



1
00:00:00,000 --> 00:00:02,583
(serene music)

2
00:00:05,813 --> 00:00:08,359
- Welcome to another
episode of E.Z. Science,

3
00:00:08,359 --> 00:00:11,230
I'm Ellen Stofan, the
John and Adrienne Mars

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00:00:11,230 --> 00:00:13,160
Director of the Smithsonian's National

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00:00:13,160 --> 00:00:16,170
Air and Space museum, or Dr. E.

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00:00:16,170 --> 00:00:17,600
- And I'm Thomas Zurbuchen, the associate

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00:00:17,600 --> 00:00:19,800
administrator for science at NASA,

8
00:00:19,800 --> 00:00:21,670
also referred to as Dr. Z.

9
00:00:21,670 --> 00:00:23,881
- We're here today to talk
about a subject that's

10
00:00:23,881 --> 00:00:26,264
pretty near and dear to my heart,

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00:00:26,264 --> 00:00:29,067
and that's the Hubble Space Telescope.

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00:00:29,067 --> 00:00:32,812
You can see behind us, the

structural dynamic test vehicle

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00:00:32,812 --> 00:00:35,120
of Hubble and off to the side here,

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00:00:35,120 --> 00:00:37,780
at the National Air and
Space Museum, we have some

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00:00:37,780 --> 00:00:40,350
of the instruments that
were actually brought back

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00:00:40,350 --> 00:00:42,350
from Hubble, the ones that
weren't working so well,

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00:00:42,350 --> 00:00:44,790
they had to put new
instruments up on board,

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00:00:44,790 --> 00:00:47,480
so if you haven't been here
before, come and see this

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00:00:47,480 --> 00:00:49,250
amazing history of Hubble.

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00:00:49,250 --> 00:00:51,750
- To me this is one of the
real highlights in the museum,

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00:00:51,750 --> 00:00:54,840
and kind of every time I'm
here I'm standing I'm in awe.

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00:00:54,840 --> 00:00:58,512
So first of all, this mission
is what I would consider

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00:00:58,512 --> 00:01:01,580

the most important discovery
machine we've ever done.

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00:01:01,580 --> 00:01:04,720

If you look at that mission,
last year alone, there

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00:01:04,720 --> 00:01:08,130

are close to a thousand
new publications written,

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00:01:08,130 --> 00:01:10,510

it's not just a science
mission, it's a science mission

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00:01:10,510 --> 00:01:13,730

enabled by human
exaperations, by astronauts.

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00:01:13,730 --> 00:01:15,260

- [Dr. E] The fact that
the astronauts were able

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00:01:15,260 --> 00:01:17,990

to go up in shuttle and
replace the instruments,

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00:01:17,990 --> 00:01:20,432

constantly putting better,
more advanced instrumentation

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00:01:20,432 --> 00:01:24,210

on board, has really allowed
Hubble over its twenty-nine

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00:01:24,210 --> 00:01:28,300

years to completely change
our view of the universe.

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00:01:28,300 --> 00:01:31,800

- So there's a story that
was out there about a planet

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00:01:31,800 --> 00:01:34,770

called 'K2-18B'

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00:01:34,770 --> 00:01:36,260

and here's a question regard with

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00:01:36,260 --> 00:01:38,707

the hashtag 'E.Z. Science', and it said

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00:01:38,707 --> 00:01:42,319

"Hubble just found water
vapor on an exoplanet,

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00:01:42,319 --> 00:01:46,953

in a habitable zone, what does
that mean for other planets?"

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00:01:46,953 --> 00:01:50,470

- So recently some scientists
actually discovered water

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00:01:50,470 --> 00:01:52,880

vapor in the atmosphere of this planet.

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00:01:52,880 --> 00:01:57,170

We now have over four thousand
planets around other stars

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00:01:57,170 --> 00:02:00,073

that have been detected, a
lot of them are very large,

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00:02:00,073 --> 00:02:03,106

so we're not really thinking
about those as sort of

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00:02:03,106 --> 00:02:06,542

Earth 2.0. a place where we
could go to look for life.

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00:02:06,542 --> 00:02:09,400

But the intriguing thing
is, we're pretty sure water

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00:02:09,400 --> 00:02:12,020

is critical to life, life
here on Earth evolved

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00:02:12,020 --> 00:02:14,620

in the ocean so when we
go out and look at planets

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00:02:14,620 --> 00:02:17,490

around other stars, we're
looking for that blue planet,

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00:02:17,490 --> 00:02:20,671

that ocean planet like the
Earth, so the fact that we found

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00:02:20,671 --> 00:02:25,470

water vapor, was exciting but
unfortunately not sufficient

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00:02:25,470 --> 00:02:28,460

because habitability
is a complicated thing.

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00:02:28,460 --> 00:02:31,693

- Yeah, so found water
here, a water vapor but,

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00:02:31,693 --> 00:02:35,050

there's many questions we
have about for example:

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00:02:35,050 --> 00:02:39,200

Do these planets magnetic
protections layers like our Earth?

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00:02:39,200 --> 00:02:42,637

Is the surface actually solid,
or would you just sink in?

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00:02:42,637 --> 00:02:45,710

Like if something is a gaseous
type of planet, there's

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00:02:45,710 --> 00:02:47,860

many, many questions so we're just at the

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00:02:47,860 --> 00:02:50,090

beginning of that journey.

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00:02:50,090 --> 00:02:52,101

- That's right and when you
look at our own solar system,

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00:02:52,101 --> 00:02:55,182

obviously the earth is
habitable, it's been habitable

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00:02:55,182 --> 00:02:57,839

for hundred of millions of
years, and yet if you look

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00:02:57,839 --> 00:03:01,870

at Venus or Mars, Mars was
habitable for a very small

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00:03:01,870 --> 00:03:04,600

portion of its history and
a lot of us feel strongly

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00:03:04,600 --> 00:03:06,533

that there could be evidence
of past life on Mars.

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00:03:06,533 --> 00:03:10,910

Venus was maybe habitable
for a very short time in its

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00:03:10,910 --> 00:03:13,591

history and as early in
Earth's history, this planet

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00:03:13,591 --> 00:03:16,550

was not habitable and as
our solar system evolves,

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00:03:16,550 --> 00:03:20,000

Earth will become no longer
habitable so you have to

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00:03:20,000 --> 00:03:23,540

think of habitability as
not just a condition but

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00:03:23,540 --> 00:03:27,112

actually a phase that a planet
could potentially go through.

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00:03:27,112 --> 00:03:29,710

- What we have done with
the exoplanets is we've,

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00:03:29,710 --> 00:03:31,970

using Kepler, looked at one part of the

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00:03:31,970 --> 00:03:34,330

sky and just stared at it.

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00:03:34,330 --> 00:03:37,499

And from that we managed to

do a tally of exoplanets,

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00:03:37,499 --> 00:03:40,175

so we know that for every
star at least, there's one

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00:03:40,175 --> 00:03:43,566

exoplanet out there,
most of those exoplanets

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00:03:43,566 --> 00:03:45,800

live in systems just like we do.

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00:03:45,800 --> 00:03:49,170

There's other planets in our solar system,

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00:03:49,170 --> 00:03:53,300

what we're now doing with
TESS is we're looking at

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00:03:53,300 --> 00:03:57,153

the entire sky, to really
find the closest such things

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00:03:57,153 --> 00:03:59,835

to investigate and like you said,

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00:03:59,835 --> 00:04:03,040

there's very little we know about this.

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00:04:03,040 --> 00:04:06,720

It's very critical to be
able to follow up with

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00:04:06,720 --> 00:04:10,290

telescopes like this one,
the Hubble Space Telescope

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00:04:10,290 --> 00:04:12,144

but also James Webb that's coming out in

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00:04:12,144 --> 00:04:14,490

just a couple of years out there.

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00:04:14,490 --> 00:04:16,963

- We're incredibly excited
about the James Webb telescope

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00:04:16,963 --> 00:04:20,550

because if you think of
TESS, Kepler, Hubble,

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00:04:20,550 --> 00:04:23,170

finding these exoplanets
and getting a little bit

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00:04:23,170 --> 00:04:25,480

of information, James
Webb is really gonna be

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00:04:25,480 --> 00:04:27,679

able to take us to the next level.

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00:04:27,679 --> 00:04:30,033

- What's really amazing
about Webb, is when

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00:04:30,033 --> 00:04:32,991

Webb was conceived early on, exoplanets

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00:04:32,991 --> 00:04:35,300

were kind of a side story.

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00:04:35,300 --> 00:04:38,120

Right now, it's one of
the key stories because

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00:04:38,120 --> 00:04:40,077

we discovered this abundance of exoplanets

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00:04:40,077 --> 00:04:43,183

and we have an abundance
of questions, many, many

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00:04:43,183 --> 00:04:46,400

questions that we didn't
know how to ask before.

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00:04:46,400 --> 00:04:48,510

- So what the Webb telescope
can do, is it can look at

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00:04:48,510 --> 00:04:50,452

much higher resolution of
the atmospheres of some of

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00:04:50,452 --> 00:04:52,384

these planets around other stars.

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00:04:52,384 --> 00:04:55,188

Not just looking for water
vapor, but also gasses like

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00:04:55,188 --> 00:04:59,710

carbon dioxide, methane
and it's these combinations

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00:04:59,710 --> 00:05:01,640

of gasses that we're looking for.

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00:05:01,640 --> 00:05:05,600

The presence of water vapor
isn't sufficient for life,

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00:05:05,600 --> 00:05:08,232

but if you see a mixture of
gasses and especially if those

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00:05:08,232 --> 00:05:11,940

gasses seem to be out of equilibrium, or there's something

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00:05:11,940 --> 00:05:14,710

causing an imbalance in the gasses, chemically and the

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00:05:14,710 --> 00:05:17,480

atmosphere, that starts to make us think,

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00:05:17,480 --> 00:05:20,280

not only could that planet be habitable,

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00:05:20,280 --> 00:05:22,890

but is it actually inhabited.

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00:05:22,890 --> 00:05:25,580

When I started out as a planetary scientist, you know,

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00:05:25,580 --> 00:05:28,130

there were nine planets and then because of the

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00:05:28,130 --> 00:05:30,214

declassification of Pluto we went down to eight,

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00:05:30,214 --> 00:05:34,150

but for kids who are students now, by the time they're

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00:05:34,150 --> 00:05:36,410

ready to become planetary scientists, which of course

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00:05:36,410 --> 00:05:38,010

they're all gonna do, they are gonna be

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00:05:38,010 --> 00:05:40,870

thousands of planets for them to study.

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00:05:40,870 --> 00:05:42,720

And we got another questions on E.Z.

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00:05:42,720 --> 00:05:45,523

Science it's asking about TESS,

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00:05:45,523 --> 00:05:48,930

"What is the transiting
exo-planet survey satellite?

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00:05:48,930 --> 00:05:50,425

How does that actually work?"

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00:05:50,425 --> 00:05:53,270

- What the TESS mission is
doing, it's looking in a large

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00:05:53,270 --> 00:05:57,426

part of the sky and it's staring
at it and as it's staring,

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00:05:57,426 --> 00:06:00,980

it's looking at the
stability of light, so every

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00:06:00,980 --> 00:06:04,000

once in a while, one
of those exoplanets is

127

00:06:04,000 --> 00:06:07,640

going right in front of
the star that it's around,

128

00:06:07,640 --> 00:06:10,280

and when it does so it every so faintly,

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00:06:10,280 --> 00:06:13,858

reduces the light of that star, creating

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00:06:13,858 --> 00:06:16,790

a transient feature and so that's what

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00:06:16,790 --> 00:06:20,590

we're observing for all those
stars, in that part of the sky

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00:06:20,590 --> 00:06:22,077

that TESS is looking at.

133

00:06:22,077 --> 00:06:26,650

- And we can then use,
how the light has dimmed

134

00:06:26,650 --> 00:06:29,290

to say what's the size of that planet,

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00:06:29,290 --> 00:06:31,274

what kind of orbit it's in,
which really helps us then

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00:06:31,274 --> 00:06:33,858

start to nail down which of
these planets are more like

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00:06:33,858 --> 00:06:36,500

Earth, which ones are more
like Jupiter, we're just

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00:06:36,500 --> 00:06:38,500

about out of time, I'm
sorry to say, thank you

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00:06:38,500 --> 00:06:40,656

for joining us for another

episode of E.Z. Science.

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00:06:40,656 --> 00:06:42,982

- And please keep sending those questions,

141

00:06:42,982 --> 00:06:46,100

with hashtag 'E.Z. Science'

so we can answer them