1
00:00:07,879 --> 00:00:12,240
the Hubble Space Telescope is one of the

2
00:00:10,439 --> 00:00:14,160
most productive telescopes in history

3
00:00:12,240 --> 00:00:17,039
what makes it so special

4
00:00:14,160 --> 00:00:18,990
well the Hubble Space Telescope has the

5
00:00:17,039 --> 00:00:21,739
three things that every realtor looks

6
00:00:18,989 --> 00:00:25,799
for when trying to sell a house location

7
00:00:21,739 --> 00:00:28,738
location and location by being above

8
00:00:25,800 --> 00:00:31,469
Earth's atmosphere Hubble has a clearer

9
00:00:28,739 --> 00:00:33,929
view of the universe now when we were

10
00:00:31,469 --> 00:00:36,988
young we all learned the song twinkle

11
00:00:33,929 --> 00:00:39,600
twinkle little star that twinkling is

12
00:00:36,988 --> 00:00:40,858
caused by Earth's atmosphere and it

13
00:00:39,600 --> 00:00:44,550
interferes with astronomical

14
00:00:40,859 --> 00:00:47,070
observations in this image you can see

15
00:00:44,549 --> 00:00:49,169
the haze of Earth's atmosphere that

16
00:00:47,070 --> 00:00:51,960
every ground-based telescope has to look

17
00:00:49,170 --> 00:00:55,439
through but that space telescopes do not

18
00:00:51,960 --> 00:00:57,149
as a demonstration let's take a look at

19
00:00:55,439 --> 00:01:00,178
this ground-based image of the Whirlpool

20
00:00:57,149 --> 00:01:01,948
Galaxy on large scales it looks very

21
00:01:00,179 --> 00:01:05,700
much like this Hubble image of the

22
00:01:01,948 --> 00:01:08,969
Whirlpool Galaxy however if we zoom in

23
00:01:05,700 --> 00:01:13,109
and examine the details then the Hubble

24
00:01:08,969 --> 00:01:16,289
image is much cleaner we go back and

25
00:01:13,109 --> 00:01:19,500
forth between the Hubble image and the

26
00:01:16,290 --> 00:01:23,820
ground-based image and the Hubble image

27
00:01:19,500 --> 00:01:26,368
the difference is clear the other major

28
00:01:23,819 --> 00:01:29,519
advantage of being in space is that all

29

00:01:26,368 --> 00:01:32,009
wavelengths of light are observable this

30
00:01:29,519 --> 00:01:34,048
diagram shows how different wavelengths

31
00:01:32,009 --> 00:01:36,840
of light penetrate through Earth's

32
00:01:34,049 --> 00:01:38,969
atmosphere in the center we have the

33
00:01:36,840 --> 00:01:40,649
optical window which includes visible

34
00:01:38,968 --> 00:01:43,949
light as well as a little bit of the

35
00:01:40,649 --> 00:01:45,930
infrared and ultraviolet light on the

36
00:01:43,950 --> 00:01:47,909
right we have the radio window which

37
00:01:45,930 --> 00:01:50,399
includes radio waves and some of the

38
00:01:47,909 --> 00:01:53,520
microwaves these are the wavelengths

39
00:01:50,399 --> 00:01:56,099
that make it to the ground so we have

40
00:01:53,519 --> 00:01:57,840
telescopes on mountaintops such as hit

41
00:01:56,099 --> 00:02:01,288
Peak National Observatory in Arizona

42
00:01:57,840 --> 00:02:03,570
that observe in the optical window we

43
00:02:01,289 --> 00:02:06,689

have giant radio dishes that observe in

44
00:02:03,569 --> 00:02:09,090
radio waves and we have this array of

45
00:02:06,688 --> 00:02:12,359
dishes high in the mountains in Chile

46
00:02:09,090 --> 00:02:14,060
that observes in microwaves nASA has

47
00:02:12,360 --> 00:02:17,180
even done some infrared observations

48
00:02:14,060 --> 00:02:19,349
from a plane high in the stratosphere

49
00:02:17,180 --> 00:02:21,599
for the rest of the wavelengths

50
00:02:19,349 --> 00:02:24,689
you've got to launch a telescope into

51
00:02:21,599 --> 00:02:27,049
space in addition to the Hubble Space

52
00:02:24,689 --> 00:02:30,240
Telescope NASA's Great observatories

53
00:02:27,050 --> 00:02:32,939
include the spitzer space telescope that

54
00:02:30,240 --> 00:02:35,100
observes an infrared light as well as

55
00:02:32,939 --> 00:02:38,879
the Chandra x-ray Observatory that

56
00:02:35,099 --> 00:02:40,859
observes in x-rays NASA's next great

57
00:02:38,879 --> 00:02:43,949
Observatory the James Webb Space

58
00:02:40,860 --> 00:02:46,620
Telescope combines the high resolution

59
00:02:43,949 --> 00:02:48,989
of Hubble with the infrared wavelengths

60
00:02:46,620 --> 00:02:51,810
of Spitzer to address important

61
00:02:48,990 --> 00:02:53,700
unanswered scientific questions in fact

62
00:02:51,810 --> 00:02:56,360
there have been space telescopes across

63
00:02:53,699 --> 00:02:58,889
the entire electromagnetic spectrum

64
00:02:56,360 --> 00:03:01,560
space telescopes have an unobstructed

65
00:02:58,889 --> 00:03:04,319
view they can provide high-resolution

66
00:03:01,560 --> 00:03:06,990
images across a broad range of

67
00:03:04,319 --> 00:03:10,639
wavelengths for galaxies and other

68
00:03:06,990 --> 00:03:10,640
astronomical objects in the universe