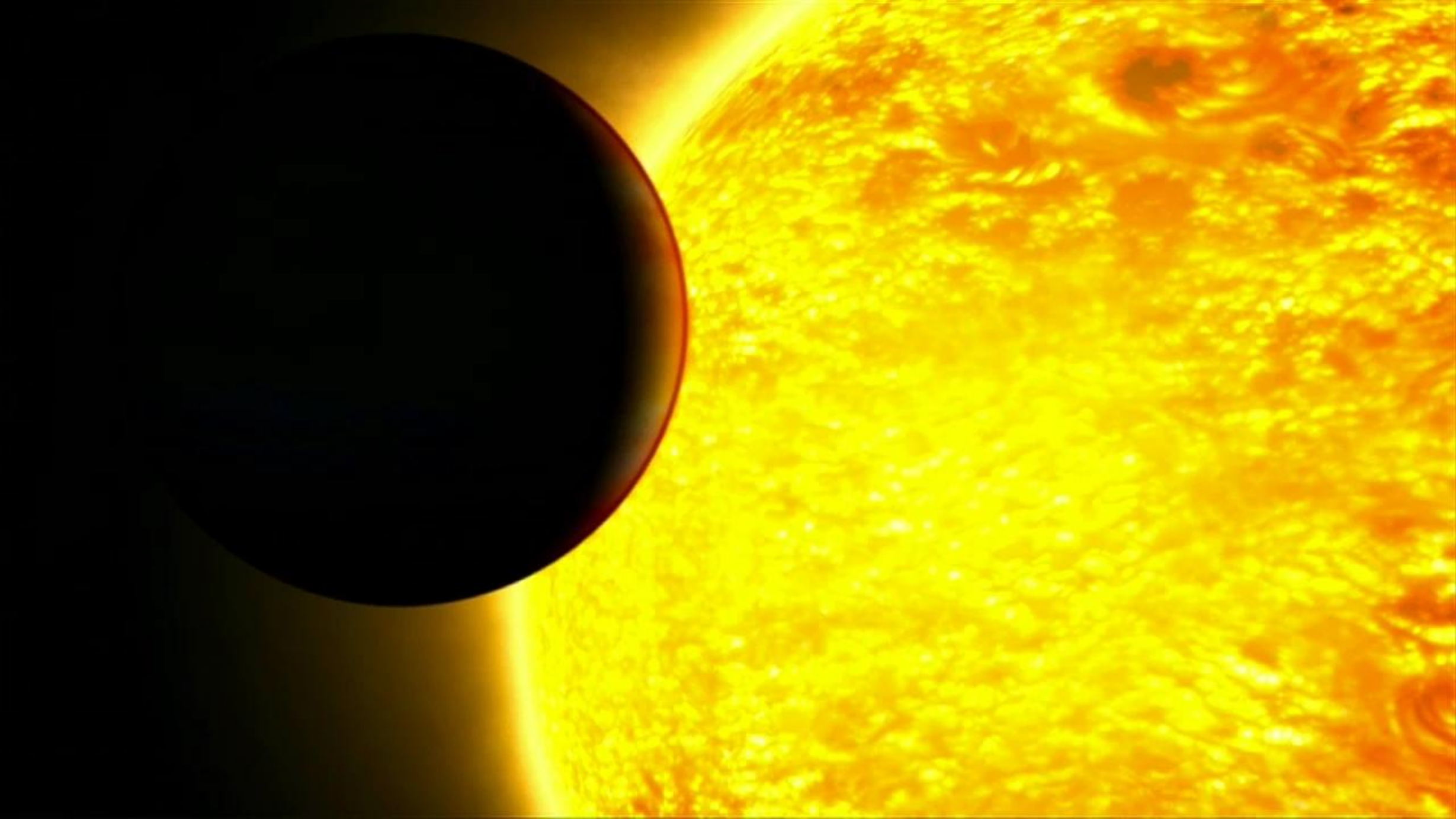

1
00:00:10,389 --> 00:00:14,619
IT'S A MYSTERY THAT HAS BEGUILED MANKIND
SINCE THE BEGINNING…

2
00:00:14,619 --> 00:00:20,810
Matt Mountain: Ultimately the question is
"are we alone in the universe and that's

3
00:00:20,810 --> 00:00:25,810
where I think the next step that will take
us… and that's a transformative time for

4
00:00:25,810 --> 00:00:27,150
human history.

5
00:00:27,150 --> 00:00:32,110
THE LAST 25 YEARS HAVE BEEN TRANFORMATIVE.
WHEN HUBBLE WAS LAUNCHED THE ONLY PLANETS

6
00:00:32,110 --> 00:00:37,300
WE KNEW ABOUT WERE THOSE ORBITING OUR SUN…
BUT FOR THE PAST DECADE, ASTRONOMERS HAVE

7
00:00:37,300 --> 00:00:43,850
DISCOVERED A RAPIDLY-GROWING NUMBER OF SO-CALLED
EXOPLANETS WHIRLING AROUND OTHER STARS AS WELL.

8
00:00:44,309 --> 00:00:48,809
Sara Seager: The main way we found planets
right now is by the transit technique. And

9
00:00:48,809 --> 00:00:53,000
that is when a planet goes in front of the
star as seen from the telescope. The starlight

10
00:00:53,000 --> 00:00:59,350
drops by a tiny amount, by 1% or even less.
And by measuring a star's brightness. minute

11

00:00:59,350 --> 00:01:05,039
by minute or hour by hour or day by day, we
are able to spot a planet transit.

12
00:01:05,039 --> 00:01:10,289
WHILE HUBBLE CAN'T TAKE CREDIT FOR ACTUALLY
FINDING THESE TRANSITING PLANETS, THEIR DISCOVERIES

13
00:01:10,289 --> 00:01:16,000
GAVE HUBBLE ASTRONOMERS A NEVER-BEFORE-IMAGINED
OPPORTUNITY TO DETERMINE WHAT'S ACTUALLY

14
00:01:16,000 --> 00:01:20,790
IN THE ATMOSPHERE OF AN EXOPLANET… TOO FAR
AWAY FOR US TO VISIT.

15
00:01:20,790 --> 00:01:24,970
Sara Seager: The analogy I really like is
looking at a rainbow. If we could look at

16
00:01:24,970 --> 00:01:29,280
the colors of a rainbow very very closely,
we would see tiny tiny dark lines, many of

17
00:01:29,280 --> 00:01:34,729
them spread all throughout the rainbow. And
those lines are caused by gases in the atmosphere

18
00:01:34,729 --> 00:01:38,600
absorbing radiation… they're essentially
taking out some of the light in the rainbow.

19
00:01:38,600 --> 00:01:42,689
And with Hubble, we do the same thing, we
take the light from a star or a planet and

20
00:01:42,689 --> 00:01:47,700
spread it out and we look for places in the
colors where light is missing and because

21

00:01:47,700 --> 00:01:53,100
each gas has its own fingerprint or its own
distinct set of lines to be removed from the

22
00:01:53,100 --> 00:01:56,640
white light spectrum, we're able to identify
the gases in the atmosphere.

23
00:01:56,640 --> 00:02:00,920
Dave Charbonneau: it's taken us from just
measuring basic properties of the planets

24
00:02:00,920 --> 00:02:06,130
like their mass and their size to actually
allowing us to study the atmospheres and therefore

25
00:02:06,130 --> 00:02:09,179
maybe giving the planets a bit of a personality.

26
00:02:09,179 --> 00:02:14,150
AND AS IT TURNS OUT, THOSE PERSONALITIES ARE
NOT LIKE THOSE FOUND IN OUR OWN SOLAR SYSTEM.

27
00:02:14,150 --> 00:02:19,269
Dave Charbonneau: there's this incredible
diversity of architectures of where we find

28
00:02:19,269 --> 00:02:23,000
the planets relative to their stars and what
the planets in fact, look like… I think

29
00:02:23,000 --> 00:02:27,260
it's Hubble that's really made them all
unique worlds.

30
00:02:27,260 --> 00:02:32,370
WORLDS THAT INTRIGUED US EVEN MORE WHEN HUBBLE'S
LAST SERVICING MISSION STARTED PAYING DIVIDENDS.

31
00:02:32,370 --> 00:02:38,340

Jacob Bean: We have new instruments aboard
Hubble since 2009, in particular, an instrument

32
00:02:38,340 --> 00:02:41,099
called the Wide Field Camera 3. We're using
it very intensively to study exoplanet atmospheres.

33
00:02:41,099 --> 00:02:44,500
We're using it to measure the water abundance
in planetary atmospheres. We're using it

34
00:02:44,500 --> 00:02:48,290
to study the temperature structure in exoplanet
atmospheres. And we're using it to study

35
00:02:48,290 --> 00:02:51,790
weather patterns on exoplanet atmospheres.
And so it's a really exciting time.

36
00:02:51,790 --> 00:02:56,950
BUT RIGHT NOW, HUBBLE IS REALLY ONLY TELLING
US ABOUT THE ATMOSPHERES AROUND GIANT PLANETS,

37
00:02:56,950 --> 00:02:58,629
MANY TIMES LARGER THAN OUR OWN.

38
00:02:58,629 --> 00:03:03,890
Seager: in some ways, we see the giant planets
as a stepping stone to see if we can observe

39
00:03:03,890 --> 00:03:08,069
them and understand them for our future quest
for life beyond earth.

40
00:03:08,069 --> 00:03:12,159
Charbonneau: What we want now, are smaller
planets, planets that are perhaps more like

41
00:03:12,159 --> 00:03:18,030
the earth and planets that pass in front of

very close stars, the very closest stars for

42
00:03:18,030 --> 00:03:23,080
which we can find those planets because they
are going to be the easiest ones to study.

43
00:03:23,080 --> 00:03:27,209
STUDYING THOSE SMALLER PLANETS IS WHAT'S
ON THE DOCKET FOR THE HUBBLE'S SUCCESSOR,

44
00:03:27,209 --> 00:03:28,780
THE JAMES WEBB SPACE TELESCOPE.

45
00:03:28,780 --> 00:03:33,909
Jacob Bean: We'll be able to probe the abundances
of different molecules. Right now we're

46
00:03:33,909 --> 00:03:37,939
only sensitive to only water. Water is very
important but there are molecules that we

47
00:03:37,939 --> 00:03:43,069
want to know the abundances too. Carbon monoxide.
Carbon dioxide. Methane. Ammonia. These are

48
00:03:43,069 --> 00:03:47,439
very important molecules from the standpoint
of planetary atmosphere physics and the formation

49
00:03:47,439 --> 00:03:49,799
of planets.

50
00:03:49,799 --> 00:03:53,840
PLANETS THAT MAY HOLD THE ANSWER OF WHETHER
OR NOT WE ARE ALONE.

51
00:03:53,840 --> 00:03:59,159
Charbonneau: I'd say my dream is to start
my career as an astronomer and end it as a

52
00:03:59,159 --> 00:04:05,500
biologist. So what I would really like to
do is get at the question of life in the universe.

53
00:04:05,500 --> 00:04:08,810
Seager: I do think there's life out there
somewhere. Our galaxy has over a hundred billion

54
00:04:08,810 --> 00:04:13,260
stars. Our galaxy has hundreds of billions
of stars and our universe has upwards of hundreds

55
00:04:13,260 --> 00:04:18,220
of billions of galaxies. So the chance for
life to exist is out there somewhere appears

56
00:04:18,220 --> 00:04:23,240
to be inevitable. A harder question is there
life somewhere near here? Around a planet

57
00:04:23,240 --> 00:04:28,710
orbiting a nearby star that we can actually
look at closely. That's a much tougher question.

58
00:04:28,710 --> 00:04:34,110
TOUGH QUESTIONS WE ARE ON THE CUSP OF ANSWERING…
BECAUSE OF THE HUBBLE'S PIONEERING WORK.