
NASA
Hubble's
Field Guide to Galaxies

1
00:00:06,309 --> 00:00:03,990
looking back some 13 billion years

2
00:00:08,950 --> 00:00:06,319
nasa's hubble space telescope offers a

3
00:00:13,030 --> 00:00:08,960
glimpse of the early universe revealing

4
00:00:15,350 --> 00:00:13,040
countless galaxies in a tiny area of sky

5
00:00:16,470 --> 00:00:15,360
galaxies are the visible foundation of

6
00:00:19,590 --> 00:00:16,480
the universe

7
00:00:22,550 --> 00:00:19,600
each one a collection of stars planets

8
00:00:24,390 --> 00:00:22,560
gas dust and dark matter held together

9
00:00:26,710 --> 00:00:24,400
by gravity

10
00:00:29,750 --> 00:00:26,720
hubble's observations give us insight

11
00:00:32,150 --> 00:00:29,760
into how galaxies form grow and evolve

12
00:00:34,150 --> 00:00:32,160
through time

13
00:00:36,709 --> 00:00:34,160

hubble's namesake astronomer edwin

14
00:00:39,030 --> 00:00:36,719
hubble pioneered the study of galaxies

15
00:00:41,590 --> 00:00:39,040
based simply on their appearance

16
00:00:42,830 --> 00:00:41,600
he divided galaxies into three basic

17
00:00:45,190 --> 00:00:42,840
forms

18
00:00:46,790 --> 00:00:45,200
ellipticals spirals

19
00:00:49,270 --> 00:00:46,800
and irregulars

20
00:00:51,510 --> 00:00:49,280
labeled the tuning fork diagram edwin

21
00:00:53,750 --> 00:00:51,520
hubble's basic arrangement is still in

22
00:00:56,470 --> 00:00:53,760
use today

23
00:00:59,189 --> 00:00:56,480
elliptical galaxies are nearly spherical

24
00:01:01,590 --> 00:00:59,199
to egg-shaped groups of old stars that

25
00:01:02,709 --> 00:01:01,600
lack the gas and dust needed to form new

26
00:01:04,630 --> 00:01:02,719
stars

27
00:01:07,590 --> 00:01:04,640
rotation doesn't play a big part in

28
00:01:10,550 --> 00:01:07,600
their shape the movements of their stars

29
00:01:13,590 --> 00:01:10,560
often in long oval orbits determines an

30
00:01:16,550 --> 00:01:13,600
elliptical shape elliptical galaxies are

31
00:01:18,789 --> 00:01:16,560
often near the center of galaxy clusters

32
00:01:20,120 --> 00:01:18,799
suggesting they may form when galaxies

33
00:01:21,190 --> 00:01:20,130
merge

34
00:01:24,870 --> 00:01:21,200
[Music]

35
00:01:27,270 --> 00:01:24,880
the best known galaxies are spirals

36
00:01:29,910 --> 00:01:27,280
the center of a spiral galaxy has a

37
00:01:31,270 --> 00:01:29,920
large roughly spherical swarm of stars

38
00:01:33,429 --> 00:01:31,280

called a bulge

39
00:01:35,749 --> 00:01:33,439
this bulge looks similar to an

40
00:01:38,390 --> 00:01:35,759
elliptical galaxy but spirals differ

41
00:01:41,030 --> 00:01:38,400
from ellipticals because they rotate

42
00:01:44,469 --> 00:01:41,040
rotation gives spiral galaxies the flat

43
00:01:47,270 --> 00:01:44,479
disc that holds their spiral shaped arms

44
00:01:49,590 --> 00:01:47,280
unlike ellipticals spirals have a mix of

45
00:01:52,550 --> 00:01:49,600
young and old stars

46
00:01:54,950 --> 00:01:52,560
star formation in spirals is similar to

47
00:01:57,350 --> 00:01:54,960
a traffic jam on the interstate

48
00:01:59,670 --> 00:01:57,360
like cars on the highway slower moving

49
00:02:01,990 --> 00:01:59,680
matter in the spiral's disk creates a

50
00:02:04,149 --> 00:02:02,000
bottleneck concentrating star-forming

51
00:02:05,910 --> 00:02:04,159
gas and dust along the inner part of

52
00:02:08,469 --> 00:02:05,920
their spiral arms

53
00:02:11,670 --> 00:02:08,479
this traffic jam of matter can get so

54
00:02:13,830 --> 00:02:11,680
dense that it gravitationally collapses

55
00:02:16,869 --> 00:02:13,840
creating new stars

56
00:02:20,070 --> 00:02:16,879
spiral galaxies are subdivided into

57
00:02:22,070 --> 00:02:20,080
unbarred and barred and organized by the

58
00:02:24,229 --> 00:02:22,080
size of their central bulge and how

59
00:02:27,030 --> 00:02:24,239
tightly their arms are wound

60
00:02:30,229 --> 00:02:27,040
bars form in spiral galaxies when star

61
00:02:32,229 --> 00:02:30,239
orbits become unstable and stretched out

62
00:02:35,270 --> 00:02:32,239
as their orbits lengthen they create a

63
00:02:37,910 --> 00:02:35,280

bar the bar grows as gravity captures

64
00:02:40,309 --> 00:02:37,920
more nearby stars

65
00:02:43,110 --> 00:02:40,319
irregular galaxies don't fit into one of

66
00:02:45,030 --> 00:02:43,120
the other categories they are shapeless

67
00:02:46,150 --> 00:02:45,040
and have no symmetry or ordered

68
00:02:49,430 --> 00:02:46,160
structure

69
00:02:51,750 --> 00:02:49,440
irregulars may hold old and young stars

70
00:02:54,150 --> 00:02:51,760
and often have knots of gas and dust

71
00:02:56,550 --> 00:02:54,160
forming new stars

72
00:02:59,030 --> 00:02:56,560
astronomers have expanded edwin hubble's

73
00:03:01,190 --> 00:02:59,040
basic tuning fork diagram to include

74
00:03:02,710 --> 00:03:01,200
galaxies that fall between his three

75
00:03:05,270 --> 00:03:02,720
categories

76
00:03:07,750 --> 00:03:05,280
intermediate spiral galaxies sit between

77
00:03:09,350 --> 00:03:07,760
unbarred and barred spirals and have a

78
00:03:11,589 --> 00:03:09,360
small bar

79
00:03:14,229 --> 00:03:11,599
lenticular galaxies sit between

80
00:03:16,390 --> 00:03:14,239
elliptical galaxies and spirals

81
00:03:19,589 --> 00:03:16,400
they have a central bulge of stars and a

82
00:03:22,229 --> 00:03:19,599
flattened disc but no spiral arms

83
00:03:24,869 --> 00:03:22,239
like ellipticals lenticular galaxies

84
00:03:27,030 --> 00:03:24,879
don't have much gas and dust and also

85
00:03:29,030 --> 00:03:27,040
have mainly old stars

86
00:03:31,110 --> 00:03:29,040
when viewed edge on their shape

87
00:03:33,110 --> 00:03:31,120
resembles a lens which is why they're

88
00:03:35,430 --> 00:03:33,120

called lenticular

89
00:03:37,670 --> 00:03:35,440
edwin hubble's tuning fork was a first

90
00:03:39,030 --> 00:03:37,680
step in understanding galaxies and how

91
00:03:40,789 --> 00:03:39,040
they evolve

92
00:03:43,190 --> 00:03:40,799
observations by the hubble space

93
00:03:45,430 --> 00:03:43,200
telescope will continue to improve our