



#AskNASA AT HOME

WHAT IS **HUBBLE**

REVEALING

ABOUT THE UNIVERSE?

1
00:00:05,472 --> 00:00:06,940
>> HI, I'M JENNIFER.

2
00:00:06,940 --> 00:00:08,375
I'M AN ASTROPHYSICIST

3
00:00:08,375 --> 00:00:09,609
WITH NASA'S HUBBLE SPACE

4
00:00:09,609 --> 00:00:11,077
TELESCOPE MISSION,

5
00:00:11,077 --> 00:00:13,246
WHICH OBSERVES THE UNIVERSE.

6
00:00:13,246 --> 00:00:14,748
THIS IS "#ASKNASA"

7
00:00:14,748 --> 00:00:15,582
AND I'M HERE TO ANSWER

8
00:00:15,582 --> 00:00:17,584
YOUR QUESTIONS.

9
00:00:25,024 --> 00:00:26,493
THE HUBBLE SPACE TELESCOPE

10
00:00:26,493 --> 00:00:30,096
HAS BEEN OPERATING FOR 30 YEARS,

11
00:00:30,096 --> 00:00:32,499
BUT IT'S STILL VERY POWERFUL.

12
00:00:32,499 --> 00:00:33,666
I THINK WE HUMANS

13
00:00:33,666 --> 00:00:35,135

HAVE A CURIOSITY

14

00:00:35,135 --> 00:00:36,202

ABOUT HOW WE FIT IN

15

00:00:36,202 --> 00:00:37,904

TO THE NATURAL WORLD

16

00:00:37,904 --> 00:00:39,172

AND HOW OUR PLANET FITS

17

00:00:39,172 --> 00:00:41,608

INTO THIS MUCH LARGER UNIVERSE.

18

00:00:41,608 --> 00:00:43,042

WE HAVE A LOT MORE TO LEARN

19

00:00:43,042 --> 00:00:43,810

AND ONE OF THE THINGS

20

00:00:43,810 --> 00:00:45,478

THAT HUBBLE HAS TOLD US

21

00:00:45,478 --> 00:00:46,679

THROUGH ITS OBSERVATIONS

22

00:00:46,679 --> 00:00:47,714

IS THAT OUR UNIVERSE

23

00:00:47,714 --> 00:00:50,383

IS REALLY ACTIVE AND DYNAMIC.

24

00:00:50,383 --> 00:00:51,518

THE GALAXIES, THE STARS,

25

00:00:51,518 --> 00:00:52,685

THE PLANETS ARE NOT JUST

26

00:00:52,685 --> 00:00:54,254
SITTING THERE, STAGNANT.

27

00:00:54,254 --> 00:00:56,189
WE ACTUALLY HAVE LEARNED

28

00:00:56,189 --> 00:00:57,524
THROUGH HUBBLE OBSERVATIONS

29

00:00:57,524 --> 00:00:59,359
THAT STARS ARE STILL FORMING

30

00:00:59,359 --> 00:01:01,327
IN THESE INTERSTELLAR CLOUDS.

31

00:01:01,327 --> 00:01:01,995
WE'VE LEARNED THAT

32

00:01:01,995 --> 00:01:03,096
OUR OWN SOLAR SYSTEM

33

00:01:03,096 --> 00:01:05,031
IS INCREDIBLY DYNAMIC.

34

00:01:05,031 --> 00:01:06,766
ONE OF THE EARLIEST OBSERVATIONS

35

00:01:06,766 --> 00:01:08,535
FROM HUBBLE SHOWED A COMET

36

00:01:08,535 --> 00:01:10,603
CRASHING INTO JUPITER.

37

00:01:10,603 --> 00:01:12,105
WE'VE DISCOVERED, ACTUALLY,

38

00:01:12,105 --> 00:01:14,073

THAT THE MOONS AROUND PLANETS

39

00:01:14,073 --> 00:01:15,542
IN OUR OWN SOLAR SYSTEM

40

00:01:15,542 --> 00:01:16,810
ARE INTERESTING PLACES

41

00:01:16,810 --> 00:01:18,144
IN THEIR OWN RIGHT.

42

00:01:18,144 --> 00:01:19,379
HUBBLE FOUND EVIDENCE

43

00:01:19,379 --> 00:01:21,080
FOR WATER VAPOR PLUMES

44

00:01:21,080 --> 00:01:23,583
BEING EJECTED FROM THE SURFACE

45

00:01:23,583 --> 00:01:24,984
OF THE MOON EUROPA

46

00:01:24,984 --> 00:01:26,386
AROUND JUPITER.

47

00:01:26,386 --> 00:01:27,821
SO HUBBLE CONTINUES TO BE

48

00:01:27,821 --> 00:01:29,589
AT THE FOREFRONT OF

49

00:01:29,589 --> 00:01:31,825
ASTRONOMICAL EXPLORATION.

50

00:01:35,295 --> 00:01:36,863
WE ARE LOOKING AT

51
00:01:36,863 --> 00:01:38,565
WHAT WE CALL EXOPLANETS.

52
00:01:38,565 --> 00:01:40,166
SO EXOPLANETS

53
00:01:40,166 --> 00:01:41,901
ARE PLANETS THAT ARE ORBITING

54
00:01:41,901 --> 00:01:44,103
STARS OTHER THAN OUR SUN.

55
00:01:44,103 --> 00:01:44,971
AND HUBBLE IS ACTUALLY

56
00:01:44,971 --> 00:01:46,406
FINDING WATER VAPOR

57
00:01:46,406 --> 00:01:47,574
IN THE ATMOSPHERES

58
00:01:47,574 --> 00:01:49,542
OF SOME OF THESE EXOPLANETS.

59
00:01:49,542 --> 00:01:50,677
THAT'S A HOT TOPIC FOR

60
00:01:50,677 --> 00:01:52,679
HUBBLE STUDY RIGHT NOW.

61
00:01:52,679 --> 00:01:54,013
ON THE BIGGER SCALE,

62
00:01:54,013 --> 00:01:56,049
WE WERE VERY SURPRISED

63
00:01:56,049 --> 00:01:57,650

WHEN IT WAS DETERMINED THAT

64

00:01:57,650 --> 00:01:59,519

THE EXPANSION RATE--

65

00:01:59,519 --> 00:02:00,487

THAT IS, THE RATE THAT

66

00:02:00,487 --> 00:02:01,688

SPACE IS STRETCHING

67

00:02:01,688 --> 00:02:02,856

AND THE GALAXIES SEEM TO BE

68

00:02:02,856 --> 00:02:04,958

MOVING APART FROM EACH OTHER.

69

00:02:04,958 --> 00:02:06,793

IS INCREASING,

70

00:02:06,793 --> 00:02:08,294

IN OTHER WORDS,

71

00:02:08,294 --> 00:02:09,829

THE UNIVERSE EXPANSION

72

00:02:09,829 --> 00:02:11,531

IS ACCELERATING.

73

00:02:11,531 --> 00:02:12,332

NOW, WE DON'T KNOW

74

00:02:12,332 --> 00:02:13,900

WHAT WOULD CAUSE THAT,

75

00:02:13,900 --> 00:02:15,535

M-MATTER IN THE UNIVERSE TENDS

76
00:02:15,535 --> 00:02:17,403
TO HAVE A GRAVITATIONAL PULL

77
00:02:17,403 --> 00:02:19,205
THAT PULLS THINGS BACK TOGETHER

78
00:02:19,205 --> 00:02:20,607
OR AT LEAST WOULD SLOW DOWN

79
00:02:20,607 --> 00:02:21,875
THIS EXPANSION.

80
00:02:21,875 --> 00:02:23,443
NOT SPEED IT UP.

81
00:02:23,443 --> 00:02:26,012
AND SO WE CALL IT DARK ENERGY,

82
00:02:26,012 --> 00:02:27,647
THIS MENURE-- MYSTERIOUS

83
00:02:27,647 --> 00:02:29,382
PHENOMENON THAT SEEMS TO BE

84
00:02:29,382 --> 00:02:31,050
ACCELERATING THE EXPANSION

85
00:02:31,050 --> 00:02:32,652
OF THE UNIVERSE.

86
00:02:32,652 --> 00:02:34,187
THE HUBBLE SPACE TELESCOPE

87
00:02:34,187 --> 00:02:36,155
RECEIVES COMMANDS TRANSMITTED

88
00:02:36,155 --> 00:02:37,857

UP FROM THE GROUND.

89

00:02:37,857 --> 00:02:39,158

SO HERE AT NASA'S

90

00:02:39,158 --> 00:02:40,793

GODDARD SPACE FLIGHT CENTER,

91

00:02:40,793 --> 00:02:42,262

WE HAVE A CONTROL ROOM WHERE

92

00:02:42,262 --> 00:02:44,030

THE TELESCOPE IS MONITORED.

93

00:02:44,030 --> 00:02:45,331

WE TRANSMIT COMMANDS

94

00:02:45,331 --> 00:02:46,599

UP TO HUBBLE

95

00:02:46,599 --> 00:02:48,268

THAT TELL IT WHERE TO POINT.

96

00:02:48,268 --> 00:02:50,336

THE DATA ARE RECORDED

97

00:02:50,336 --> 00:02:51,704

AND EVENTUALLY,

98

00:02:51,704 --> 00:02:52,739

SCIENTISTS WILL DETERMINE

99

00:02:52,739 --> 00:02:54,107

THE ANSWERS TO THE QUESTIONS

100

00:02:54,107 --> 00:02:55,341

THEY WERE TRYING TO ASK

101
00:02:55,341 --> 00:02:57,877
BY TAKING THESE OBSERVATIONS.

102
00:02:57,877 --> 00:02:59,512
NOW, THE IMAGES FROM HUBBLE

103
00:02:59,512 --> 00:03:00,213
THAT MOST OF US

104
00:03:00,213 --> 00:03:02,015
REALLY ENJOY LOOKING AT--

105
00:03:02,015 --> 00:03:03,816
THESE IMAGES OF GALAXIES,

106
00:03:03,816 --> 00:03:05,251
AND NEBULAE AND STARS

107
00:03:05,251 --> 00:03:06,252
AND PLANETS,

108
00:03:06,252 --> 00:03:06,953
THE WEB SITES

109
00:03:06,953 --> 00:03:08,888
LIKE NASA.GOV/HUBBLE

110
00:03:08,888 --> 00:03:10,857
AND HUBBLESITE.ORG.

111
00:03:10,857 --> 00:03:11,991
HOST THESE IMAGES,

112
00:03:11,991 --> 00:03:13,493
THEY'RE FREELY AVAILABLE

113
00:03:13,493 --> 00:03:14,994

AND OUR EXPOSURES WITH HUBBLE

114

00:03:14,994 --> 00:03:16,596

ARE GOING ON EVERY SINGLE DAY.

115

00:03:16,596 --> 00:03:17,830

SO WE'RE CAN-- WE'RE STILL

116

00:03:17,830 --> 00:03:19,699

A VERY ACTIVE OBSERVATORY.

117

00:03:19,699 --> 00:03:21,167

HUBBLE IS TEACHING US A LOT

118

00:03:21,167 --> 00:03:22,302

ABOUT THE UNIVERSE

119

00:03:22,302 --> 00:03:23,369

NOT ONLY THROUGH

120

00:03:23,369 --> 00:03:24,404

LOOKING AT THE COLORS

121

00:03:24,404 --> 00:03:25,672

THAT OUR EYES CAN SEE,

122

00:03:25,672 --> 00:03:27,807

BUT LOOKING BEYOND THAT

123

00:03:27,807 --> 00:03:28,741

RANGE OF COLORS

124

00:03:28,741 --> 00:03:30,443

THAT OUR EYES CAN SEE.

125

00:03:30,443 --> 00:03:31,644

SO OUR EYES CAN SEE

126
00:03:31,644 --> 00:03:33,246
THE COLORS OF THE RAINBOW

127
00:03:33,246 --> 00:03:35,682
FROM VIOLET TO RED.

128
00:03:35,682 --> 00:03:36,482
HUBBLE CAN SEE THOSE

129
00:03:36,482 --> 00:03:37,517
VISIBLE COLORS,

130
00:03:37,517 --> 00:03:39,385
BUT HUBBLE CAN ALSO SEE

131
00:03:39,385 --> 00:03:41,120
A LITTLE BIT REDDER THAN RED.

132
00:03:41,120 --> 00:03:42,589
INTO THE INFRARED PART

133
00:03:42,589 --> 00:03:44,824
OF THE ELECTROMAGNETIC SPECTRUM.

134
00:03:44,824 --> 00:03:45,725
AND HUBBLE CAN SEE

135
00:03:45,725 --> 00:03:47,794
A LITTLE BIT BLUER THAN BLUE

136
00:03:47,794 --> 00:03:49,662
INTO THE ULTRAVIOLET PART

137
00:03:49,662 --> 00:03:51,564
OF THE ELECTROMAGNETIC SPECTRUM.

138
00:03:51,564 --> 00:03:53,299

BUT A LOT OF THINGS IN SPACE

139

00:03:53,299 --> 00:03:54,500

THAT WE'RE INTERESTED IN

140

00:03:54,500 --> 00:03:56,069

EMIT THEIR RADIATION

141

00:03:56,069 --> 00:03:58,338

IN THOSE INVISIBLE COLORS.

142

00:03:58,338 --> 00:04:00,340

NOW, ONE EXAMPLE IS SEEN

143

00:04:00,340 --> 00:04:01,741

IN THE FAMOUS IMAGES

144

00:04:01,741 --> 00:04:04,077

OF THE EAGLE NEBULA.

145

00:04:04,077 --> 00:04:04,744

NOW, WITH HUBBLE'S

146

00:04:04,744 --> 00:04:06,145

VISIBLE LIGHT CAMERA,

147

00:04:06,145 --> 00:04:07,480

YOU CAN SEE THESE

148

00:04:07,480 --> 00:04:09,549

DRAMATIC PILLARS.

149

00:04:09,549 --> 00:04:11,284

IF YOU LOOK AT THAT SAME REGION

150

00:04:11,284 --> 00:04:12,785

WITH HUBBLE'S INFRARED

151
00:04:12,785 --> 00:04:14,621
CAMERA CAPABILITY,

152
00:04:14,621 --> 00:04:15,755
YOU CAN SEE THROUGH

153
00:04:15,755 --> 00:04:16,990
SOME OF THAT DUST.

154
00:04:16,990 --> 00:04:18,625
YOU SEE INTO THOSE PILLARS.

155
00:04:18,625 --> 00:04:20,259
YOU SEE A LOT MORE STARS

156
00:04:20,259 --> 00:04:21,995
THAT WERE PREVIOUSLY VEILED.

157
00:04:21,995 --> 00:04:22,929
WHEN THE JAMES WEBB

158
00:04:22,929 --> 00:04:25,031
SPACE TELESCOPE LAUNCHES,

159
00:04:25,031 --> 00:04:26,165
WE WILL BE ABLE TO SEE

160
00:04:26,165 --> 00:04:27,367
EVEN FARTHER INTO

161
00:04:27,367 --> 00:04:28,668
THE INFRARED PART OF

162
00:04:28,668 --> 00:04:30,503
THE ELECTROMAGNETIC SPECTRUM.

163
00:04:30,503 --> 00:04:31,504

SO WE'RE LOOKING FORWARD

164

00:04:31,504 --> 00:04:32,972

TO HAVING COMPLEMENTARY

165

00:04:32,972 --> 00:04:34,240

OBSERVATIONS TO GIVE US

166

00:04:34,240 --> 00:04:35,475

A LOT MORE INFORMATION

167

00:04:35,475 --> 00:04:37,477

ABOUT DISTANT GALAXIES

168

00:04:37,477 --> 00:04:39,379

AND ABOUT STAR FORMING NURSERIES

169

00:04:39,379 --> 00:04:41,981

RIGHT HERE IN OUR OWN GALAXY.

170

00:04:41,981 --> 00:04:43,616

THE HUBBLE SPACE TELESCOPE

171

00:04:43,616 --> 00:04:45,752

CAN SEE DEEP INTO SPACE

172

00:04:45,752 --> 00:04:46,886

WHICH IS REALLY LOOKING

173

00:04:46,886 --> 00:04:48,588

DEEP BACK IN TIME.

174

00:04:48,588 --> 00:04:50,823

BECAUSE IT'S TAKEN TIME FOR--

175

00:04:50,823 --> 00:04:52,692

FOR DISTANT OBJECTS

176
00:04:52,692 --> 00:04:53,626
TO HAVE THEIR LIGHT

177
00:04:53,626 --> 00:04:55,995
TRAVERSE SPACE TO GET TO US.

178
00:04:55,995 --> 00:04:57,330
SOME OF THE GALAXIES

179
00:04:57,330 --> 00:04:59,198
THAT HUBBLE HAS SEEN

180
00:04:59,198 --> 00:05:01,334
ARE SHINING TO US FROM MILLIONS

181
00:05:01,334 --> 00:05:02,802
OF YEARS IN THE PAST.

182
00:05:02,802 --> 00:05:04,070
AND SOME OF THE GALAXIES

183
00:05:04,070 --> 00:05:06,005
THAT HUBBLE HAS SEEN

184
00:05:06,005 --> 00:05:07,707
HAVE TAKEN BILLIONS OF YEARS

185
00:05:07,707 --> 00:05:08,675
TO GET TO US.

186
00:05:08,675 --> 00:05:10,109
WE TYPICALLY THINK IN TERMS

187
00:05:10,109 --> 00:05:11,577
OF LIGHT YEARS INSTEAD

188
00:05:11,577 --> 00:05:13,046

OF MILES OR KILOMETERS

189

00:05:13,046 --> 00:05:13,813

WHEN WE'RE TALKING

190

00:05:13,813 --> 00:05:15,014

ABOUT DEEP SPACE BECAUSE

191

00:05:15,014 --> 00:05:17,083

THE DISTANCES ARE SO VAST.

192

00:05:17,083 --> 00:05:18,785

BUT HUBBLE IS-IS SEEING MORE

193

00:05:18,785 --> 00:05:21,287

THAN 13 BILLION LIGHT YEARS

194

00:05:21,287 --> 00:05:24,090

INTO THE DISTANT PAST

195

00:05:24,090 --> 00:05:25,892

AND INTO THE DISTANT UNIVERSE

196

00:05:25,892 --> 00:05:26,793

AND THAT IS TRULY

197

00:05:26,793 --> 00:05:29,462

AWE INSPIRING.

198

00:05:29,462 --> 00:05:30,096

>> DO YOU HAVE A QUESTION

199

00:05:30,096 --> 00:05:31,030

FOR NASA?

200

00:05:31,030 --> 00:05:31,831

SEND YOUR QUESTIONS

