
15 000 LBS
WEIGHT 95 LBS
CLASS 118 GSE

1
00:00:06,010 --> 00:00:09,700
- Hi. I'm Ellen Stofan,
also known as Dr. E.

2
00:00:09,700 --> 00:00:12,550
- And I'm Thomas Zurbuchen,
also known as Dr. Z.

3
00:00:12,550 --> 00:00:16,000
- And welcome to another
episode of "E.Z. Science."

4
00:00:16,000 --> 00:00:17,800
We're here at the Smithsonian's

5
00:00:17,800 --> 00:00:19,700
National Air and Space Museum,

6
00:00:19,700 --> 00:00:21,970
standing in front of the backup mirror

7
00:00:21,970 --> 00:00:23,910
to the Hubble Space Telescope.

8
00:00:23,910 --> 00:00:25,910
But we're not here really
to talk about Hubble.

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00:00:25,910 --> 00:00:28,350
There's another big launch coming up.

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00:00:28,350 --> 00:00:29,380
- [Thomas] We're talking about

11
00:00:29,380 --> 00:00:31,570
the launch of the James
Webb Space Telescope.

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00:00:31,570 --> 00:00:34,330
Many people have talked
about it as the next Hubble

13
00:00:34,330 --> 00:00:36,220
because Hubble has been transformative

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00:00:36,220 --> 00:00:38,170
in our understanding of the sky.

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00:00:38,170 --> 00:00:39,050
- And it's fun to be here

16
00:00:39,050 --> 00:00:40,800
in front of the backup mirror for Hubble.

17
00:00:40,800 --> 00:00:41,987
And so for people who are wondering,

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00:00:41,987 --> 00:00:43,860
"Why doesn't this thing
actually look like a mirror?"

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00:00:43,860 --> 00:00:44,800
It's the backup mirror.

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00:00:44,800 --> 00:00:47,020
It's two plates of glass
that are about an inch thick

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00:00:47,020 --> 00:00:49,330
with that supporting structure in between.

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00:00:49,330 --> 00:00:50,570
And if it had launched,

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00:00:50,570 --> 00:00:52,650
it would have been coated
in a reflective material,

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00:00:52,650 --> 00:00:55,120
so it would have looked
more like a mirror.

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00:00:55,120 --> 00:00:58,590
These telescopes use these
big mirrors to collect light,

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00:00:58,590 --> 00:01:00,400
which then go into an instrument.

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00:01:00,400 --> 00:01:02,230
So spectrographs are
really cool instruments,

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00:01:02,230 --> 00:01:04,780
and they've been used in
astronomy and astrophysics

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00:01:04,780 --> 00:01:06,020
for over 100 years.

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00:01:06,020 --> 00:01:08,210
- Spectrographs, of course,

31
00:01:08,210 --> 00:01:10,455
having the ability of
splitting up the light

32
00:01:10,455 --> 00:01:12,340
and looking at the composition of light

33
00:01:12,340 --> 00:01:13,700
and actually the originator,

34
00:01:13,700 --> 00:01:16,920
whether it's what gases is and so forth.

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00:01:16,920 --> 00:01:19,610
And frankly, spectrograph
also here in the museum.

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00:01:19,610 --> 00:01:22,240
- In fact, we have over 100
years' worth of spectrographs

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00:01:22,240 --> 00:01:23,770
here at the Air and Space Museum.

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00:01:23,770 --> 00:01:27,650
In 1929, Edwin Hubble
actually used a spectrograph

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00:01:27,650 --> 00:01:30,770
to determine the fact that
the universe was expanding.

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00:01:30,770 --> 00:01:33,910
We have a spectrograph
from the Hale Telescope

41
00:01:33,910 --> 00:01:35,770
at the Palomar Observatory in California

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00:01:35,770 --> 00:01:39,200
that was used from the 1950s to the 1970s

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00:01:39,200 --> 00:01:42,700
to look at the redshift of
galaxies, of white dwarfs.

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00:01:42,700 --> 00:01:43,750
And that helped us, again,

45
00:01:43,750 --> 00:01:47,580
understand the expansion of the universe.

46
00:01:47,580 --> 00:01:49,850
But I'm really fascinated with this issue

47
00:01:49,850 --> 00:01:52,980
of using a spectrograph
to really understand

48
00:01:52,980 --> 00:01:56,430
what materials things are
made of, how are they moving,

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00:01:56,430 --> 00:01:58,740
and really just collecting that light,

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00:01:58,740 --> 00:02:00,270
which James Webb will do,

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00:02:00,270 --> 00:02:03,810
from very early in the
history of the universe.

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00:02:03,810 --> 00:02:05,337
- If you compare Hubble with Webb,

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00:02:05,337 --> 00:02:08,070
there's really two fundamental changes.

54
00:02:08,070 --> 00:02:08,903
The first one is,

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00:02:08,903 --> 00:02:11,740
if you look at the mirror,
this is 2.4 meters.

56
00:02:11,740 --> 00:02:14,920
It's like this, roughly,
kind of my height.

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00:02:14,920 --> 00:02:18,770
You look at Webb, and unfolded,
it's six and a half meters.

58
00:02:18,770 --> 00:02:22,370
It's like three of me, or
more, with the hand up.

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00:02:22,370 --> 00:02:25,200
So the other thing that's really exciting,

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00:02:25,200 --> 00:02:26,690
the light that we're looking at

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00:02:26,690 --> 00:02:29,720
is actually much, much colder.

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00:02:29,720 --> 00:02:32,170
- And this idea that this
super-cold temperature

63
00:02:32,170 --> 00:02:33,920
and collecting this light
with this big mirror

64
00:02:33,920 --> 00:02:37,420
is actually allowing
you to look back in time

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00:02:37,420 --> 00:02:41,020
as much as 100 million
years after the Big Bang,

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00:02:41,020 --> 00:02:43,720
which in the history of the
universe, over 13 billion years,

67
00:02:43,720 --> 00:02:46,990
100 million years is really
soon after the big bang.

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00:02:46,990 --> 00:02:49,577
- Recently, I looked at the
album of one of my children

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00:02:49,577 --> 00:02:50,800
with all the pictures.

70
00:02:50,800 --> 00:02:54,510
And I imagined, suppose I didn't
know about the first year,

71
00:02:54,510 --> 00:02:57,020
what I would miss about
the story of my child

72
00:02:57,020 --> 00:02:58,650
that's now in college.

73
00:02:58,650 --> 00:03:00,130
And I think of the universe that way.

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00:03:00,130 --> 00:03:01,770
We have not seen those pictures.

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00:03:01,770 --> 00:03:04,380
- One of the questions I've
always found the craziest

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00:03:04,380 --> 00:03:07,330
is this issue of black holes
at the centers of galaxies.

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00:03:07,330 --> 00:03:09,760
Right now, pretty much
every galaxy we've looked at

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00:03:09,760 --> 00:03:11,020
has a black hole at the center.

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00:03:11,020 --> 00:03:12,750
And so we are really curious

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00:03:12,750 --> 00:03:15,370
about these very early galaxies.

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00:03:15,370 --> 00:03:16,750
Did they already have black holes?

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00:03:16,750 --> 00:03:18,050
Do black holes come later?

83
00:03:18,050 --> 00:03:20,440
Do you start with a black
hole? How does that work?

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00:03:20,440 --> 00:03:22,010
And that's one of the questions

85
00:03:22,010 --> 00:03:24,510
that JWST is really gonna go after.

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00:03:24,510 --> 00:03:27,410
And we're actually gonna
be able to use JWST

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00:03:27,410 --> 00:03:30,590
to start looking at the
composition of atmospheres

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00:03:30,590 --> 00:03:32,370
of planets around other stars.

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00:03:32,370 --> 00:03:35,541
And that's really critical in
this issue of "Are we alone?"

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00:03:35,541 --> 00:03:36,690
- Absolutely.

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00:03:36,690 --> 00:03:39,340
Looking at especially cold atmospheres

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00:03:39,340 --> 00:03:43,840
and stars that are there, we
can see molecular components,

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00:03:43,840 --> 00:03:45,910
things that relate to life here on Earth,

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00:03:45,910 --> 00:03:47,580
oxygen and so forth.

95
00:03:47,580 --> 00:03:49,160
Could you just imagine that?

96
00:03:49,160 --> 00:03:50,760
We're about to open that door.

97
00:03:50,760 --> 00:03:52,850
- And what I think people
don't necessarily appreciate is

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00:03:52,850 --> 00:03:56,484
the way we've had to push
technology to get to this point.

99
00:03:56,484 --> 00:03:57,317
- Absolutely.

100
00:03:57,317 --> 00:04:00,190
And that's the beauty of
doing amazing new science.

101
00:04:00,190 --> 00:04:01,440
We develop new technologies.

102
00:04:01,440 --> 00:04:03,750
So consider this technology that was used

103
00:04:03,750 --> 00:04:05,640
to shape the mirrors correctly.

104
00:04:05,640 --> 00:04:08,370
That technology right now is being used

105
00:04:08,370 --> 00:04:10,610
by eye surgeons around the world.

106
00:04:10,610 --> 00:04:12,320
That's just one of the many benefits

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00:04:12,320 --> 00:04:14,300
that come from a development like this.

108
00:04:14,300 --> 00:04:15,380
- So exciting,

109
00:04:15,380 --> 00:04:17,850
and I wish I could be with
you at the launch, Thomas,

110
00:04:17,850 --> 00:04:19,400
but it's a little bit far away.

111
00:04:19,400 --> 00:04:22,580
And so can you tell us
where the launch is?

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00:04:22,580 --> 00:04:25,540
- Yeah. It's from French
Guiana, a town called Kourou.

113
00:04:25,540 --> 00:04:27,960

It's right at that
coastal community there,

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00:04:27,960 --> 00:04:30,360
where the European Spaceport is.

115
00:04:30,360 --> 00:04:32,170
We're fly on an Ariane 5

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00:04:32,170 --> 00:04:33,930
provided by the European Space Agency.

117
00:04:33,930 --> 00:04:37,040
The Canadian Space Agency also
provided an instrument here.

118
00:04:37,040 --> 00:04:38,850
So we're excited and ready for it.

119
00:04:38,850 --> 00:04:41,640
- Just like Hubble, JWST is gonna help us

120
00:04:41,640 --> 00:04:43,900
rewrite textbooks for years to come.

121
00:04:43,900 --> 00:04:44,733
Stay tuned.

122
00:04:44,733 --> 00:04:47,840
Watch for the launch of the
James Webb Space Telescope,