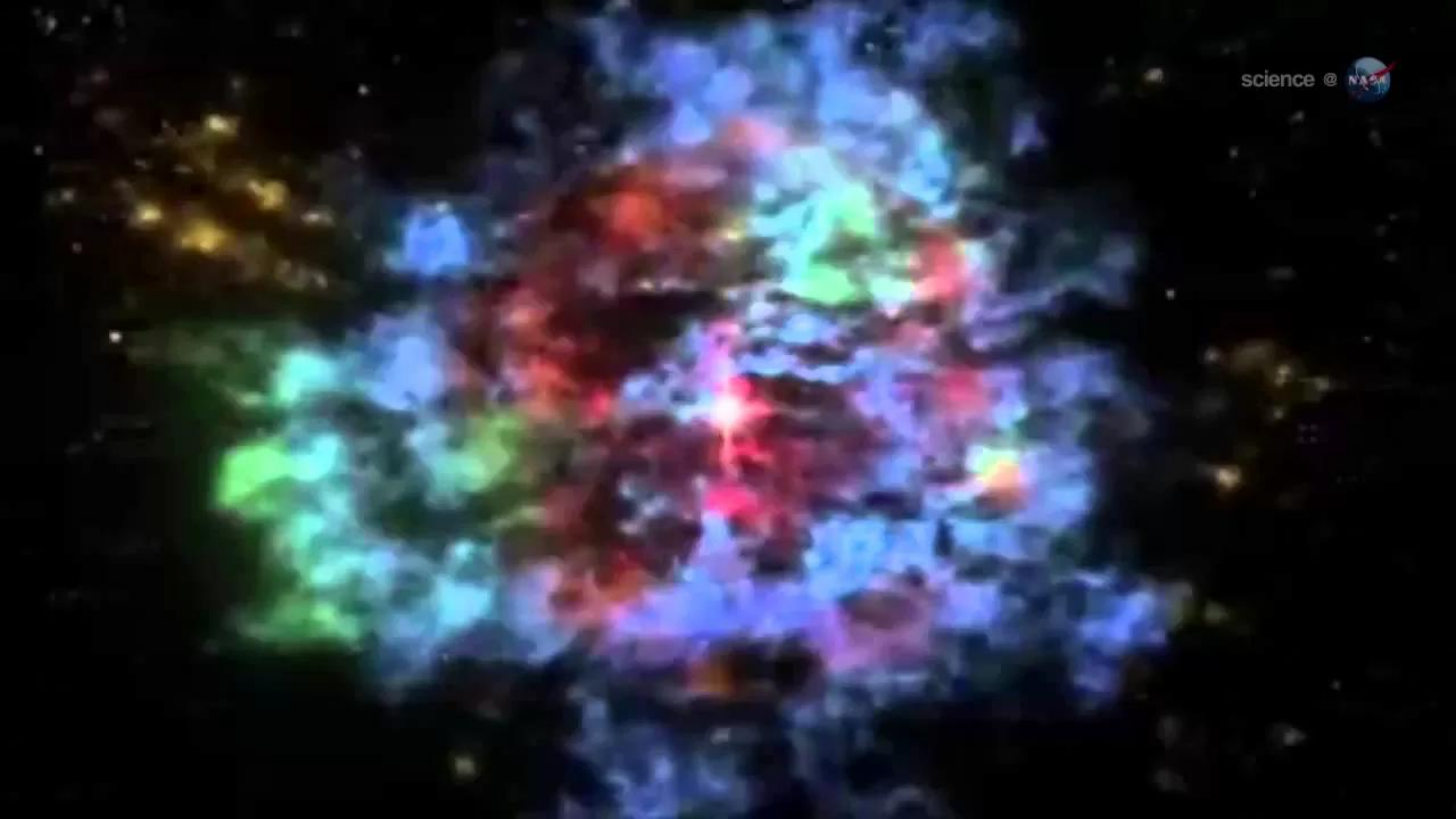
science @ NASA

1
00:00:07,349 --> 00:00:04,309
[Music]

2
00:00:09,669 --> 00:00:07,359
a star turns inside out presented by

3
00:00:12,470 --> 00:00:09,679
science at nasa

4
00:00:14,310 --> 00:00:12,480
in the immortal words of carl sagan we

5
00:00:16,470 --> 00:00:14,320
are star stuff

6
00:00:19,510 --> 00:00:16,480
what he meant is the key elements of

7
00:00:21,990 --> 00:00:19,520
life were forged in the hearts of stars

8
00:00:24,390 --> 00:00:22,000
the iron that turns our blood red the

9
00:00:26,710 --> 00:00:24,400
oxygen that fills our lungs the carbon

10
00:00:29,189 --> 00:00:26,720
that gives infinite variety to organic

11
00:00:32,709 --> 00:00:29,199
compounds they were all cooked up in a

12
00:00:35,030 --> 00:00:32,719
stellar inferno billions of years ago

13
00:00:37,510 --> 00:00:35,040

so when researchers recently got a look

14
00:00:39,430 --> 00:00:37,520
at a star turned inside out they knew

15
00:00:40,869 --> 00:00:39,440
they were looking at the stuff of life

16
00:00:43,630 --> 00:00:40,879
itself

17
00:00:46,310 --> 00:00:43,640
the story begins just after the big bang

18
00:00:48,470 --> 00:00:46,320
13.7 billion years ago

19
00:00:50,790 --> 00:00:48,480
according to modern cosmology the

20
00:00:54,470 --> 00:00:50,800
newborn universe was made entirely of

21
00:00:56,549 --> 00:00:54,480
the three simplest atoms hydrogen helium

22
00:00:59,510 --> 00:00:56,559
and small amounts of lithium

23
00:01:02,549 --> 00:00:59,520
the cosmos was devoid of stars and very

24
00:01:04,310 --> 00:01:02,559
likely devoid of life as well

25
00:01:06,710 --> 00:01:04,320
a quick glance around the room is proof

26
00:01:08,630 --> 00:01:06,720
that times have changed light elements

27
00:01:10,710 --> 00:01:08,640
that filled the early universe are rare

28
00:01:12,550 --> 00:01:10,720
on earth while our planet and we

29
00:01:15,030 --> 00:01:12,560
ourselves consist mainly of heavier

30
00:01:17,749 --> 00:01:15,040
stuff like oxygen and carbon which we're

31
00:01:20,950 --> 00:01:17,759
missing at the dawn of cosmic history

32
00:01:23,590 --> 00:01:20,960
the difference is star formation

33
00:01:25,910 --> 00:01:23,600
a little more than 13 billion years ago

34
00:01:28,070 --> 00:01:25,920
the first stars collapsed from clouds of

35
00:01:30,230 --> 00:01:28,080
hydrogen and helium

36
00:01:31,830 --> 00:01:30,240
as gravity drew the gas inward

37
00:01:34,069 --> 00:01:31,840
temperatures reached levels that

38
00:01:37,109 --> 00:01:34,079

triggered nuclear fusion the same

39
00:01:39,429 --> 00:01:37,119
process that powers our sun today

40
00:01:41,670 --> 00:01:39,439
in a stellar fusion reactor hydrogen and

41
00:01:44,389 --> 00:01:41,680
helium are smashed together to build up

42
00:01:46,389 --> 00:01:44,399
heavier elements such as carbon nitrogen

43
00:01:48,469 --> 00:01:46,399
oxygen and iron

44
00:01:51,030 --> 00:01:48,479
since then heavy elements have been

45
00:01:53,190 --> 00:01:51,040
forming in stars throughout the universe

46
00:01:55,670 --> 00:01:53,200
supernova explosions presumably did the

47
00:01:58,149 --> 00:01:55,680
rest flinging their contents far and

48
00:02:00,550 --> 00:01:58,159
wide seeding galaxies with the atomic

49
00:02:02,789 --> 00:02:00,560
building blocks of life

50
00:02:04,310 --> 00:02:02,799
recent data from nasa's chandra x-ray

51
00:02:06,469 --> 00:02:04,320
observatory provide dramatic

52
00:02:08,469 --> 00:02:06,479
confirmation for this idea

53
00:02:10,550 --> 00:02:08,479
researchers una huang of the goddard

54
00:02:12,790 --> 00:02:10,560
space flight center and john lamming of

55
00:02:15,030 --> 00:02:12,800
the naval research laboratory used

56
00:02:18,390 --> 00:02:15,040
chandra to map elements in the debris of

57
00:02:20,630 --> 00:02:18,400
a supernova known as cassiopeia a

58
00:02:23,110 --> 00:02:20,640
cassay for short

59
00:02:25,830 --> 00:02:23,120
cassay is located about 11 000 light

60
00:02:28,470 --> 00:02:25,840
years from earth the original star a

61
00:02:32,630 --> 00:02:28,480
behemoth at least 15 times as massive as

62
00:02:34,630 --> 00:02:32,640
the sun exploded more than 300 years ago

63
00:02:36,869 --> 00:02:34,640

hot glowing debris from the explosion is

64
00:02:39,910 --> 00:02:36,879
still visible and a favorite target of

65
00:02:42,070 --> 00:02:39,920
astronomers who study supernovas

66
00:02:44,229 --> 00:02:42,080
the researchers scanned cassay using

67
00:02:46,229 --> 00:02:44,239
chandra's advanced ccd imaging

68
00:02:49,190 --> 00:02:46,239
spectrometer this revealed

69
00:02:52,070 --> 00:02:49,200
concentrations of iron sulfur silicon

70
00:02:53,589 --> 00:02:52,080
magnesium neon and oxygen

71
00:02:56,150 --> 00:02:53,599
comparing a chemical model of the

72
00:02:58,550 --> 00:02:56,160
original star to the actual distribution

73
00:03:00,070 --> 00:02:58,560
of elements seen today they realized

74
00:03:02,390 --> 00:03:00,080
something amazing

75
00:03:05,030 --> 00:03:02,400
when the star exploded it turned itself

76
00:03:06,949 --> 00:03:05,040
inside out most of the iron which

77
00:03:09,670 --> 00:03:06,959
originally formed deep inside of the

78
00:03:11,509 --> 00:03:09,680
star is now located near the outer edges

79
00:03:13,830 --> 00:03:11,519
of the debris cloud

80
00:03:16,149 --> 00:03:13,840
other heavy elements are also located at

81
00:03:18,229 --> 00:03:16,159
the outer limits of the debris zone

82
00:03:20,869 --> 00:03:18,239
these data show that elements cooked

83
00:03:22,390 --> 00:03:20,879
deep inside stars are not necessarily

84
00:03:24,869 --> 00:03:22,400
trapped inside

85
00:03:28,550 --> 00:03:24,879
supernova explosions can free them

86
00:03:31,350 --> 00:03:28,560
spewing core materials into deep space

87
00:03:33,990 --> 00:03:31,360
there the atoms of life intermingle with

88
00:03:36,309 --> 00:03:34,000

other interstellar atoms and molecules

89
00:03:39,750 --> 00:03:36,319
forming clouds of gas that collapse to

90
00:03:42,149 --> 00:03:39,760
form new stars new planets and maybe

91
00:03:45,830 --> 00:03:42,159
just maybe new life forms

92
00:03:48,710 --> 00:03:45,840
we are star stuff after all