Explore New Hubble Images of Celestial Objects From the Caldwell Catalog

1
00:00:19,910 --> 00:00:18,150
hi everyone welcome to today's live

2
00:00:21,750 --> 00:00:19,920
stream my name is elizabeth and i'm here

3
00:00:23,509 --> 00:00:21,760
on behalf of the hubble space telescope

4
00:00:25,990 --> 00:00:23,519
outreach team at nasa's goddard space

5
00:00:28,230 --> 00:00:26,000
flight center today we're so excited to

6
00:00:30,070 --> 00:00:28,240
share newly released hubble images of 30

7
00:00:32,549 --> 00:00:30,080
beautiful celestial objects in honor of

8
00:00:34,709 --> 00:00:32,559
hubble's 30th anniversary year we're

9
00:00:36,150 --> 00:00:34,719
live now on facebook and youtube so feel

10
00:00:37,670 --> 00:00:36,160
free to comment your questions and we'll

11
00:00:40,150 --> 00:00:37,680
try to get to them later in the show or

12
00:00:42,150 --> 00:00:40,160
afterward on social media

13
00:00:44,549 --> 00:00:42,160

so this has been quite the landmark year

14
00:00:45,910 --> 00:00:44,559
for the hubble space telescope which has

15
00:00:48,150 --> 00:00:45,920
been orbiting above earth's murky

16
00:00:50,310 --> 00:00:48,160
atmosphere for 30 years since april

17
00:00:52,229 --> 00:00:50,320
1990. hubble continues to bring us

18
00:00:53,270 --> 00:00:52,239
stunning discoveries and images of our

19
00:00:55,029 --> 00:00:53,280
universe

20
00:00:57,430 --> 00:00:55,039
joining me today we have hubble senior

21
00:00:58,790 --> 00:00:57,440
project scientist dr jennifer wiseman

22
00:01:01,110 --> 00:00:58,800
and deputy director for science

23
00:01:02,549 --> 00:01:01,120
communication dr michelle thawler

24
00:01:04,469 --> 00:01:02,559
let's go ahead and take a look at some

25
00:01:06,070 --> 00:01:04,479
of these new images now

26
00:01:08,149 --> 00:01:06,080
all these objects belong to something

27
00:01:10,070 --> 00:01:08,159
called the caldwell catalog

28
00:01:11,590 --> 00:01:10,080
these images are really gorgeous aren't

29
00:01:13,190 --> 00:01:11,600
they

30
00:01:15,910 --> 00:01:13,200
so the caldwell catalog includes

31
00:01:18,230 --> 00:01:15,920
galaxies star clusters and nebulas which

32
00:01:20,149 --> 00:01:18,240
are clouds of dust and gas in space

33
00:01:23,830 --> 00:01:20,159
let's go ahead and jump right in first

34
00:01:26,070 --> 00:01:23,840
up we have an image of caldwell 45.

35
00:01:27,670 --> 00:01:26,080
cultural 45 this is a gorgeous spiral

36
00:01:29,510 --> 00:01:27,680
galaxy and it has something called

37
00:01:32,230 --> 00:01:29,520
nuclear rings so jennifer can you

38
00:01:35,910 --> 00:01:32,240

explain what that means

39
00:01:37,270 --> 00:01:35,920
sure so this galaxy just spectacular in

40
00:01:39,990 --> 00:01:37,280
this image

41
00:01:42,069 --> 00:01:40,000
is showing off its big spiral arms which

42
00:01:44,550 --> 00:01:42,079
you can see reaching around the outer

43
00:01:46,550 --> 00:01:44,560
parts of the galaxy you can see a lot of

44
00:01:48,870 --> 00:01:46,560
dust in these spiral arms and you can

45
00:01:51,030 --> 00:01:48,880
see these kind of purplish hot spots

46
00:01:52,950 --> 00:01:51,040
these are regions where star formation

47
00:01:54,710 --> 00:01:52,960
is particularly active

48
00:01:56,950 --> 00:01:54,720
and the bright light from those massive

49
00:01:59,429 --> 00:01:56,960
stars is ionizing the gas giving us

50
00:02:01,910 --> 00:01:59,439
these beautiful colors in the core you

51
00:02:03,830 --> 00:02:01,920
see this glow of yellowish

52
00:02:05,429 --> 00:02:03,840
light there's so many stars there that

53
00:02:06,469 --> 00:02:05,439
the starlight just kind of blends

54
00:02:08,630 --> 00:02:06,479
together

55
00:02:11,190 --> 00:02:08,640
and around the center of this galaxy we

56
00:02:12,390 --> 00:02:11,200
have a ring of particularly bright

57
00:02:14,790 --> 00:02:12,400
emission

58
00:02:16,630 --> 00:02:14,800
this is a caused when there's the

59
00:02:19,910 --> 00:02:16,640
conditions are just right in galaxies

60
00:02:22,470 --> 00:02:19,920
like this for intense star formation so

61
00:02:25,030 --> 00:02:22,480
this galaxy is producing new stars at a

62
00:02:29,350 --> 00:02:25,040
high rate and in particular in that ring

63
00:02:33,190 --> 00:02:31,030

yeah it's really beautiful we've got

64
00:02:35,030 --> 00:02:33,200
another image of a spiral galaxy called

65
00:02:37,509 --> 00:02:35,040
both 36

66
00:02:39,350 --> 00:02:37,519
so color 36 it seems like we're almost

67
00:02:41,110 --> 00:02:39,360
missing a chunk of the photo here so

68
00:02:43,030 --> 00:02:41,120
what are we seeing jennifer or not

69
00:02:45,430 --> 00:02:43,040
seeing it

70
00:02:47,910 --> 00:02:45,440
that's a good question so first of all

71
00:02:51,110 --> 00:02:47,920
you see that it's a beautiful spiral

72
00:02:53,350 --> 00:02:51,120
galaxy another case of of just a

73
00:02:56,390 --> 00:02:53,360
marvelous windmill type pattern of

74
00:02:58,869 --> 00:02:56,400
spiral arms with lots of stars star

75
00:03:01,270 --> 00:02:58,879
formation dusty regions

76
00:03:04,309 --> 00:03:01,280
that kind of stair step shape in the

77
00:03:06,710 --> 00:03:04,319
upper right is actually an aspect of the

78
00:03:08,790 --> 00:03:06,720
camera that was used to take this image

79
00:03:11,430 --> 00:03:08,800
the wide field planetary camera 2 is

80
00:03:15,270 --> 00:03:11,440
almost like having four cameras in the

81
00:03:17,589 --> 00:03:15,280
four quadrants of this region and the

82
00:03:20,550 --> 00:03:17,599
upper right quadrant that camera

83
00:03:22,710 --> 00:03:20,560
actually can see things in higher detail

84
00:03:23,990 --> 00:03:22,720
than the other three quadrants the other

85
00:03:26,470 --> 00:03:24,000
three cameras

86
00:03:29,430 --> 00:03:26,480
so if we want it all to kind of be at

87
00:03:31,430 --> 00:03:29,440
the same resolution we have to shrink

88
00:03:33,589 --> 00:03:31,440

down the image from that upper right

89
00:03:36,070 --> 00:03:33,599
camera or that upper right quadrant so

90
00:03:38,470 --> 00:03:36,080
that it matches the same resolution

91
00:03:40,869 --> 00:03:38,480
capability of the other three quadrants

92
00:03:42,710 --> 00:03:40,879
or the other three camera pieces and

93
00:03:45,430 --> 00:03:42,720
when we shrink it down it kind of gives

94
00:03:47,190 --> 00:03:45,440
us this resulting stair step pattern in

95
00:03:49,430 --> 00:03:47,200
the final image

96
00:03:51,589 --> 00:03:49,440
but if you can kind of ignore the

97
00:03:54,390 --> 00:03:51,599
stair-step pattern you can see the

98
00:03:57,429 --> 00:03:54,400
gorgeous gorgeous central part of this

99
00:04:00,309 --> 00:03:57,439
galaxy and the spiral arms around it and

100
00:04:03,509 --> 00:04:00,319
again another example of nature's a

101
00:04:05,509 --> 00:04:03,519
spectacular means of arranging stars

102
00:04:07,910 --> 00:04:05,519
and continuing the production of new

103
00:04:10,229 --> 00:04:07,920
stars in active spiral galaxies like

104
00:04:12,149 --> 00:04:10,239
this one

105
00:04:13,830 --> 00:04:12,159
yeah thank you jennifer we've got

106
00:04:16,870 --> 00:04:13,840
another beautiful galaxy image of

107
00:04:20,229 --> 00:04:16,880
caldwell 29

108
00:04:22,710 --> 00:04:20,239
astronomers suspect that there is a

109
00:04:24,390 --> 00:04:22,720
supermassive black hole so michelle

110
00:04:26,629 --> 00:04:24,400
could you tell us more about what black

111
00:04:28,870 --> 00:04:26,639
holes are

112
00:04:30,629 --> 00:04:28,880
oh absolutely so i mean the amazing

113
00:04:32,790 --> 00:04:30,639

thing about a black hole is that it's a

114
00:04:35,110 --> 00:04:32,800
region of the universe where gravity is

115
00:04:36,710 --> 00:04:35,120
so extreme it can actually suck light in

116
00:04:37,670 --> 00:04:36,720
itself and that's why we call them black

117
00:04:42,230 --> 00:04:37,680
holes

118
00:04:44,150 --> 00:04:42,240
being formed by stars that die and their

119
00:04:45,990 --> 00:04:44,160
their cores collapse under the force of

120
00:04:48,390 --> 00:04:46,000
gravity but in this case we're talking

121
00:04:50,150 --> 00:04:48,400
here about a super massive black hole in

122
00:04:52,469 --> 00:04:50,160
the center of a galaxy black holes can

123
00:04:54,469 --> 00:04:52,479
get to millions or even billions of

124
00:04:56,390 --> 00:04:54,479
times the mass of our sun

125
00:04:58,950 --> 00:04:56,400
so this galaxy has a particularly

126
00:05:00,310 --> 00:04:58,960
mysterious bright center and although

127
00:05:02,070 --> 00:05:00,320
we're seeing visible light here in

128
00:05:04,310 --> 00:05:02,080
hubble and uh maybe a little bit into

129
00:05:06,390 --> 00:05:04,320
the ultraviolet and infrared what we

130
00:05:08,790 --> 00:05:06,400
also measure from this galaxy is x-ray

131
00:05:10,469 --> 00:05:08,800
light x-ray light is only naturally

132
00:05:13,189 --> 00:05:10,479
produced when the gases reach

133
00:05:15,990 --> 00:05:13,199
temperatures of over millions of degrees

134
00:05:18,150 --> 00:05:16,000
so as things fall in closer to this huge

135
00:05:20,469 --> 00:05:18,160
black hole they get caught by the black

136
00:05:22,469 --> 00:05:20,479
hole's gravity and accelerated faster

137
00:05:25,029 --> 00:05:22,479
and faster around almost like water

138
00:05:27,270 --> 00:05:25,039

going down a drain all of that friction

139
00:05:29,270 --> 00:05:27,280
heats the gas up to millions of degrees

140
00:05:31,830 --> 00:05:29,280
and it flickers on and off in x-ray

141
00:05:33,430 --> 00:05:31,840
light so in the core of this galaxy that

142
00:05:35,990 --> 00:05:33,440
you're looking at here there is a

143
00:05:37,830 --> 00:05:36,000
monstrous huge black hole and one of the

144
00:05:39,749 --> 00:05:37,840
big mysteries that hubble and other

145
00:05:41,590 --> 00:05:39,759
telescopes are trying to solve right now

146
00:05:44,390 --> 00:05:41,600
is how black holes could actually grow

147
00:05:47,350 --> 00:05:44,400
that big millions or billions of stars

148
00:05:48,629 --> 00:05:47,360
must have gone into that black hole

149
00:05:50,550 --> 00:05:48,639
wow

150
00:05:52,469 --> 00:05:50,560
so the caldwell catalog also contains

151
00:05:55,029 --> 00:05:52,479
something called planetary nebulas like

152
00:05:56,710 --> 00:05:55,039
this image of caldwell 56

153
00:05:58,469 --> 00:05:56,720
but the term planetary nebula is a

154
00:06:00,469 --> 00:05:58,479
little bit misleading so michelle what

155
00:06:01,590 --> 00:06:00,479
are we looking at

156
00:06:03,270 --> 00:06:01,600
well sure so here we're looking at

157
00:06:04,629 --> 00:06:03,280
something closer to us when you look out

158
00:06:06,469 --> 00:06:04,639
to galaxies you're looking at things

159
00:06:08,629 --> 00:06:06,479
that are millions or tens of millions of

160
00:06:10,469 --> 00:06:08,639
light years away in this case this is a

161
00:06:12,710 --> 00:06:10,479
nebula a glowing cloud of gas that's in

162
00:06:14,629 --> 00:06:12,720
our own galaxy about 1 600 light years

163
00:06:16,950 --> 00:06:14,639

away and as you mentioned we call these

164
00:06:18,550 --> 00:06:16,960
planetary nebulas but unfortunately that

165
00:06:20,469 --> 00:06:18,560
name was picked before we really

166
00:06:22,790 --> 00:06:20,479
understood what they were we saw all

167
00:06:24,550 --> 00:06:22,800
this glowing material around a star and

168
00:06:26,710 --> 00:06:24,560
we thought hey maybe there are planets

169
00:06:28,390 --> 00:06:26,720
forming but instead of the birth of a

170
00:06:30,550 --> 00:06:28,400
solar system what we're actually looking

171
00:06:33,110 --> 00:06:30,560
at here is the death of a solar system

172
00:06:36,070 --> 00:06:33,120
planetary nebulas are formed when a star

173
00:06:38,550 --> 00:06:36,080
begins to die and it bloats up to huge

174
00:06:39,430 --> 00:06:38,560
sizes then begins to drift away into

175
00:06:41,270 --> 00:06:39,440
space

176
00:06:44,469 --> 00:06:41,280
and what's left at the very center of

177
00:06:46,070 --> 00:06:44,479
this nebula is a white dwarf star a star

178
00:06:48,550 --> 00:06:46,080
that's actually just lost its nuclear

179
00:06:50,870 --> 00:06:48,560
reactions entirely and is slowly cooling

180
00:06:52,629 --> 00:06:50,880
off so this is a wonderful planetary

181
00:06:53,990 --> 00:06:52,639
nebula that it's a little bit poignant

182
00:06:55,749 --> 00:06:54,000
we're actually looking at the death of a

183
00:06:57,830 --> 00:06:55,759
solar system and that's the gases that

184
00:07:00,629 --> 00:06:57,840
you see glowing here being unraveled

185
00:07:02,390 --> 00:07:00,639
from this dying star

186
00:07:04,150 --> 00:07:02,400
very cool thank you michelle

187
00:07:06,550 --> 00:07:04,160
so the next cosmic object we're going to

188
00:07:08,950 --> 00:07:06,560

look at is caldwell 73 which is a

189
00:07:12,070 --> 00:07:08,960
globular cluster you can find caldwell

190
00:07:14,230 --> 00:07:12,080
73 in the southern skies with binoculars

191
00:07:16,230 --> 00:07:14,240
but michelle what exactly is a globular

192
00:07:17,909 --> 00:07:16,240
cluster

193
00:07:19,510 --> 00:07:17,919
oh these are absolutely wonderful these

194
00:07:21,749 --> 00:07:19,520
are the largest star clusters that are

195
00:07:23,589 --> 00:07:21,759
part of our galaxy the milky way they

196
00:07:25,189 --> 00:07:23,599
orbit around the milky way but not

197
00:07:27,990 --> 00:07:25,199
actually usually in the disk of the

198
00:07:30,309 --> 00:07:28,000
milky way we are in this disk of gas and

199
00:07:31,830 --> 00:07:30,319
dust going around the globular clusters

200
00:07:33,990 --> 00:07:31,840
are going every which way around the

201
00:07:36,309 --> 00:07:34,000
milky way sort of like a swarm of angry

202
00:07:38,070 --> 00:07:36,319
bees and they are huge

203
00:07:39,909 --> 00:07:38,080
this particular globular cluster the

204
00:07:41,430 --> 00:07:39,919
center of it is about 40 000 light years

205
00:07:44,950 --> 00:07:41,440
away from the sun

206
00:07:47,589 --> 00:07:44,960
and um it has the mass of over half a

207
00:07:49,589 --> 00:07:47,599
million suns and because we think that

208
00:07:51,430 --> 00:07:49,599
most of the stars in this uh globular

209
00:07:53,029 --> 00:07:51,440
cluster are actually not as massive as

210
00:07:54,950 --> 00:07:53,039
the sun that means it probably has a

211
00:07:56,469 --> 00:07:54,960
million stars or more

212
00:07:58,950 --> 00:07:56,479
the amazing thing about these globular

213
00:08:00,790 --> 00:07:58,960

clusters is they're also very old so

214
00:08:03,110 --> 00:08:00,800
this particular cluster we estimate to

215
00:08:05,270 --> 00:08:03,120
be a little bit over nine billion years

216
00:08:06,790 --> 00:08:05,280
old and when you think about the sun

217
00:08:08,629 --> 00:08:06,800
being somewhere between four and a half

218
00:08:11,029 --> 00:08:08,639
and five billion years old this is an

219
00:08:12,790 --> 00:08:11,039
old cluster indeed so these clusters may

220
00:08:14,390 --> 00:08:12,800
give us clues about how the galaxy

221
00:08:16,390 --> 00:08:14,400
formed and even what the universe was

222
00:08:18,309 --> 00:08:16,400
like many billions of years before the

223
00:08:19,909 --> 00:08:18,319
sun the earth formed so it's absolutely

224
00:08:21,990 --> 00:08:19,919
lovely i mean doesn't it look like sort

225
00:08:24,309 --> 00:08:22,000
of scattered diamonds and jewels on

226
00:08:25,670 --> 00:08:24,319
black velvet you know i i've had the uh

227
00:08:27,670 --> 00:08:25,680
the privilege to be looking at this

228
00:08:29,270 --> 00:08:27,680
cluster in the southern hemisphere and

229
00:08:32,870 --> 00:08:29,280
you know even through a small telescope

230
00:08:32,870 --> 00:08:32,880
it is absolutely spectacular

231
00:08:35,990 --> 00:08:34,630
yes it definitely is

232
00:08:37,589 --> 00:08:36,000
now one of the coolest things about

233
00:08:39,269 --> 00:08:37,599
hubble is that it can look at cosmic

234
00:08:40,870 --> 00:08:39,279
objects in different wavelengths of

235
00:08:42,790 --> 00:08:40,880
light so let's take this image of

236
00:08:45,110 --> 00:08:42,800
caldwell 52

237
00:08:46,870 --> 00:08:45,120
hubble was able to image this galaxy

238
00:08:48,949 --> 00:08:46,880

this elliptical galaxy in both visible

239
00:08:50,470 --> 00:08:48,959
light and infrared so jennifer when

240
00:08:54,070 --> 00:08:50,480
hubble is looking at an object in the

241
00:08:56,710 --> 00:08:54,080
infrared what is that telling us

242
00:08:59,509 --> 00:08:56,720
we are so fortunate that hubble is able

243
00:09:01,750 --> 00:08:59,519
to look at objects like this galaxy with

244
00:09:04,070 --> 00:09:01,760
different kinds of of eyes if you will

245
00:09:06,150 --> 00:09:04,080
certainly we can look in visible light

246
00:09:08,550 --> 00:09:06,160
but hubble also has the capability of

247
00:09:11,269 --> 00:09:08,560
taking in ultraviolet light which is

248
00:09:13,829 --> 00:09:11,279
bluer than blue and also

249
00:09:16,389 --> 00:09:13,839
somewhat into the infrared part of the

250
00:09:18,150 --> 00:09:16,399
electromagnetic spectrum of light so

251
00:09:20,550 --> 00:09:18,160
redder than red

252
00:09:23,990 --> 00:09:20,560
when hubble looks at visible light it's

253
00:09:25,990 --> 00:09:24,000
capturing starlight in visible light and

254
00:09:28,150 --> 00:09:26,000
also sometimes you can see

255
00:09:30,790 --> 00:09:28,160
regions where dust in the galaxy is

256
00:09:32,710 --> 00:09:30,800
blocking out some of that starlight so

257
00:09:34,790 --> 00:09:32,720
you can kind of see the blockage there

258
00:09:36,790 --> 00:09:34,800
when we look in the infrared part of the

259
00:09:38,230 --> 00:09:36,800
spectrum using hubble's infrared

260
00:09:40,870 --> 00:09:38,240
capabilities

261
00:09:43,030 --> 00:09:40,880
we can see more of the reddish stars

262
00:09:45,350 --> 00:09:43,040
throughout the galaxy and more of the

263
00:09:48,949 --> 00:09:45,360

emission coming from dust throughout the

264
00:09:51,590 --> 00:09:48,959
galaxy as well kind of the glow from

265
00:09:54,070 --> 00:09:51,600
dusty regions heated regions and if we

266
00:09:56,230 --> 00:09:54,080
can combine what we see in infrared

267
00:09:58,630 --> 00:09:56,240
light with what we see in visible light

268
00:10:00,630 --> 00:09:58,640
we get a much richer picture of what

269
00:10:03,350 --> 00:10:00,640
we're seeing in that galaxy we can learn

270
00:10:06,630 --> 00:10:03,360
a lot more so in the hubble image you

271
00:10:08,949 --> 00:10:06,640
can actually see the infrared uh picture

272
00:10:11,110 --> 00:10:08,959
up at the top middle the visible light

273
00:10:13,269 --> 00:10:11,120
in the bottom and the combination of the

274
00:10:15,829 --> 00:10:13,279
two in the upper right and you can see

275
00:10:18,470 --> 00:10:15,839
how much we can see and learn a lot more

276
00:10:20,949 --> 00:10:18,480
by having both visible and infrared

277
00:10:22,150 --> 00:10:20,959
light combined

278
00:10:24,550 --> 00:10:22,160
definitely

279
00:10:26,389 --> 00:10:24,560
and jennifer even after 30 years hubble

280
00:10:27,990 --> 00:10:26,399
is still bringing us amazing views of

281
00:10:29,750 --> 00:10:28,000
the universe so could you tell us what

282
00:10:31,670 --> 00:10:29,760
this landmark anniversary means for the

283
00:10:34,069 --> 00:10:31,680
mission

284
00:10:37,350 --> 00:10:34,079
well we are delighted that the hubble

285
00:10:39,509 --> 00:10:37,360
space telescope is working very well

286
00:10:42,790 --> 00:10:39,519
even though it's been operating in space

287
00:10:45,430 --> 00:10:42,800
for 30 years it's a satellite in orbit

288
00:10:47,750 --> 00:10:45,440

around planet earth it was launched and

289
00:10:49,350 --> 00:10:47,760
deployed by the space shuttle back in

290
00:10:52,069 --> 00:10:49,360
1990

291
00:10:54,389 --> 00:10:52,079
and thankfully we've had several return

292
00:10:57,829 --> 00:10:54,399
visits from astronauts to the hubble

293
00:10:59,829 --> 00:10:57,839
space telescope over the years each time

294
00:11:02,230 --> 00:10:59,839
astronauts have returned to hubble

295
00:11:04,630 --> 00:11:02,240
they've been able to repair things or

296
00:11:06,310 --> 00:11:04,640
install new and improved

297
00:11:09,670 --> 00:11:06,320
instruments including science

298
00:11:12,949 --> 00:11:09,680
instruments so we now have on hubble a

299
00:11:14,470 --> 00:11:12,959
really fantastic suite of cameras and

300
00:11:16,870 --> 00:11:14,480
spectrographs

301
00:11:18,710 --> 00:11:16,880
we have good gyroscopes and batteries

302
00:11:21,269 --> 00:11:18,720
that help us be able to operate the

303
00:11:23,110 --> 00:11:21,279
telescope and point it accurately

304
00:11:25,590 --> 00:11:23,120
and we're confident that the hubble

305
00:11:27,670 --> 00:11:25,600
space telescope will be able to operate

306
00:11:30,389 --> 00:11:27,680
well for quite a few years to come

307
00:11:32,949 --> 00:11:30,399
hopefully throughout most of this decade

308
00:11:35,430 --> 00:11:32,959
and maybe beyond and that's good news

309
00:11:37,829 --> 00:11:35,440
for science because hubble right now is

310
00:11:40,069 --> 00:11:37,839
really at the peak of its scientific

311
00:11:41,030 --> 00:11:40,079
capability even 30 years into its

312
00:11:42,790 --> 00:11:41,040
mission

313
00:11:45,110 --> 00:11:42,800

we're doing things with hubble now that

314
00:11:47,590 --> 00:11:45,120
we hadn't even imagined before it was

315
00:11:50,629 --> 00:11:47,600
launched like studying the atmospheres

316
00:11:52,710 --> 00:11:50,639
of exoplanets planets orbiting stars

317
00:11:53,670 --> 00:11:52,720
other than our sun outside of our solar

318
00:11:56,230 --> 00:11:53,680
system

319
00:11:58,629 --> 00:11:56,240
and we're looking ever more deeply into

320
00:12:00,550 --> 00:11:58,639
the universe at distant galaxies as well

321
00:12:01,990 --> 00:12:00,560
understanding the history of the

322
00:12:04,629 --> 00:12:02,000
universe

323
00:12:07,110 --> 00:12:04,639
we are also looking forward to hubble

324
00:12:09,350 --> 00:12:07,120
operating uh in complement with the

325
00:12:12,150 --> 00:12:09,360
james webb space telescope that is due

326
00:12:13,269 --> 00:12:12,160
to launch the latter part of next year

327
00:12:15,030 --> 00:12:13,279
when web

328
00:12:17,269 --> 00:12:15,040
launches and operates it will be a

329
00:12:19,990 --> 00:12:17,279
wonderful telescope that's very adept in

330
00:12:21,829 --> 00:12:20,000
the infrared part of the spectrum

331
00:12:23,030 --> 00:12:21,839
looking deeper into the infrared than

332
00:12:24,389 --> 00:12:23,040
hubble can

333
00:12:26,230 --> 00:12:24,399
can achieve

334
00:12:28,790 --> 00:12:26,240
well whereas hubble can see visible and

335
00:12:30,870 --> 00:12:28,800
ultraviolet light that the web telescope

336
00:12:33,350 --> 00:12:30,880
won't see so in complement these two

337
00:12:36,470 --> 00:12:33,360
observatories will be a very powerful

338
00:12:38,870 --> 00:12:36,480

tool for understanding distant galaxies

339
00:12:41,509 --> 00:12:38,880
the early universe and also star and

340
00:12:43,910 --> 00:12:41,519
planet formation in our nearby

341
00:12:45,990 --> 00:12:43,920
gala our own galaxy as well

342
00:12:48,310 --> 00:12:46,000
so we're very excited to celebrate

343
00:12:50,870 --> 00:12:48,320
hubble's 30th birthday both for looking

344
00:12:52,069 --> 00:12:50,880
back but also for looking forward to

345
00:12:55,910 --> 00:12:52,079
what we're going to learn about the

346
00:12:59,590 --> 00:12:58,069
fantastic so if you're just joining us

347
00:13:01,509 --> 00:12:59,600
for live and talking about newly

348
00:13:03,829 --> 00:13:01,519
released hubble images of objects from

349
00:13:05,030 --> 00:13:03,839
something called the caldwell catalog

350
00:13:06,470 --> 00:13:05,040
the coolest part about the callable

351
00:13:08,230 --> 00:13:06,480
catalog is that you can find these

352
00:13:10,470 --> 00:13:08,240
cosmic objects in the night sky with

353
00:13:13,509 --> 00:13:10,480
telescopes or sometimes even with just

354
00:13:15,750 --> 00:13:13,519
binoculars or your eyes but what exactly

355
00:13:17,750 --> 00:13:15,760
is the caldwell catalog

356
00:13:19,750 --> 00:13:17,760
joining me now we have hubble's science

357
00:13:21,910 --> 00:13:19,760
operations manager kevin hartnett and

358
00:13:23,750 --> 00:13:21,920
our lead science writer vanessa thomas

359
00:13:24,790 --> 00:13:23,760
they're also both amateur astronomers

360
00:13:27,350 --> 00:13:24,800
which means they use their own

361
00:13:29,110 --> 00:13:27,360
telescopes to look at the night sky

362
00:13:30,790 --> 00:13:29,120
so vanessa you are responsible for

363
00:13:32,470 --> 00:13:30,800

pulling together this collection of

364
00:13:34,389 --> 00:13:32,480
images could you tell us what the

365
00:13:36,790 --> 00:13:34,399
caldwell catalog is and what its purpose

366
00:13:43,430 --> 00:13:39,990
yes of course the cultural catalog is a

367
00:13:46,470 --> 00:13:43,440
collection of a 109 celestial objects

368
00:13:49,030 --> 00:13:46,480
galaxies star clusters and nebulas that

369
00:13:51,829 --> 00:13:49,040
as you said can be seen with uh

370
00:13:53,350 --> 00:13:51,839
amateur-sized telescopes and sometimes

371
00:13:54,949 --> 00:13:53,360
uh they are bright enough that you can

372
00:13:57,030 --> 00:13:54,959
see them with binoculars or even the

373
00:14:00,230 --> 00:13:57,040
naked eye and the collection was put

374
00:14:01,110 --> 00:14:00,240
together by a man uh named sir patrick

375
00:14:03,350 --> 00:14:01,120
moore

376
00:14:05,590 --> 00:14:03,360
and he was a british amateur astronomer

377
00:14:07,910 --> 00:14:05,600
and science communicator and he put the

378
00:14:10,710 --> 00:14:07,920
collection together for fellow amateur

379
00:14:12,949 --> 00:14:10,720
astronomers to uh have some targets to

380
00:14:14,870 --> 00:14:12,959
look at with their own telescopes he

381
00:14:17,189 --> 00:14:14,880
found these objects interesting and

382
00:14:20,150 --> 00:14:17,199
wanted to share his list with others and

383
00:14:21,829 --> 00:14:20,160
it was inspired by a more famous catalog

384
00:14:23,829 --> 00:14:21,839
that was put together even earlier

385
00:14:25,350 --> 00:14:23,839
called the messier catalog that was put

386
00:14:27,350 --> 00:14:25,360
together by a french

387
00:14:30,150 --> 00:14:27,360
astronomer and that also included

388
00:14:32,550 --> 00:14:30,160

galaxies star clusters and nebulas that

389
00:14:34,710 --> 00:14:32,560
amateurs can see with their with their

390
00:14:36,550 --> 00:14:34,720
own telescopes the difference between

391
00:14:38,710 --> 00:14:36,560
the two catalogs is that messier's

392
00:14:40,949 --> 00:14:38,720
catalog included only objects that could

393
00:14:43,430 --> 00:14:40,959
be seen in the northern hemisphere while

394
00:14:45,910 --> 00:14:43,440
where the caldwell catalog

395
00:14:48,150 --> 00:14:45,920
includes objects can be seen uh in both

396
00:14:50,230 --> 00:14:48,160
the northern and southern hemispheres so

397
00:14:53,590 --> 00:14:50,240
wherever you live in the world you can

398
00:14:55,829 --> 00:14:53,600
see some of the caldwell catalog objects

399
00:14:57,670 --> 00:14:55,839
that's awesome thank you vanessa so

400
00:14:59,590 --> 00:14:57,680
kevin speaking of finding these caldwell

401
00:15:01,590 --> 00:14:59,600
objects in the night sky you actually

402
00:15:03,430 --> 00:15:01,600
took an image of caldwell 14 which is

403
00:15:05,350 --> 00:15:03,440
the double cluster in the constellation

404
00:15:07,189 --> 00:15:05,360
perseus let's go ahead and take a

405
00:15:09,189 --> 00:15:07,199
side-by-side look of the image you got

406
00:15:10,949 --> 00:15:09,199
and the image that hubble has both

407
00:15:12,550 --> 00:15:10,959
images look amazing so could you tell us

408
00:15:14,470 --> 00:15:12,560
a bit more about them and how people

409
00:15:16,870 --> 00:15:14,480
could find caldwell objects in the night

410
00:15:22,550 --> 00:15:19,509
sure well caldwell 14

411
00:15:24,949 --> 00:15:22,560
is an amazing object and this is a great

412
00:15:26,710 --> 00:15:24,959
time of the year to see it it's located

413
00:15:30,629 --> 00:15:26,720

in the night sky between the

414
00:15:33,030 --> 00:15:30,639
constellations of cassiopeia and perseus

415
00:15:36,230 --> 00:15:33,040
and is frequently called the double

416
00:15:39,110 --> 00:15:36,240
cluster in perseus and you can see why

417
00:15:41,670 --> 00:15:39,120
with a small telescope from a dark site

418
00:15:42,470 --> 00:15:41,680
you can see basically what i've imaged

419
00:15:44,230 --> 00:15:42,480
here

420
00:15:46,550 --> 00:15:44,240
two distinct

421
00:15:50,069 --> 00:15:46,560
open clusters of stars

422
00:15:52,870 --> 00:15:50,079
each with hundreds of glittering members

423
00:15:58,310 --> 00:15:52,880
it's really an unforgettable sight

424
00:16:03,350 --> 00:16:02,150
this graphic shows the location of

425
00:16:05,910 --> 00:16:03,360
hubble's

426
00:16:07,670 --> 00:16:05,920
image in the greater context of the

427
00:16:09,829 --> 00:16:07,680
double cluster

428
00:16:11,670 --> 00:16:09,839
one thing stands out immediately

429
00:16:14,790 --> 00:16:11,680
hubble's field of view

430
00:16:16,870 --> 00:16:14,800
is tiny compared to the size of the

431
00:16:18,389 --> 00:16:16,880
double cluster it would take hubble

432
00:16:20,470 --> 00:16:18,399
space telescope

433
00:16:22,310 --> 00:16:20,480
hundreds of images

434
00:16:26,069 --> 00:16:22,320
all stitched together to form a big

435
00:16:28,550 --> 00:16:26,079
mosaic to capture all of caldwell 14.

436
00:16:31,430 --> 00:16:28,560
this is one of the reasons why nasa is

437
00:16:33,509 --> 00:16:31,440
preparing the w first mission

438
00:16:35,509 --> 00:16:33,519

because this space telescope with one

439
00:16:38,550 --> 00:16:35,519
shot will take

440
00:16:41,189 --> 00:16:38,560
all of caldwell 14 with the resolution

441
00:16:43,670 --> 00:16:41,199
of the hubble space telescope

442
00:16:46,230 --> 00:16:43,680
now how do we find

443
00:16:48,069 --> 00:16:46,240
the caldwell cattle

444
00:16:48,949 --> 00:16:48,079
objects in the night sky

445
00:16:51,350 --> 00:16:48,959
well

446
00:16:54,310 --> 00:16:51,360
um if you don't have a motorized go-to

447
00:16:57,030 --> 00:16:54,320
telescope you'll need different things

448
00:16:59,749 --> 00:16:57,040
uh first you'll need a good listing of

449
00:17:02,069 --> 00:16:59,759
the objects and some detailed star

450
00:17:04,870 --> 00:17:02,079
charts for where to find them now these

451
00:17:07,829 --> 00:17:04,880
thankfully are easily available online

452
00:17:10,789 --> 00:17:07,839
or in an atlas or even in a phone app

453
00:17:12,870 --> 00:17:10,799
second you need a dark spot get out away

454
00:17:14,069 --> 00:17:12,880
from city lights if you can

455
00:17:16,390 --> 00:17:14,079
and

456
00:17:18,549 --> 00:17:16,400
let your eyes dark adapt to the night

457
00:17:20,949 --> 00:17:18,559
sky and you'll begin to see those

458
00:17:23,669 --> 00:17:20,959
fainter stars and constellations that

459
00:17:26,309 --> 00:17:23,679
you can't see from the city location

460
00:17:28,789 --> 00:17:26,319
it's helpful at this

461
00:17:32,070 --> 00:17:28,799
in this regard to go on on a night when

462
00:17:35,350 --> 00:17:32,080
there isn't a bright moon in the sky

463
00:17:37,510 --> 00:17:35,360

then you need to choose your optical aid

464
00:17:40,390 --> 00:17:37,520
based on the

465
00:17:42,470 --> 00:17:40,400
brightness and the size of the object

466
00:17:44,070 --> 00:17:42,480
that you're looking for so

467
00:17:47,190 --> 00:17:44,080
again you can use anything from

468
00:17:48,789 --> 00:17:47,200
binoculars like these seven by fifties

469
00:17:50,789 --> 00:17:48,799
which are great

470
00:17:53,270 --> 00:17:50,799
or a small telescope like this three and

471
00:17:54,710 --> 00:17:53,280
a half inch here or for some of the

472
00:17:55,830 --> 00:17:54,720
fainter objects

473
00:17:57,990 --> 00:17:55,840
um

474
00:18:01,350 --> 00:17:58,000
something in a six inch class like this

475
00:18:04,390 --> 00:18:02,150
so

476
00:18:05,590 --> 00:18:04,400
final thing is really to remember

477
00:18:09,029 --> 00:18:05,600
patience

478
00:18:11,990 --> 00:18:09,039
and persistence this is a treasure hunt

479
00:18:14,390 --> 00:18:12,000
and imagine what it's like

480
00:18:16,789 --> 00:18:14,400
to see with your own eye in the

481
00:18:19,190 --> 00:18:16,799
telescope the light from a distant

482
00:18:21,270 --> 00:18:19,200
galaxy that's millions of millions of

483
00:18:25,430 --> 00:18:21,280
light years away

484
00:18:27,590 --> 00:18:25,440
it's really worth it it's unforgettable

485
00:18:29,190 --> 00:18:27,600
thank you so much kevin before we jump

486
00:18:31,669 --> 00:18:29,200
into some audio questions let's check

487
00:18:33,350 --> 00:18:31,679
back in with vanessa so vanessa there

488
00:18:35,990 --> 00:18:33,360

are more images and information about

489
00:18:37,590 --> 00:18:36,000
the caldwell catalog online so could you

490
00:18:40,150 --> 00:18:37,600
tell us more about what we can find on

491
00:18:43,669 --> 00:18:40,160
hubble's website

492
00:18:47,190 --> 00:18:43,679
absolutely if you go to nasa.gov

493
00:18:49,510 --> 00:18:47,200
hubble you will find uh a link to our

494
00:18:51,029 --> 00:18:49,520
caldwell catalog and there you'll find

495
00:18:54,070 --> 00:18:51,039
some background information about the

496
00:18:56,470 --> 00:18:54,080
catalog and hubble's uh images of these

497
00:18:58,470 --> 00:18:56,480
objects and you'll see a gallery of all

498
00:19:00,390 --> 00:18:58,480
of the objects in the caldwell catalog

499
00:19:01,990 --> 00:19:00,400
that hubble has has observed and we've

500
00:19:03,190 --> 00:19:02,000
released images of

501
00:19:05,029 --> 00:19:03,200
and you'll see some of the new ones

502
00:19:06,870 --> 00:19:05,039
highlighted and new and if you click on

503
00:19:09,590 --> 00:19:06,880
one of those objects you'll get it the

504
00:19:11,270 --> 00:19:09,600
full image and you may even see more

505
00:19:13,590 --> 00:19:11,280
images than just one because sometimes

506
00:19:14,710 --> 00:19:13,600
hubble has seen more uh or taken more

507
00:19:17,430 --> 00:19:14,720
than one

508
00:19:19,669 --> 00:19:17,440
image of an object and uh you'll find

509
00:19:21,830 --> 00:19:19,679
some information about that object as

510
00:19:23,990 --> 00:19:21,840
well as how to observe it uh you'll see

511
00:19:26,630 --> 00:19:24,000
a basic star chart that'll give you an

512
00:19:27,830 --> 00:19:26,640
idea of where the object is located in

513
00:19:29,590 --> 00:19:27,840

the night sky

514
00:19:31,590 --> 00:19:29,600
and it'll tell you what constellation

515
00:19:34,549 --> 00:19:31,600
it's in and what time of year to look

516
00:19:36,470 --> 00:19:34,559
for this object if you look at the at

517
00:19:39,029 --> 00:19:36,480
the description it'll give you more

518
00:19:41,190 --> 00:19:39,039
detail about whether it's in the

519
00:19:43,110 --> 00:19:41,200
northern hemisphere sky or if it's in

520
00:19:45,510 --> 00:19:43,120
the southern hemisphere sky and whether

521
00:19:48,950 --> 00:19:45,520
you need a telescope or binoculars or if

522
00:19:52,789 --> 00:19:50,789
great thank you all right now we're

523
00:19:55,270 --> 00:19:52,799
going to take a look at some questions

524
00:19:57,029 --> 00:19:55,280
we have one from facebook okay so what

525
00:19:58,870 --> 00:19:57,039
can hubble tell us about elusive

526
00:20:01,590 --> 00:19:58,880
phenomena like singularities and

527
00:20:02,950 --> 00:20:01,600
gravitational distortions

528
00:20:04,549 --> 00:20:02,960
jennifer would you be interested in that

529
00:20:07,350 --> 00:20:04,559
or michelle

530
00:20:10,310 --> 00:20:07,360
feel free to jump in

531
00:20:11,669 --> 00:20:10,320
i can take a shot at it um we are able

532
00:20:15,029 --> 00:20:11,679
to see

533
00:20:17,510 --> 00:20:15,039
uh the effects of some of these unseen

534
00:20:20,630 --> 00:20:17,520
phenomena so let's take

535
00:20:23,029 --> 00:20:20,640
dark matter for example we now know that

536
00:20:25,510 --> 00:20:23,039
the majority of mass

537
00:20:27,669 --> 00:20:25,520
in the universe is unseen it's dark

538
00:20:30,390 --> 00:20:27,679

matter but we know it's there because of

539
00:20:33,190 --> 00:20:30,400
its effects it's gravitational effects

540
00:20:34,549 --> 00:20:33,200
one of those effects of dark matter is

541
00:20:37,669 --> 00:20:34,559
to actually

542
00:20:40,149 --> 00:20:37,679
distort space-time all mass actually can

543
00:20:42,230 --> 00:20:40,159
do this and if you have a lot of matter

544
00:20:44,950 --> 00:20:42,240
together such as in a cluster of

545
00:20:47,669 --> 00:20:44,960
galaxies there's a lot more dark matter

546
00:20:49,669 --> 00:20:47,679
than the visible star light and that can

547
00:20:52,070 --> 00:20:49,679
actually distort space-time

548
00:20:53,750 --> 00:20:52,080
significantly enough that when we look

549
00:20:56,390 --> 00:20:53,760
at that region with the hubble space

550
00:20:58,390 --> 00:20:56,400
telescope the light coming through that

551
00:21:02,470 --> 00:20:58,400
distorted region from a background

552
00:21:03,990 --> 00:21:02,480
galaxy will get magnified and distorted

553
00:21:06,390 --> 00:21:04,000
stretched out sometimes we'll see

554
00:21:09,350 --> 00:21:06,400
multiple apparitions of that background

555
00:21:10,630 --> 00:21:09,360
galaxy we call this gravitational

556
00:21:13,270 --> 00:21:10,640
lensing

557
00:21:16,310 --> 00:21:13,280
and through it we're able to discover

558
00:21:18,630 --> 00:21:16,320
and detect and map out the distribution

559
00:21:20,710 --> 00:21:18,640
of dark matter in that cluster of

560
00:21:23,430 --> 00:21:20,720
galaxies even though we can't see the

561
00:21:25,590 --> 00:21:23,440
dark matter and we can also learn things

562
00:21:27,909 --> 00:21:25,600
from the background galaxies that are

563
00:21:29,430 --> 00:21:27,919

very distant but are getting magnified

564
00:21:31,750 --> 00:21:29,440
by this effect

565
00:21:33,590 --> 00:21:31,760
so that's one of these sort of unseen

566
00:21:35,830 --> 00:21:33,600
phenomena that hubble is very good at

567
00:21:38,310 --> 00:21:35,840
studying because we can see its effects

568
00:21:40,310 --> 00:21:38,320
through gravitational lensing

569
00:21:43,430 --> 00:21:40,320
we're also contributing to the study of

570
00:21:45,990 --> 00:21:43,440
dark energy this is the the mysterious

571
00:21:48,310 --> 00:21:46,000
force that seems to be propelling the

572
00:21:49,909 --> 00:21:48,320
expansion of the universe to faster and

573
00:21:51,590 --> 00:21:49,919
faster rates

574
00:21:53,590 --> 00:21:51,600
hubble as well as telescopes on the

575
00:21:56,390 --> 00:21:53,600
ground working together were used to

576
00:21:58,630 --> 00:21:56,400
actually determine that our universe

577
00:22:01,029 --> 00:21:58,640
is not only expanding but accelerating

578
00:22:03,750 --> 00:22:01,039
and we're using these telescopes to

579
00:22:05,830 --> 00:22:03,760
get a more precise measurement of that

580
00:22:07,830 --> 00:22:05,840
rate of expansion of the universe now

581
00:22:10,070 --> 00:22:07,840
and the history of that expansion over

582
00:22:12,470 --> 00:22:10,080
time we don't yet know exactly what dark

583
00:22:14,870 --> 00:22:12,480
energy is but hubble is giving us a lot

584
00:22:17,350 --> 00:22:14,880
new a lot of new information to help us

585
00:22:18,950 --> 00:22:17,360
find out

586
00:22:20,870 --> 00:22:18,960
great thanks jennifer

587
00:22:24,149 --> 00:22:20,880
okay one other question we have so are

588
00:22:25,830 --> 00:22:24,159

these actually photos taken by hubble as

589
00:22:28,070 --> 00:22:25,840
it is or is it like a reconstruction of

590
00:22:29,270 --> 00:22:28,080
raw images so maybe if someone wants to

591
00:22:30,870 --> 00:22:29,280
talk about

592
00:22:34,230 --> 00:22:30,880
how we get the hubble images that we see

593
00:22:38,630 --> 00:22:36,630
let's see

594
00:22:40,630 --> 00:22:38,640
all right

595
00:22:42,710 --> 00:22:40,640
sounds good i can take that

596
00:22:45,190 --> 00:22:42,720
i uh so

597
00:22:47,430 --> 00:22:45,200
humble takes images in black and white

598
00:22:49,990 --> 00:22:47,440
actually through different filters so it

599
00:22:51,590 --> 00:22:50,000
uses filters to isolate the type of

600
00:22:54,310 --> 00:22:51,600
wavelength that astronomers want to

601
00:22:55,990 --> 00:22:54,320
observe so hubble's images actually come

602
00:22:58,470 --> 00:22:56,000
down black and white and to get color

603
00:23:01,750 --> 00:22:58,480
images we have to take multiple uh

604
00:23:05,110 --> 00:23:01,760
images exposures in multiple filters

605
00:23:07,510 --> 00:23:05,120
so we put those multiple filter images

606
00:23:10,870 --> 00:23:07,520
together to create these beautiful color

607
00:23:13,510 --> 00:23:10,880
images that you see and uh yes and we do

608
00:23:17,270 --> 00:23:13,520
additional processing uh sometimes um

609
00:23:20,070 --> 00:23:17,280
hubble takes uh multiple images of an

610
00:23:22,149 --> 00:23:20,080
object uh because maybe the object is

611
00:23:24,549 --> 00:23:22,159
too large to fit in the field of view so

612
00:23:26,470 --> 00:23:24,559
we have to take multiple images to

613
00:23:28,950 --> 00:23:26,480

to get the whole object or to get more

614
00:23:30,789 --> 00:23:28,960
of the object of interest and so we have

615
00:23:32,390 --> 00:23:30,799
to mosaic those images together as well

616
00:23:33,830 --> 00:23:32,400
so there is some processing that goes on

617
00:23:34,870 --> 00:23:33,840
yes

618
00:23:36,789 --> 00:23:34,880
gotcha

619
00:23:38,710 --> 00:23:36,799
thanks vanessa awesome okay so on

620
00:23:41,190 --> 00:23:38,720
facebook it sounds like we have someone

621
00:23:43,110 --> 00:23:41,200
who is a beginner amateur astronomer

622
00:23:47,190 --> 00:23:43,120
looking for some tips so kevin do you

623
00:23:52,950 --> 00:23:50,390
well um my best tip for folks that are

624
00:23:55,029 --> 00:23:52,960
getting into astronomy is to find a

625
00:23:57,830 --> 00:23:55,039
friend to do it with now one has to be

626
00:24:00,470 --> 00:23:57,840
careful these days because of covid of

627
00:24:01,750 --> 00:24:00,480
course uh to be in a group doing this

628
00:24:04,549 --> 00:24:01,760
but there are

629
00:24:06,310 --> 00:24:04,559
clubs many clubs out there for

630
00:24:11,750 --> 00:24:06,320
astronomer

631
00:24:14,310 --> 00:24:11,760
if you join a club which meet virtually

632
00:24:17,110 --> 00:24:14,320
now you can learn a lot about different

633
00:24:19,590 --> 00:24:17,120
types of telescopes

634
00:24:22,230 --> 00:24:19,600
different tricks to observe

635
00:24:23,909 --> 00:24:22,240
and it's all very helpful

636
00:24:24,870 --> 00:24:23,919
rather than trying to do it alone so

637
00:24:26,950 --> 00:24:24,880
that's

638
00:24:27,909 --> 00:24:26,960

really perhaps the best tip that i can

639
00:24:30,149 --> 00:24:27,919
give you

640
00:24:32,310 --> 00:24:30,159
don't do it by yourself or if you feel

641
00:24:33,750 --> 00:24:32,320
like you have to because of covid take

642
00:24:35,990 --> 00:24:33,760
advantage of

643
00:24:38,149 --> 00:24:36,000
online meetings or

644
00:24:39,669 --> 00:24:38,159
youtube videos there's lots of them out

645
00:24:43,029 --> 00:24:39,679
there that describe

646
00:24:45,110 --> 00:24:43,039
uh telescopes or binoculars and how to

647
00:24:48,390 --> 00:24:45,120
use them uh there's a wealth of

648
00:24:50,230 --> 00:24:48,400
information online these days

649
00:24:52,310 --> 00:24:50,240
great thank you kevin all right i think

650
00:24:55,909 --> 00:24:52,320
we're just gonna do one more uh from

651
00:24:57,590 --> 00:24:55,919
facebook how far away is hubble from us

652
00:25:01,590 --> 00:24:57,600
so

653
00:25:04,549 --> 00:25:01,600
anyone want to take that one on

654
00:25:06,789 --> 00:25:04,559
uh i can i can take a jump at it but uh

655
00:25:09,029 --> 00:25:06,799
it's about 300 and

656
00:25:12,310 --> 00:25:09,039
it varies actually but varies between

657
00:25:15,190 --> 00:25:12,320
about 340 and 360 miles above the

658
00:25:18,149 --> 00:25:15,200
surface of the earth over the years of

659
00:25:20,230 --> 00:25:18,159
its mission it's not that far away from

660
00:25:23,590 --> 00:25:20,240
the surface of the earth it's it's in

661
00:25:25,510 --> 00:25:23,600
low earth orbit again not to get it a

662
00:25:27,669 --> 00:25:25,520
lot closer to the things that we're

663
00:25:29,750 --> 00:25:27,679

trying to observe with hubble but to

664
00:25:31,909 --> 00:25:29,760
simply get it above

665
00:25:34,310 --> 00:25:31,919
much of the earth's atmosphere so that

666
00:25:35,350 --> 00:25:34,320
we don't have to look through

667
00:25:40,710 --> 00:25:35,360
that

668
00:25:42,789 --> 00:25:40,720
look at

669
00:25:44,549 --> 00:25:42,799
and also the atmosphere of the earth

670
00:25:46,470 --> 00:25:44,559
actually filters out some of the light

671
00:25:48,149 --> 00:25:46,480
that we want to capture with hubble like

672
00:25:50,549 --> 00:25:48,159
ultraviolet light

673
00:25:52,230 --> 00:25:50,559
so it's not very far up it was deployed

674
00:25:54,310 --> 00:25:52,240
there also because that's where the

675
00:25:56,310 --> 00:25:54,320
space shuttle could go and we wanted to

676
00:25:58,710 --> 00:25:56,320
use the space shuttle to take the the

677
00:26:00,870 --> 00:25:58,720
hubble up into orbit and to return to

678
00:26:02,470 --> 00:26:00,880
visit it several times

679
00:26:04,630 --> 00:26:02,480
you should note however that a lot of

680
00:26:06,870 --> 00:26:04,640
telescopes now in space and there are

681
00:26:09,110 --> 00:26:06,880
other space telescopes uh

682
00:26:10,950 --> 00:26:09,120
now and also in the future

683
00:26:12,710 --> 00:26:10,960
are not being put in low earth orbit

684
00:26:13,669 --> 00:26:12,720
some of them are being put much farther

685
00:26:15,990 --> 00:26:13,679
away

686
00:26:18,070 --> 00:26:16,000
the james webb space telescope to be

687
00:26:19,269 --> 00:26:18,080
launched next year the latter part of

688
00:26:21,510 --> 00:26:19,279

next year

689
00:26:23,110 --> 00:26:21,520
will be a million miles away at a place

690
00:26:25,750 --> 00:26:23,120
in space called

691
00:26:27,669 --> 00:26:25,760
l2 that that is quite

692
00:26:30,630 --> 00:26:27,679
far away we want to keep the webb

693
00:26:33,669 --> 00:26:30,640
telescope very cold we want those sun

694
00:26:35,990 --> 00:26:33,679
shields that you see in the image there

695
00:26:37,110 --> 00:26:36,000
protecting the telescope from sunlight

696
00:26:38,710 --> 00:26:37,120
and heat

697
00:26:40,789 --> 00:26:38,720
to be effective

698
00:26:43,190 --> 00:26:40,799
and we want to be able to have the most

699
00:26:45,190 --> 00:26:43,200
sensitive infrared observations possible

700
00:26:47,190 --> 00:26:45,200
so that's why the webb telescope will be

701
00:26:49,110 --> 00:26:47,200
put much farther away

702
00:26:51,830 --> 00:26:49,120
from earth than hubble

703
00:26:55,430 --> 00:26:53,750
absolutely i think we do have time for

704
00:26:57,669 --> 00:26:55,440
one more question and maybe michelle can

705
00:27:00,149 --> 00:26:57,679
take this one uh speaking of james webb

706
00:27:02,149 --> 00:27:00,159
which is coming next year um

707
00:27:03,909 --> 00:27:02,159
is hubble getting upgraded after james

708
00:27:07,269 --> 00:27:03,919
webb or what are we looking at with the

709
00:27:09,190 --> 00:27:07,279
future of our space telescopes

710
00:27:10,950 --> 00:27:09,200
well you know right now uh there is

711
00:27:13,190 --> 00:27:10,960
actually no plans to visit hubble with

712
00:27:14,630 --> 00:27:13,200
the astronauts again and and part of

713
00:27:16,470 --> 00:27:14,640

that is because we don't have the space

714
00:27:18,389 --> 00:27:16,480
shuttle so hubble is not actually in the

715
00:27:19,669 --> 00:27:18,399
correct orbit uh you know the space

716
00:27:22,310 --> 00:27:19,679
station for example is in a very

717
00:27:24,470 --> 00:27:22,320
different orbit than hubble so uh we

718
00:27:26,870 --> 00:27:24,480
hope that hubble keeps working as well

719
00:27:29,269 --> 00:27:26,880
as it is now maybe even for a decade the

720
00:27:31,190 --> 00:27:29,279
last mission that went up there in 2009

721
00:27:32,389 --> 00:27:31,200
replaced a number of the the cameras so

722
00:27:34,230 --> 00:27:32,399
the cameras are actually much younger

723
00:27:35,830 --> 00:27:34,240
than 30 years uh just a little bit more

724
00:27:37,430 --> 00:27:35,840
than 10 years old and they also did

725
00:27:38,870 --> 00:27:37,440
things like replace gyroscopes so that

726
00:27:40,470 --> 00:27:38,880
the telescope would be able to point

727
00:27:41,909 --> 00:27:40,480
itself very well

728
00:27:43,350 --> 00:27:41,919
so you know some of the things that i'm

729
00:27:44,870 --> 00:27:43,360
really excited about as far as what

730
00:27:47,110 --> 00:27:44,880
we're doing in the future hubble we're

731
00:27:49,269 --> 00:27:47,120
working on for example catalogs that

732
00:27:51,990 --> 00:27:49,279
astronomers all around the world can use

733
00:27:53,669 --> 00:27:52,000
catalogs of of say star regions where

734
00:27:54,710 --> 00:27:53,679
where young stars are being formed right

735
00:27:55,909 --> 00:27:54,720
now

736
00:27:58,070 --> 00:27:55,919
another thing that we're doing that i'm

737
00:27:59,830 --> 00:27:58,080
very excited about is uh monitoring the

738
00:28:01,510 --> 00:27:59,840

atmospheres of planets like jupiter and

739
00:28:02,870 --> 00:28:01,520
saturn so a lot of people have heard

740
00:28:04,549 --> 00:28:02,880
that the red spot of jupiter is

741
00:28:06,950 --> 00:28:04,559
shrinking it's actually changing color

742
00:28:09,110 --> 00:28:06,960
as well so hubble will be doing that too

743
00:28:10,789 --> 00:28:09,120
so so hubble has a huge future ahead of

744
00:28:12,950 --> 00:28:10,799
it and although we're not expecting to

745
00:28:14,710 --> 00:28:12,960
actually upgrade it at this point it's

746
00:28:17,029 --> 00:28:14,720
still going to be this incredibly

747
00:28:19,029 --> 00:28:17,039
relevant and wonderful observatory and

748
00:28:20,950 --> 00:28:19,039
uh when the james webb space telescope

749
00:28:22,710 --> 00:28:20,960
is launched later next year the two

750
00:28:25,029 --> 00:28:22,720
observatories we hope will be able to

751
00:28:26,630 --> 00:28:25,039
work in conjunction to some degree and

752
00:28:28,389 --> 00:28:26,640
this will allow us to do something

753
00:28:30,070 --> 00:28:28,399
called calibration where we make sure

754
00:28:32,230 --> 00:28:30,080
that one telescope is agreeing with the

755
00:28:33,830 --> 00:28:32,240
other telescope we can make our our

756
00:28:36,070 --> 00:28:33,840
images and our measurements as accurate

757
00:28:37,350 --> 00:28:36,080
as they can possibly be so that's that's

758
00:28:39,590 --> 00:28:37,360
something i'm looking forward to next

759
00:28:41,350 --> 00:28:39,600
year it's going to be a big event

760
00:28:42,630 --> 00:28:41,360
yeah it's going to be awesome

761
00:28:44,710 --> 00:28:42,640
well thank you all for sending in these

762
00:28:46,230 --> 00:28:44,720
questions unfortunately we're going to

763
00:28:47,430 --> 00:28:46,240

have to wrap things up for today but if

764
00:28:49,110 --> 00:28:47,440
we didn't get to your question here

765
00:28:51,350 --> 00:28:49,120
we'll try to answer it later on social

766
00:28:52,789 --> 00:28:51,360
media thank you for joining us we love

767
00:28:54,470 --> 00:28:52,799
sharing these newly released hubble

768
00:28:56,549 --> 00:28:54,480
images of objects from the caldwell

769
00:28:58,470 --> 00:28:56,559
catalog with you all the images we

770
00:29:01,510 --> 00:28:58,480
talked about and many more can be found

771
00:29:03,510 --> 00:29:01,520
online at nasa.gov hubble there you can

772
00:29:05,110 --> 00:29:03,520
also find more hubble content and fun

773
00:29:07,430 --> 00:29:05,120
online activities you can do with your

774
00:29:09,590 --> 00:29:07,440
family or on your own be sure to keep up

775
00:29:12,389 --> 00:29:09,600
with us on social media at nasa hubble

776
00:29:13,990 --> 00:29:12,399
on twitter facebook instagram and flickr