1
00:00:18,950 --> 00:00:16,870
what is the universe made of

2
00:00:21,349 --> 00:00:18,960
the vast majority of it consists of the

3
00:00:22,710 --> 00:00:21,359
wispy cosmic lightweights hydrogen and

4
00:00:24,550 --> 00:00:22,720
helium

5
00:00:26,710 --> 00:00:24,560
everything else on the periodic table

6
00:00:28,710 --> 00:00:26,720
contributes only a small fraction of the

7
00:00:30,310 --> 00:00:28,720
whole

8
00:00:33,110 --> 00:00:30,320
elements heavier than hydrogen and

9
00:00:36,630 --> 00:00:33,120
helium are forged in stars and during

10
00:00:38,950 --> 00:00:36,640
their explosive deaths as supernovas

11
00:00:40,709 --> 00:00:38,960
type 1a supernovas are nature's most

12
00:00:43,030 --> 00:00:40,719
productive foundries

13
00:00:44,470 --> 00:00:43,040

an old white dwarf star pulls gas off

14
00:00:46,630 --> 00:00:44,480
its giant neighbor

15
00:00:49,190 --> 00:00:46,640
the dwarf gains mass until it becomes

16
00:00:51,350 --> 00:00:49,200
unstable and blows itself to bits the

17
00:00:54,229 --> 00:00:51,360
explosion creates vast amounts of heavy

18
00:00:57,029 --> 00:00:54,239
elements and blasts them into space

19
00:00:58,950 --> 00:00:57,039
suzaku is an orbiting x-ray observatory

20
00:01:00,869 --> 00:00:58,960
operated jointly by nasa and the

21
00:01:02,470 --> 00:01:00,879
japanese space agency

22
00:01:04,710 --> 00:01:02,480
and it recently spotted the metals

23
00:01:06,710 --> 00:01:04,720
chromium and manganese in intergalactic

24
00:01:08,710 --> 00:01:06,720
space for the first time

25
00:01:10,950 --> 00:01:08,720
it's the largest known concentration of

26
00:01:13,030 --> 00:01:10,960
rare metals in the universe

27
00:01:15,030 --> 00:01:13,040
suzaku was looking at x-rays shining

28
00:01:17,109 --> 00:01:15,040
from the core region of the perseus

29
00:01:19,990 --> 00:01:17,119
galaxy cluster and detected the metals

30
00:01:22,070 --> 00:01:20,000
in hot thin intergalactic gas

31
00:01:24,469 --> 00:01:22,080
the gas is so thin it's close to a

32
00:01:26,950 --> 00:01:24,479
vacuum but it fills a volume of space in

33
00:01:30,469 --> 00:01:26,960
the cluster about 1.4 million light

34
00:01:34,550 --> 00:01:32,550
supernovas forged the metals and blasted

35
00:01:36,710 --> 00:01:34,560
them out of the galaxies but a single

36
00:01:38,469 --> 00:01:36,720
stellar explosion wasn't powerful enough

37
00:01:40,149 --> 00:01:38,479
to get the job done

38
00:01:42,310 --> 00:01:40,159

that requires periods of higher than

39
00:01:44,389 --> 00:01:42,320
normal star birth and death

40
00:01:46,310 --> 00:01:44,399
these so-called starbursts stirred up

41
00:01:47,190 --> 00:01:46,320
vast outflows of matter called super

42
00:01:49,510 --> 00:01:47,200
winds

43
00:01:54,230 --> 00:01:49,520
heavy elements forged by supernovas rode

44
00:01:58,950 --> 00:01:56,469
a single supernova can produce thousands

45
00:02:01,190 --> 00:01:58,960
of times earth's mass in chromium the

46
00:02:03,670 --> 00:02:01,200
suzaku astronomers estimate that it took

47
00:02:05,429 --> 00:02:03,680
some 3 billion supernovas to forge the

48
00:02:07,190 --> 00:02:05,439
treasure trove they found in the perseus

49
00:02:09,109 --> 00:02:07,200
cluster

50
00:02:11,110 --> 00:02:09,119
the total reservoir of heavy metal

51
00:02:12,309 --> 00:02:11,120
discovered by suzaku is even more

52
00:02:14,869 --> 00:02:12,319
staggering

53
00:02:17,510 --> 00:02:14,879
the perseus core region holds 30 million

54
00:02:22,869 --> 00:02:17,520
times the sun's mass and chromium about

55
00:02:26,869 --> 00:02:24,949
suzaku's chemical census of the universe

56
00:02:28,949 --> 00:02:26,879
is just beginning but it's already