1
00:00:05,269 --> 00:00:03,189
for the longest time

2
00:00:06,389 --> 00:00:05,279
space seemed like a big nearly empty

3
00:00:08,470 --> 00:00:06,399
place

4
00:00:09,669 --> 00:00:08,480
and we were really only familiar with

5
00:00:10,950 --> 00:00:09,679
our home

6
00:00:12,709 --> 00:00:10,960
earth

7
00:00:14,470 --> 00:00:12,719
but as we learned more

8
00:00:17,189 --> 00:00:14,480
we realized there was actually a lot out

9
00:00:19,750 --> 00:00:17,199
there including planets orbiting the sun

10
00:00:21,269 --> 00:00:19,760
and even other stars

11
00:00:23,029 --> 00:00:21,279
to get to these more distant worlds

12
00:00:26,390 --> 00:00:23,039
though it helps to start thinking of

13
00:00:29,349 --> 00:00:26,400

space as a bunch of nested bubbles

14
00:00:31,669 --> 00:00:29,359
our first bubble is a magnetosphere

15
00:00:33,510 --> 00:00:31,679
earth's invisible magnetic field that

16
00:00:35,830 --> 00:00:33,520
protects us from high energy particles

17
00:00:37,590 --> 00:00:35,840
and radiation from the sun

18
00:00:39,030 --> 00:00:37,600
allowing life as we know it to develop

19
00:00:40,470 --> 00:00:39,040
and thrive

20
00:00:42,950 --> 00:00:40,480
the next bubble

21
00:00:44,470 --> 00:00:42,960
just past the solar system

22
00:00:46,790 --> 00:00:44,480
is the heliosphere

23
00:00:48,869 --> 00:00:46,800
the edge of the sun's influence where

24
00:00:51,029 --> 00:00:48,879
the particles and fields of interstellar

25
00:00:53,270 --> 00:00:51,039
space take over

26
00:00:55,110 --> 00:00:53,280
the two voyager spacecraft have left

27
00:00:57,670 --> 00:00:55,120
this bubble and are our first

28
00:01:00,950 --> 00:00:57,680
interstellar spacecraft it took voyager

29
00:01:03,750 --> 00:01:00,960
1 35 years and it took voyager 2 41

30
00:01:06,789 --> 00:01:03,760
years to travel this far

31
00:01:08,950 --> 00:01:06,799
the next stop is our nearest stars

32
00:01:11,429 --> 00:01:08,960
the alpha centauri system at just over

33
00:01:12,469 --> 00:01:11,439
four light years away is close by cosmic

34
00:01:14,310 --> 00:01:12,479
standards

35
00:01:16,550 --> 00:01:14,320
but it would take either voyager about

36
00:01:17,670 --> 00:01:16,560
75 000 years to get there at current

37
00:01:19,910 --> 00:01:17,680
speeds

38
00:01:22,789 --> 00:01:19,920

we clearly need to use other tools to

39
00:01:25,590 --> 00:01:22,799
look for worlds that far away

40
00:01:27,749 --> 00:01:25,600
enter kepler a space telescope that

41
00:01:30,230 --> 00:01:27,759
radically changed our understanding of

42
00:01:32,230 --> 00:01:30,240
planets outside of our solar system also

43
00:01:35,190 --> 00:01:32,240
known as exoplanets

44
00:01:36,630 --> 00:01:35,200
in finding thousands of new planets

45
00:01:38,830 --> 00:01:36,640
kepler showed that there are more

46
00:01:40,390 --> 00:01:38,840
planets in our galaxy than there are

47
00:01:41,990 --> 00:01:40,400
stars

48
00:01:43,510 --> 00:01:42,000
but kepler looked at only a small

49
00:01:45,270 --> 00:01:43,520
fraction of the sky

50
00:01:47,109 --> 00:01:45,280
and many of the planets it discovered

51
00:01:48,950 --> 00:01:47,119
are too far away to study in much

52
00:01:50,950 --> 00:01:48,960
further detail

53
00:01:53,429 --> 00:01:50,960
and that brings us to tess

54
00:01:55,590 --> 00:01:53,439
our newest planet hunter the transiting

55
00:01:56,789 --> 00:01:55,600
exoplanet survey satellite works like

56
00:01:59,190 --> 00:01:56,799
kepler

57
00:02:01,190 --> 00:01:59,200
and over the next two years it will scan

58
00:02:03,990 --> 00:02:01,200
almost the entire sky

59
00:02:06,709 --> 00:02:04,000
by looking at closer and brighter stars

60
00:02:09,749 --> 00:02:06,719
tess will find and measure the sizes of

61
00:02:12,070 --> 00:02:09,759
dozens of small nearby planets best

62
00:02:14,630 --> 00:02:12,080
suited for detailed investigation by

63
00:02:17,190 --> 00:02:14,640

powerful telescopes on the ground and in

64
00:02:19,190 --> 00:02:17,200
space like the future james webb space

65
00:02:20,710 --> 00:02:19,200
telescope

66
00:02:22,390 --> 00:02:20,720
and by doing that

67
00:02:25,270 --> 00:02:22,400
we might finally begin to answer the

68
00:02:26,309 --> 00:02:25,280
question of whether earth is alone

69
00:02:28,949 --> 00:02:26,319
or

70
00:02:30,630 --> 00:02:28,959
our own

71
00:02:33,190 --> 00:02:30,640
small and rocky

72
00:02:35,110 --> 00:02:33,200
covered in oceans and dense clouds or

73
00:02:46,250 --> 00:02:35,120
even possibly