1
00:00:08,960 --> 00:00:13,380
HUBBLE… THE TELESCOPE THAT WAS SUPPOSED
TO UNLOCK SOME OF THE BIGGEST MYSTERIES OF

2
00:00:13,380 --> 00:00:17,890
THE UNIVERSE … WELL, IT DID ALL THAT, AND
THEN SOME.

3
00:00:17,890 --> 00:00:23,930
Grunsfeld: Hubble, more than any of the others,
had so much capability in its basic design

4
00:00:23,930 --> 00:00:29,720
that it allowed scientists to answer those
questions, but in the process, many more questions

5
00:00:29,720 --> 00:00:30,660
popped up.

6
00:00:30,660 --> 00:00:37,660
Livio: Hubble’s greatness was not so much perhaps
in discovering entirely new things but in

7
00:00:39,730 --> 00:00:46,730
taking all kinds of hints and suggestions
that we’ve had before on a variety of phenomena

8
00:00:48,469 --> 00:00:53,230
and turning those into actual facts.

9
00:00:53,230 --> 00:00:59,039
FOR EXAMPLE… WE’VE
KNOWN FOR A LONG TIME THE UNIVERSE IS EXPANDING IN ALL

10
00:00:59,039 --> 00:00:59,960
DIRECTIONS

11
00:00:59,960 --> 00:01:04,430
Saul: The big question at the time was “how

much was the universe slowing down" and

12
00:01:04,430 --> 00:01:09,010
the reason that this was such an exciting
question was because that would tell you how

13
00:01:09,010 --> 00:01:13,079
much stuff there was in the universe that
would gravitationally attract and slow the

14
00:01:13,079 --> 00:01:13,689
expansion.

15
00:01:13,689 --> 00:01:18,409
BUT ASKING THAT QUESTION LED TO ONE OF THE
BIGGEST SURPRISES OF THE 20TH CENTURY… OUR

16
00:01:18,409 --> 00:01:24,630
UNIVERSE IS EXPANDING AT AN EVER FASTER RATE…
UNDER THE PUSH OF WHAT'S BEEN CALLED "DARK

17
00:01:24,630 --> 00:01:25,219
ENERGY."

18
00:01:25,219 --> 00:01:32,219
Adam: Dark energy is this pretty mysterious
component of the universe. It makes up about

19
00:01:32,259 --> 00:01:37,420
70% of the mass energy budget of the universe
and its strange aspect is it appears

20
00:01:37,420 --> 00:01:42,469
to have kind of a repulsive gravity which
is causing the universe to expand faster and faster.

21
00:01:42,899 --> 00:01:47,549
Saul: It's actually speeding up and that's
bizarre… that's nothing that we expected

22
00:01:47,549 --> 00:01:51,840
and apparently, there's a new entity in
the story that we had not taken into account.

23
00:01:51,840 --> 00:01:57,200
Adam: It's not often you discover most of
the universe. That can only happen once.

24
00:01:57,200 --> 00:02:04,200
AND THAT DISCOVERY LED TO WORLD WIDE ACCLAIM

25
00:02:12,120 --> 00:02:14,090
IN 2011. Professor Saul Perlmutter, Professor Brian Schmidt, Professor Adam Riess, you have been awarded

26
00:02:14,090 --> 00:02:21,090
Saul: I couldn't imagine a more fun scientific
measurement to make than something that would

27
00:02:23,220 --> 00:02:27,720
tell you if the universe was infinite and
tell you if there was an end to the universe.

28
00:02:27,720 --> 00:02:32,470
It turned out though that the answer was even more
fun than that.

29
00:02:32,470 --> 00:02:36,940
BUT DARK ENERGY ISN'T THE ONLY ELUSIVE MYSTERY
OF THE UNIVERSE HUBBLE HAS TACKLED.

30
00:02:36,940 --> 00:02:42,080
Ford: A supermassive black hole is… where
the equivalent of several hundred thousand

31
00:02:42,080 --> 00:02:49,080
stars… or a million, or 10 million stars
like the Sun… have been crammed into a region space smaller than a pencil point.

32
00:02:52,250 --> 00:02:54,100

smaller than a pencil point.

33
00:02:54,100 --> 00:03:00,290
Jennifer Wiseman: What Hubble did is to confirm,
that in fact, there really are these supermassive

34
00:03:00,290 --> 00:03:07,290
entities, black holes, in the centers of galaxies….
and it seems like that the mass of these interior black

35
00:03:08,230 --> 00:03:15,230
holes is related to the amount of star mass
in that global central region of these galaxies.

36
00:03:16,430 --> 00:03:21,320
Ford: It tells us a lot about how galaxies
form and … how they grow

37
00:03:21,320 --> 00:03:28,320
and what it was that led to the production
of life on this tiny planet in this vast cosmos.

38
00:03:31,010 --> 00:03:36,040
A COSMOS FILLED WITH POTENTIALLY COUNTLESS
PLANETS LIKE OUR EARTH… BUT TOO FAR AWAY

39
00:03:36,040 --> 00:03:41,950
TO EVER VISIT. HUBBLE HAS BEEN TAKING US TO
THEM… IN A WAY WE NEVER DREAMED WE COULD.

40
00:03:41,950 --> 00:03:46,540
Sing: Hubble has really given us our first
look at what a planet’s atmosphere looks

41
00:03:46,540 --> 00:03:53,540
like outside of our own solar system… what's the composition for instance, what's in the planet, what is it made

42
00:03:54,730 --> 00:03:57,390
the window to that whole universe out there.

43
00:03:57,390 --> 00:04:01,920
Deming: The first detection of the atmosphere
of an extrasolar planet was made with Hubble

44
00:04:01,920 --> 00:04:05,790
by looking at the transmission of light
through the atmosphere and detecting sodium

45
00:04:05,790 --> 00:04:10,000
absorption… if you can detect the absorbing
of sodium, you can conceivably detect

46
00:04:10,000 --> 00:04:15,080
molecules that were essential to life or indicative
of life in the atmosphere of small planets.

47
00:04:15,080 --> 00:04:21,070
Livio: It's not that we will actually look
through our telescopes and see a crocodile

48
00:04:21,070 --> 00:04:28,070
walking there. So when we say, that we will detect
life, what we mean by that is that the life

49
00:04:28,770 --> 00:04:35,680
forms on that particular extrasolar planet
have done enough to modify the atmosphere

50
00:04:35,680 --> 00:04:42,300
of that planet… so that we can detect those biosignatures, signatures that can

51
00:04:42,300 --> 00:04:46,400
only be formed by life, then we
will start to be convinced that…we're

52
00:04:46,400 --> 00:04:49,770
seeing the existence of life.

53
00:04:49,770 --> 00:04:54,740

AND WHAT ELSE WE’RE SEEING IS A UNIVERSE
FAR DIFFERENT THAN THE ONE WE IMAGINED

54
00:04:54,740 --> 00:04:55,419
BEFORE HUBBLE.