

1
00:00:10,388 --> 00:00:14,618
IT'S A MYSTERY THAT HAS BEGUILED MANKIND
SINCE THE BEGINNING...

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00:00:14,618 --> 00:00:20,809
Matt Mountain: Ultimately the question is
"are we alone in the universe and that's

3
00:00:20,809 --> 00:00:25,809
where I think the next step that will take
us... and that's a transformative time for

4
00:00:25,809 --> 00:00:27,149
human history.

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00:00:27,149 --> 00:00:32,109
THE LAST 25 YEARS HAVE BEEN TRANSFORMATIVE.
WHEN HUBBLE WAS LAUNCHED THE ONLY PLANETS

6
00:00:32,109 --> 00:00:37,299
WE KNEW ABOUT WERE THOSE ORBITING OUR SUN...
BUT FOR THE PAST DECADE, ASTRONOMERS HAVE

7
00:00:37,299 --> 00:00:43,849
DISCOVERED A RAPIDLY-GROWING NUMBER OF SO-CALLED
EXOPLANETS WHIRLING AROUND OTHER STARS AS WELL.

8
00:00:44,308 --> 00:00:48,808
Sara Seager: The main way we found planets
right now is by the transit technique. And

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00:00:48,808 --> 00:00:53,000
that is when a planet goes in front of the
star as seen from the telescope. The starlight

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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

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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.

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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.

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00:01:20,790 --> 00:01:24,969
Sara Seager: The analogy I really like is
looking at a rainbow. If we could look at

16
00:01:24,969 --> 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 --> 00:01:34,728
them spread all throughout the rainbow. And
those lines are caused by gases in the atmosphere

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00:01:34,728 --> 00:01:38,599
absorbing radiation... they're essentially
taking out some of the light in the rainbow.

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00:01:38,599 --> 00:01:42,688
And with Hubble, we do the same thing, we
take the light from a star or a planet and

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00:01:42,688 --> 00:01:47,699
spread it out and we look for places in the
colors where light is missing and because

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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
00:01:53,099 --> 00:01:56,640
white light spectrum, we're able to identify
the gases in the atmosphere.

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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 --> 00:02:06,129
like their mass and their size to actually
allowing us to study the atmospheres and therefore

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00:02:06,129 --> 00:02:09,179
maybe giving the planets a bit of a personality.

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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.

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

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

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00:02:23,000 --> 00:02:27,259
it's Hubble that's really made them all
unique worlds.

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00:02:27,259 --> 00:02:32,370
WORLDS THAT INTRIGUED US EVEN MORE WHEN HUBBLE'S
LAST SERVICING MISSION STARTED PAYING DIVIDENDS.

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00:02:32,370 --> 00:02:38,340
Jacob Bean: We have new instruments aboard
Hubble since 2009, in particular, an instrument

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00:02:38,340 --> 00:02:41,098
called the Wide Field Camera 3. We're using
it very intensively to study exoplanet atmospheres.

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00:02:41,098 --> 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 --> 00:02:48,289
to study the temperature structure in exoplanet
atmospheres. And we're using it to study

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00:02:48,289 --> 00:02:51,789

weather patterns on exoplanet atmospheres.
And so it's a really exciting time.

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00:02:51,789 --> 00:02:56,949
BUT RIGHT NOW, HUBBLE IS REALLY ONLY TELLING
US ABOUT THE ATMOSPHERES AROUND GIANT PLANETS,

37
00:02:56,949 --> 00:02:58,628
MANY TIMES LARGER THAN OUR OWN.

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00:02:58,628 --> 00:03:03,889
Seager: in some ways, we see the giant planets
as a stepping stone to see if we can observe

39
00:03:03,889 --> 00:03:08,068
them and understand them for our future quest
for life beyond earth.

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00:03:08,068 --> 00:03:12,158
Charbonneau: What we want now, are smaller
planets, planets that are perhaps more like

41
00:03:12,158 --> 00:03:18,030
the earth and planets that pass in front of
very close stars, the very closest stars for

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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.

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

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

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00:03:28,780 --> 00:03:33,908
Jacob Bean: We'll be able to probe the abundances
of different molecules. Right now we're

46
00:03:33,908 --> 00:03:37,938
only sensitive to only water. Water is very
important but there are molecules that we

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00:03:37,938 --> 00:03:43,068
want to know the abundances too. Carbon monoxide.
Carbon dioxide. Methane. Ammonia. These are

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00:03:43,068 --> 00:03:47,438
very important molecules from the standpoint
of planetary atmosphere physics and the formation

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00:03:47,438 --> 00:03:49,799
of planets.

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

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00:03:53,840 --> 00:03:59,158
Charbonneau: I'd say my dream is to start
my career as an astronomer and end it as a

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00:03:59,158 --> 00:04:05,500
biologist. So what I would really like to
do is get at the question of life in the universe.

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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

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00:04:08,810 --> 00:04:13,259
stars. Our galaxy has hundreds of billions
of stars and our universe has upwards of hundreds

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00:04:13,259 --> 00:04:18,219
of billions of galaxies. So the chance for
life to exist is out there somewhere appears

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

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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.

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00:04:28,709 --> 00:04:34,109
TOUGH QUESTIONS WE ARE ON THE CUSP OF ANSWERING...
BECAUSE OF THE HUBBLE'S PIONEERING WORK.

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00:04:34,110 --> 00:04:38,389

FROM THE SPACE TELESCOPE SCIENCE INSTITUTE
IN BALTIMORE, MD, I'M MARY ESTACION.