1
00:00:29,669 --> 00:00:27,429
california this is nasa's launch

2
00:00:32,229 --> 00:00:29,679
coverage of the double asteroid

3
00:00:34,310 --> 00:00:32,239
redirection test

4
00:00:37,910 --> 00:00:34,320
in a galaxy where asteroids have

5
00:00:40,180 --> 00:00:37,920
pummeled planets for billions of years

6
00:00:41,350 --> 00:00:40,190
now one planet strikes back

7
00:00:43,190 --> 00:00:41,360
[Music]

8
00:00:45,830 --> 00:00:43,200
for the first time in our planet's

9
00:00:48,790 --> 00:00:45,840
history nasa will test an asteroid

10
00:00:51,110 --> 00:00:48,800
deflection technique

11
00:00:54,310 --> 00:00:51,120
it's the first planetary defense method

12
00:00:59,670 --> 00:00:57,350
nasa's double asteroid redirection test

13
00:01:00,869 --> 00:00:59,680

will intentionally ram itself into an

14
00:01:03,990 --> 00:01:00,879
asteroid

15
00:01:06,390 --> 00:01:04,000
and alter its orbit forever

16
00:01:07,910 --> 00:01:06,400
at the crossroads of science fiction and

17
00:01:10,149 --> 00:01:07,920
reality

18
00:01:12,550 --> 00:01:10,159
dart is part of our plan to defend

19
00:01:13,670 --> 00:01:12,560
planet earth against potential future

20
00:01:15,670 --> 00:01:13,680
impacts

21
00:01:17,429 --> 00:01:15,680
the test to protect the future of our

22
00:01:19,910 --> 00:01:17,439
planet

23
00:01:22,310 --> 00:01:19,920
begins now

24
00:01:25,429 --> 00:01:22,320
our this spacex rocket will launch the

25
00:01:27,830 --> 00:01:25,439
dart spacecraft on a 6 million

26
00:01:29,990 --> 00:01:27,840
and thank you for joining us here inside

27
00:01:31,830 --> 00:01:30,000
the nasa hangar at the vandenberg space

28
00:01:34,230 --> 00:01:31,840
force base on the central coast of

29
00:01:36,630 --> 00:01:34,240
california i'm your host daryl nail and

30
00:01:38,870 --> 00:01:36,640
joining me is kelly fast she is a

31
00:01:41,350 --> 00:01:38,880
program scientist with the planetary

32
00:01:42,870 --> 00:01:41,360
defense coordination office welcome

33
00:01:45,030 --> 00:01:42,880
kelly it's great to have you here thank

34
00:01:47,670 --> 00:01:45,040
you daryl it's fabulous to be here uh

35
00:01:49,670 --> 00:01:47,680
helping to cheer dart off the planet now

36
00:01:51,990 --> 00:01:49,680
right at the top let's talk about this

37
00:01:53,510 --> 00:01:52,000
are there any asteroids threatening

38
00:01:55,990 --> 00:01:53,520

earth that we know of

39
00:01:58,069 --> 00:01:56,000
now thankfully there are no known um

40
00:01:59,910 --> 00:01:58,079
asteroid impact threats to earth you

41
00:02:01,510 --> 00:01:59,920
keep tracking them we don't know of any

42
00:02:02,789 --> 00:02:01,520
it's the one that's that we don't know

43
00:02:04,230 --> 00:02:02,799
about that we're concerned about but

44
00:02:06,149 --> 00:02:04,240
that's why nasa

45
00:02:08,710 --> 00:02:06,159
surveys renew and this asteroid dart is

46
00:02:11,270 --> 00:02:08,720
going to hit what's the story there

47
00:02:13,190 --> 00:02:11,280
well the asteroid dynamos does not pose

48
00:02:15,270 --> 00:02:13,200
an impact threat to earth it keeps its

49
00:02:18,390 --> 00:02:15,280
distance stays like it gets no closer

50
00:02:20,470 --> 00:02:18,400
than 3.7 million miles to earth's orbit

51
00:02:23,830 --> 00:02:20,480
but that's what makes it a fabulous uh

52
00:02:26,869 --> 00:02:23,840
test uh situation for dart we can go

53
00:02:29,510 --> 00:02:26,879
safely test and impact uh the kinetic

54
00:02:31,350 --> 00:02:29,520
impact technique uh in indimos is the

55
00:02:33,670 --> 00:02:31,360
perfect laboratory for that okay and

56
00:02:34,470 --> 00:02:33,680
this spacecraft is is this something

57
00:02:36,470 --> 00:02:34,480
that

58
00:02:38,070 --> 00:02:36,480
could one day save the planet

59
00:02:40,229 --> 00:02:38,080
well what's nice about this i mean it's

60
00:02:42,070 --> 00:02:40,239
a nice mature technique kinetic impact

61
00:02:43,910 --> 00:02:42,080
you just impact something but now we're

62
00:02:44,949 --> 00:02:43,920
actually going to test it so this is

63
00:02:46,630 --> 00:02:44,959

going to be really good to have

64
00:02:49,110 --> 00:02:46,640
something in the toolbox that we've

65
00:02:50,390 --> 00:02:49,120
actually tried taking it from modeling

66
00:02:52,949 --> 00:02:50,400
to an actual

67
00:02:54,869 --> 00:02:52,959
test well it is certainly exciting just

68
00:02:57,750 --> 00:02:54,879
to hear you talk about it and when that

69
00:02:59,350 --> 00:02:57,760
moment happens in the fall of 2022 when

70
00:03:01,190 --> 00:02:59,360
that impact happens that's going to be

71
00:03:02,869 --> 00:03:01,200
quite a moment it's going to be amazing

72
00:03:04,710 --> 00:03:02,879
all right kelly thank you so much and

73
00:03:07,350 --> 00:03:04,720
there's so much more to discuss about

74
00:03:09,430 --> 00:03:07,360
android's planetary defense and the dart

75
00:03:13,110 --> 00:03:09,440
mission so let's get right into it with

76
00:03:15,070 --> 00:03:13,120
a quick breakdown of the dart spacecraft

77
00:03:18,710 --> 00:03:15,080
dart has a mass of

78
00:03:20,949 --> 00:03:18,720
670 kilograms about a golf cart size or

79
00:03:23,589 --> 00:03:20,959
vending machine size

80
00:03:26,630 --> 00:03:23,599
machine it uses hydrazine thrusters for

81
00:03:28,390 --> 00:03:26,640
propulsion and roll out solar arrays for

82
00:03:30,949 --> 00:03:28,400
electric power

83
00:03:32,710 --> 00:03:30,959
now dart has just one instrument on

84
00:03:34,869 --> 00:03:32,720
board and there it is at the bottom and

85
00:03:37,270 --> 00:03:34,879
that instrument is a draco camera which

86
00:03:40,229 --> 00:03:37,280
will feed images to an autonomous

87
00:03:43,030 --> 00:03:40,239
navigation system steering its smack dab

88
00:03:45,670 --> 00:03:43,040

into an asteroid now here's how dark got

89
00:03:48,309 --> 00:03:45,680
here it was pulled by this semi truck 2

90
00:03:50,869 --> 00:03:48,319
900 miles across the country from the

91
00:03:53,429 --> 00:03:50,879
applied physics lab in maryland all the

92
00:03:55,670 --> 00:03:53,439
way here to the vandenberg space force

93
00:03:57,670 --> 00:03:55,680
base it took the team 46 hours to make

94
00:03:59,429 --> 00:03:57,680
the trip you see that box right there

95
00:04:01,429 --> 00:03:59,439
that's the protective container that was

96
00:04:03,830 --> 00:04:01,439
removed and is being stored here in the

97
00:04:05,509 --> 00:04:03,840
nasa hangar while this dart spacecraft

98
00:04:07,030 --> 00:04:05,519
was carefully prepared for the launch

99
00:04:09,030 --> 00:04:07,040
and then put into that protective

100
00:04:12,070 --> 00:04:09,040
fairing what a beautiful shot that is

101
00:04:14,070 --> 00:04:12,080
kelly and then earlier this month

102
00:04:16,390 --> 00:04:14,080
engineers made it the dart spacecraft

103
00:04:18,629 --> 00:04:16,400
inside its protective fairing to this

104
00:04:21,030 --> 00:04:18,639
spacex falcon 9 rocket which you see

105
00:04:22,950 --> 00:04:21,040
here and darts at the top of the rocket

106
00:04:25,909 --> 00:04:22,960
it was then rolled out to the launch pad

107
00:04:28,790 --> 00:04:25,919
at space launch complex 4 east where it

108
00:04:33,749 --> 00:04:28,800
is now awaiting liftoff at 10 21 p.m

109
00:04:35,830 --> 00:04:33,759
pacific 1 21 a.m eastern time now as we

110
00:04:37,830 --> 00:04:35,840
follow pre-launch operations we also

111
00:04:38,710 --> 00:04:37,840
have some cool stuff to show you along

112
00:04:40,550 --> 00:04:38,720
the way

113
00:04:42,710 --> 00:04:40,560

our own kelly fast we'll give a fun

114
00:04:45,110 --> 00:04:42,720
demonstration there she is she's going

115
00:04:47,909 --> 00:04:45,120
to help us visualize a close approach

116
00:04:49,590 --> 00:04:47,919
asteroid and she's moving quick

117
00:04:51,189 --> 00:04:49,600
we'll also head into space where two

118
00:04:53,830 --> 00:04:51,199
astronauts will demonstrate in

119
00:04:56,950 --> 00:04:53,840
microgravity the kinetic impact

120
00:04:59,110 --> 00:04:56,960
technique that dart will be using

121
00:05:01,909 --> 00:04:59,120
and also this is kind of fun we'll hear

122
00:05:03,909 --> 00:05:01,919
from a hollywood director adam mckay

123
00:05:06,310 --> 00:05:03,919
about his new science fiction comedy

124
00:05:09,510 --> 00:05:06,320
don't look up it's about an earth-ending

125
00:05:11,590 --> 00:05:09,520
comet that he'll compare with reality

126
00:05:14,150 --> 00:05:11,600
check on launch operations and introduce

127
00:05:16,550 --> 00:05:14,160
our launch commentators for today nasa's

128
00:05:18,710 --> 00:05:16,560
marie lewis and denton gibson marie

129
00:05:21,270 --> 00:05:18,720
preparations have been going on for many

130
00:05:23,110 --> 00:05:21,280
hours where do we stand right now

131
00:05:25,110 --> 00:05:23,120
uh well at the moment daryl everything

132
00:05:26,870 --> 00:05:25,120
is still go for lawn shaw we listened to

133
00:05:28,469 --> 00:05:26,880
polls just a few minutes ago internally

134
00:05:29,909 --> 00:05:28,479
with the spacecraft team and nasa

135
00:05:32,070 --> 00:05:29,919
engineering

136
00:05:34,390 --> 00:05:32,080
no red flags everything looking right on

137
00:05:37,189 --> 00:05:34,400
course i want to introduce

138
00:05:39,270 --> 00:05:37,199

our commentator who's making his debut

139
00:05:41,110 --> 00:05:39,280
uh launch commentary tonight denton

140
00:05:43,270 --> 00:05:41,120
gibson with the launch services program

141
00:05:46,070 --> 00:05:43,280
your mission manager no stranger

142
00:05:47,749 --> 00:05:46,080
certainly to falcon 9 and uh missions

143
00:05:49,590 --> 00:05:47,759
like this but this is your first time in

144
00:05:50,790 --> 00:05:49,600
the commentary booth so welcome oh thank

145
00:05:52,310 --> 00:05:50,800
you thank you thanks for having me i'm

146
00:05:54,550 --> 00:05:52,320
excited to be here it's launch day so

147
00:05:57,029 --> 00:05:54,560
i'm looking forward to this and the

148
00:05:59,189 --> 00:05:57,039
teams on console have been uh going

149
00:06:01,029 --> 00:05:59,199
through their steps methodically uh

150
00:06:02,790 --> 00:06:01,039
since a little before seven o'clock this

151
00:06:05,830 --> 00:06:02,800
evening pacific time

152
00:06:07,990 --> 00:06:05,840
there is a live view of the face and in

153
00:06:10,870 --> 00:06:08,000
less than a minute we expect to hear the

154
00:06:13,670 --> 00:06:10,880
nasa launch manager omar baez uh poll

155
00:06:15,830 --> 00:06:13,680
the nasa team uh for launch readiness

156
00:06:17,830 --> 00:06:15,840
and uh readiness for propellant load to

157
00:06:20,870 --> 00:06:17,840
go ahead and proceed with that uh if

158
00:06:23,430 --> 00:06:20,880
that that is all go that will begin at t

159
00:06:25,350 --> 00:06:23,440
minus 35 minutes right and the reason

160
00:06:27,670 --> 00:06:25,360
why you hear this poll at this point in

161
00:06:29,110 --> 00:06:27,680
time because there's so much going on

162
00:06:31,350 --> 00:06:29,120
much later

163
00:06:33,189 --> 00:06:31,360

in the the process

164
00:06:35,029 --> 00:06:33,199
so they try to have it have the poll

165
00:06:36,469 --> 00:06:35,039
early so that way the team can focus on

166
00:06:38,550 --> 00:06:36,479
the telemetry and focus on the data

167
00:06:40,070 --> 00:06:38,560
coming from the rocket and really pay

168
00:06:43,749 --> 00:06:40,080
attention everything that's going on

169
00:06:49,110 --> 00:06:48,390
and we're just standing by for that nasa

170
00:06:51,350 --> 00:06:49,120
our

171
00:06:52,870 --> 00:06:51,360
propellant loading uh poll starting with

172
00:06:55,909 --> 00:06:52,880
nasa ce

173
00:07:00,550 --> 00:06:55,919
sma

174
00:07:02,629 --> 00:07:00,560
smd is go

175
00:07:04,469 --> 00:07:02,639
nasa mission manager

176
00:07:05,749 --> 00:07:04,479
nasa mim is go

177
00:07:09,990 --> 00:07:05,759
lsp

178
00:07:11,510 --> 00:07:10,000
cryo tank

179
00:07:13,110 --> 00:07:11,520
nasa teams to make sure that they're

180
00:07:15,110 --> 00:07:13,120
ready to go uh to proceed with

181
00:07:16,790 --> 00:07:15,120
propellant loading and launch that's the

182
00:07:17,990 --> 00:07:16,800
various teams that you heard the nasa

183
00:07:19,270 --> 00:07:18,000
launch management pulled in to make sure

184
00:07:20,070 --> 00:07:19,280
that they're ready to proceed with the

185
00:07:21,589 --> 00:07:20,080
count

186
00:07:23,749 --> 00:07:21,599
one thing i want to point out as we look

187
00:07:26,629 --> 00:07:23,759
at the rocket live on the pad on an

188
00:07:28,230 --> 00:07:26,639

unusually clear night here at vandenberg

189
00:07:30,150 --> 00:07:28,240
is the soot on the side of the rocket

190
00:07:32,230 --> 00:07:30,160
and that is because this booster has

191
00:07:33,749 --> 00:07:32,240
already been flown twice in fact but

192
00:07:35,510 --> 00:07:33,759
this is the first time for a launch

193
00:07:37,189 --> 00:07:35,520
services program mission that's correct

194
00:07:38,390 --> 00:07:37,199
we've done a lot of work getting to this

195
00:07:40,070 --> 00:07:38,400
point where

196
00:07:41,430 --> 00:07:40,080
we've we've comfortable where we are

197
00:07:43,589 --> 00:07:41,440
with this and we're looking forward to

198
00:07:44,869 --> 00:07:43,599
this launch and this is we have very a

199
00:07:45,990 --> 00:07:44,879
lot of familiarity with this booster

200
00:07:47,589 --> 00:07:46,000
because we actually launched this the

201
00:07:49,589 --> 00:07:47,599
first for the first time on sentinel 6

202
00:07:51,589 --> 00:07:49,599
almost a year ago today yeah so

203
00:07:53,749 --> 00:07:51,599
interplanetary mission so really

204
00:07:55,749 --> 00:07:53,759
exciting stuff coming up uh by the way

205
00:07:57,749 --> 00:07:55,759
weather is 90 to you all right thank you

206
00:07:59,909 --> 00:07:57,759
marie and denton and so that's a great

207
00:08:01,830 --> 00:07:59,919
report they're fueling up the rocket

208
00:08:03,749 --> 00:08:01,840
kelly it's getting kind of exciting i'm

209
00:08:05,270 --> 00:08:03,759
really relieved to hear that report that

210
00:08:06,950 --> 00:08:05,280
uh that looks like things are going to

211
00:08:08,309 --> 00:08:06,960
go and i think of the dart team i mean

212
00:08:09,029 --> 00:08:08,319
they've been working on this for years

213
00:08:10,869 --> 00:08:09,039

but

214
00:08:12,790 --> 00:08:10,879
they've brought a spacecraft to the

215
00:08:14,309 --> 00:08:12,800
launch pad through a pandemic and so

216
00:08:15,990 --> 00:08:14,319
they really need to be commanded that's

217
00:08:17,990 --> 00:08:16,000
great point and you are right about that

218
00:08:20,230 --> 00:08:18,000
astronomers now all over the world

219
00:08:23,029 --> 00:08:20,240
what's interesting to me about this is

220
00:08:25,510 --> 00:08:23,039
after this impact happens they'll be

221
00:08:27,189 --> 00:08:25,520
able to see some kind of change right

222
00:08:30,150 --> 00:08:27,199
it's a unique mission in that there's an

223
00:08:33,430 --> 00:08:30,160
astronomical component to it when dart

224
00:08:36,310 --> 00:08:33,440
impacts uh the moon of dytamos dimorphos

225
00:08:39,190 --> 00:08:36,320
in fall of 2022 it will change the

226
00:08:41,509 --> 00:08:39,200
orbital period of that little moonlit uh

227
00:08:43,350 --> 00:08:41,519
but from the earth it's just a uh a

228
00:08:45,350 --> 00:08:43,360
point of light but that point of light

229
00:08:48,070 --> 00:08:45,360
varies in brightness because that

230
00:08:50,470 --> 00:08:48,080
moonlit travels in front of and behind

231
00:08:52,630 --> 00:08:50,480
dynamos and so that can be measured and

232
00:08:54,070 --> 00:08:52,640
that rate of that light going up and

233
00:08:56,310 --> 00:08:54,080
down is what they're going to measure

234
00:08:58,710 --> 00:08:56,320
the change in that and that's how we're

235
00:09:00,710 --> 00:08:58,720
going to see exactly what dart did to

236
00:09:02,389 --> 00:09:00,720
dimorphose that's fascinating to me

237
00:09:04,070 --> 00:09:02,399
because it's literally just light you're

238
00:09:06,150 --> 00:09:04,080

looking at we've never seen this little

239
00:09:08,070 --> 00:09:06,160
moonlit but we see the light and that's

240
00:09:09,990 --> 00:09:08,080
how we gauge it more stuff to come from

241
00:09:12,949 --> 00:09:10,000
kelly thank you very much we are t minus

242
00:09:14,790 --> 00:09:12,959
41 minutes and counting here now is

243
00:09:18,070 --> 00:09:14,800
everything you need to know about the

244
00:09:22,470 --> 00:09:19,750
dart stands for the double asteroid

245
00:09:25,829 --> 00:09:22,480
redirection test and the dark mission is

246
00:09:30,070 --> 00:09:25,839
to basically go hit an asteroid and see

247
00:09:35,030 --> 00:09:33,190
earth is surrounded by small objects

248
00:09:36,870 --> 00:09:35,040
called near-earth asteroids and some of

249
00:09:39,110 --> 00:09:36,880
them are potentially hazardous so

250
00:09:41,750 --> 00:09:39,120
planetary defense is cataloging figuring

251
00:09:43,590 --> 00:09:41,760
out where all these objects are but also

252
00:09:46,230 --> 00:09:43,600
trying to prevent them from hitting the

253
00:09:50,230 --> 00:09:48,470
so far we've only been able to predict

254
00:09:51,990 --> 00:09:50,240
the impact of two or three objects ahead

255
00:09:53,110 --> 00:09:52,000
of time those objects were small enough

256
00:09:55,269 --> 00:09:53,120
they burned up in the atmosphere and

257
00:09:57,030 --> 00:09:55,279
they were no danger to anyone but what

258
00:09:58,470 --> 00:09:57,040
happens when an asteroid or any object

259
00:09:59,990 --> 00:09:58,480
is going to impact

260
00:10:01,030 --> 00:10:00,000
the earth is that the earth and that

261
00:10:02,470 --> 00:10:01,040
object

262
00:10:03,750 --> 00:10:02,480
want to be at the same place at the same

263
00:10:06,389 --> 00:10:03,760

time we can't change the speed of the

264
00:10:09,110 --> 00:10:06,399
earth so the idea would be to change the

265
00:10:11,590 --> 00:10:09,120
speed of the impactor

266
00:10:14,790 --> 00:10:11,600
now we chose to do this demonstration at

267
00:10:17,350 --> 00:10:14,800
a binary asteroid the main asteroid is

268
00:10:20,310 --> 00:10:17,360
called dynamos and its moon

269
00:10:23,350 --> 00:10:20,320
dart is actually targeted to the moon

270
00:10:25,509 --> 00:10:23,360
of the digimon system and

271
00:10:27,350 --> 00:10:25,519
that's much smaller target than any

272
00:10:28,389 --> 00:10:27,360
spacecraft has ever managed to hit

273
00:10:30,150 --> 00:10:28,399
before

274
00:10:32,710 --> 00:10:30,160
this is the first mission to fly the

275
00:10:34,790 --> 00:10:32,720
next sea there's the rosa the solar rays

276
00:10:37,350 --> 00:10:34,800
have an italian cubesat but it's really

277
00:10:39,509 --> 00:10:37,360
all about smart navigation

278
00:10:42,630 --> 00:10:39,519
the dart starts out with the traditional

279
00:10:45,430 --> 00:10:42,640
mission design concepts where we use

280
00:10:47,430 --> 00:10:45,440
star trackers and optical navigation

281
00:10:49,110 --> 00:10:47,440
this will be the first time that the

282
00:10:52,470 --> 00:10:49,120
spacecraft will

283
00:10:55,030 --> 00:10:52,480
autonomously guide to a target

284
00:10:57,509 --> 00:10:55,040
the narrow angle camera will be used by

285
00:10:59,910 --> 00:10:57,519
the spacecraft to home in on the target

286
00:11:01,430 --> 00:10:59,920
and hit it and then the cubesat will fly

287
00:11:03,670 --> 00:11:01,440
past the target

288
00:11:05,750 --> 00:11:03,680

and it will return the data directly to

289
00:11:07,350 --> 00:11:05,760
earth on its own

290
00:11:08,870 --> 00:11:07,360
the tough part about it is that we're

291
00:11:10,790 --> 00:11:08,880
guiding ourselves

292
00:11:13,190 --> 00:11:10,800
into the asteroid we're taking pictures

293
00:11:14,389 --> 00:11:13,200
and we're sending data back all at the

294
00:11:16,550 --> 00:11:14,399
same time

295
00:11:18,069 --> 00:11:16,560
you know dynamo is a system that is

296
00:11:20,150 --> 00:11:18,079
tightly locked together so we're going

297
00:11:22,150 --> 00:11:20,160
to try to push on the little move and

298
00:11:24,230 --> 00:11:22,160
try to push it away in such a way that

299
00:11:25,780 --> 00:11:24,240
it will change the orbit of the asteroid

300
00:11:27,430 --> 00:11:25,790
and it will move it

301
00:11:28,630 --> 00:11:27,440
[Music]

302
00:11:29,910 --> 00:11:28,640
mostly what we're looking to do is

303
00:11:32,630 --> 00:11:29,920
change the

304
00:11:34,630 --> 00:11:32,640
speed of the incoming object by maybe a

305
00:11:36,389 --> 00:11:34,640
centimeter per second that's not very

306
00:11:38,550 --> 00:11:36,399
fast but if you do it enough seconds in

307
00:11:39,540 --> 00:11:38,560
advance you can cause it to miss the

308
00:11:40,949 --> 00:11:39,550
earth entirely

309
00:11:42,870 --> 00:11:40,959
[Music]

310
00:11:44,710 --> 00:11:42,880
dart is actually the first planetary

311
00:11:47,990 --> 00:11:44,720
defense mission this is a continuing

312
00:11:49,910 --> 00:11:48,000
series of missions for planetary defense

313
00:11:52,790 --> 00:11:49,920

we have this unique opportunity to

314
00:11:54,389 --> 00:11:52,800
demonstrate the method and also to learn

315
00:11:56,470 --> 00:11:54,399
exactly what happens

316
00:12:02,470 --> 00:11:56,480
when you crash a spacecraft at high

317
00:12:06,710 --> 00:12:04,230
while the launch and spacecraft team are

318
00:12:08,310 --> 00:12:06,720
busy preparing for liftoff the mission

319
00:12:10,150 --> 00:12:08,320
operations team

320
00:12:12,150 --> 00:12:10,160
located across the country in laurel

321
00:12:14,230 --> 00:12:12,160
maryland is preparing to communicate

322
00:12:16,949 --> 00:12:14,240
with the dart spacecraft after an

323
00:12:19,509 --> 00:12:16,959
hour-long flight on a falcon 9. let's

324
00:12:23,269 --> 00:12:19,519
bring in samson rainey now to find out

325
00:12:27,670 --> 00:12:25,110
hi daryl i'm at the johns hopkins

326
00:12:30,550 --> 00:12:27,680
applied physics laboratory which has a

327
00:12:32,710 --> 00:12:30,560
number of historic milestones in space

328
00:12:36,230 --> 00:12:32,720
we're talking about the first mission to

329
00:12:38,629 --> 00:12:36,240
orbit mercury the first flyby of pluto

330
00:12:41,269 --> 00:12:38,639
and of course here we are with our next

331
00:12:43,190 --> 00:12:41,279
major milestone with dart right now i'm

332
00:12:45,110 --> 00:12:43,200
standing outside emissions operations

333
00:12:47,430 --> 00:12:45,120
control which is essentially the nerve

334
00:12:49,350 --> 00:12:47,440
center for the spacecraft after launch

335
00:12:51,350 --> 00:12:49,360
it controls everything from propulsion

336
00:12:52,949 --> 00:12:51,360
to the power supply let me give you a

337
00:12:54,870 --> 00:12:52,959
quick lay of the land here if you look

338
00:12:57,190 --> 00:12:54,880

behind me in this corner there is a

339
00:12:59,509 --> 00:12:57,200
u-shaped configuration that's called the

340
00:13:01,430 --> 00:12:59,519
command pit and it houses the flight

341
00:13:03,670 --> 00:13:01,440
controllers as well as the mission

342
00:13:06,389 --> 00:13:03,680
operations manager now flanking the

343
00:13:09,750 --> 00:13:06,399
command pit on either side are the

344
00:13:11,670 --> 00:13:09,760
consoles for the subsystem experts right

345
00:13:13,350 --> 00:13:11,680
now the team is basically looking at

346
00:13:16,949 --> 00:13:13,360
their consoles and making sure all

347
00:13:18,790 --> 00:13:16,959
systems are green or a go for launch

348
00:13:20,629 --> 00:13:18,800
now it might seem like quite an

349
00:13:23,509 --> 00:13:20,639
uneventful scene in the back as you're

350
00:13:25,030 --> 00:13:23,519
seeing right now but i spoke to ray

351
00:13:27,590 --> 00:13:25,040
harvey earlier he's the mission

352
00:13:29,829 --> 00:13:27,600
operations manager basically in charge

353
00:13:32,069 --> 00:13:29,839
of the overall health and functioning of

354
00:13:34,949 --> 00:13:32,079
the spacecraft and he said that

355
00:13:37,190 --> 00:13:34,959
uneventful or dare i say boring is

356
00:13:40,870 --> 00:13:37,200
exactly what we're going for in this

357
00:13:42,949 --> 00:13:40,880
final countdown to launch

358
00:13:45,269 --> 00:13:42,959
so there's a lot going on here and

359
00:13:47,350 --> 00:13:45,279
what's going to happen is

360
00:13:49,430 --> 00:13:47,360
what's cool about the spacecraft after

361
00:13:51,750 --> 00:13:49,440
launch is that there are a number of

362
00:13:52,949 --> 00:13:51,760
pre-programmed and automated sequences

363
00:13:55,350 --> 00:13:52,959

that will occur

364
00:13:57,590 --> 00:13:55,360
so about an hour after launch these

365
00:13:59,670 --> 00:13:57,600
spacecraft will separate from the launch

366
00:14:02,710 --> 00:13:59,680
vehicle at this time this grace the

367
00:14:05,350 --> 00:14:02,720
spacecraft will be in a rapid rotation

368
00:14:06,470 --> 00:14:05,360
so at that point thrusters will engage

369
00:14:08,870 --> 00:14:06,480
and fire

370
00:14:10,949 --> 00:14:08,880
and bring that spacecraft into

371
00:14:13,430 --> 00:14:10,959
stabilization they call that de-tumbling

372
00:14:14,870 --> 00:14:13,440
the spacecraft now after the spacecraft

373
00:14:18,150 --> 00:14:14,880
is stabilized the next part of the

374
00:14:20,710 --> 00:14:18,160
automated process happens which is the

375
00:14:23,670 --> 00:14:20,720
unfurling of the rosa solar arrays now

376
00:14:26,389 --> 00:14:23,680
remember each array is 28 feet long so

377
00:14:27,430 --> 00:14:26,399
it's going to be an intricate multi-step

378
00:14:28,550 --> 00:14:27,440
process

379
00:14:30,629 --> 00:14:28,560
to bring

380
00:14:33,269 --> 00:14:30,639
dart's wings to spread

381
00:14:35,430 --> 00:14:33,279
and so that probably will take two hours

382
00:14:37,269 --> 00:14:35,440
alone for that process to happen

383
00:14:39,670 --> 00:14:37,279
so after the spacecraft goes through

384
00:14:41,990 --> 00:14:39,680
those automated sequences successfully

385
00:14:43,430 --> 00:14:42,000
the team will then take control of the

386
00:14:46,150 --> 00:14:43,440
spacecraft

387
00:14:48,150 --> 00:14:46,160
navigation systems will be engaged and

388
00:14:50,790 --> 00:14:48,160

the team will then bring the dart

389
00:14:52,790 --> 00:14:50,800
spacecraft to a default orientation

390
00:14:55,189 --> 00:14:52,800
which includes most critically making

391
00:14:57,030 --> 00:14:55,199
sure that those solar arrays are pointed

392
00:14:59,110 --> 00:14:57,040
toward the sun and gathering energy for

393
00:15:00,550 --> 00:14:59,120
the journey so as you can see a lot is

394
00:15:03,030 --> 00:15:00,560
going to happen tonight and so the team

395
00:15:04,870 --> 00:15:03,040
expects a graveyard shift

396
00:15:06,230 --> 00:15:04,880
but stay tuned because later on the show

397
00:15:08,389 --> 00:15:06,240
we're going to come back and talk to

398
00:15:10,949 --> 00:15:08,399
some of the engineers and scientists

399
00:15:14,550 --> 00:15:10,959
and learn more about the mission so stay

400
00:15:18,470 --> 00:15:16,310
all right time to turn our attention to

401
00:15:20,710 --> 00:15:18,480
a critical component in the pre-launch

402
00:15:22,629 --> 00:15:20,720
operation and that's the weather it was

403
00:15:25,110 --> 00:15:22,639
a beautiful day today on the central

404
00:15:27,030 --> 00:15:25,120
coast of california and fortunately we

405
00:15:28,949 --> 00:15:27,040
also have a beautiful launch weather

406
00:15:30,710 --> 00:15:28,959
forecast so let's take a look at the

407
00:15:33,189 --> 00:15:30,720
satellite and you can see the clear

408
00:15:34,629 --> 00:15:33,199
areas we shift from day into night

409
00:15:36,710 --> 00:15:34,639
that's california in the center of

410
00:15:38,310 --> 00:15:36,720
course and that peninsula there that's

411
00:15:40,710 --> 00:15:38,320
where we're launching the rocket there

412
00:15:42,389 --> 00:15:40,720
are clouds to the north and to the west

413
00:15:45,430 --> 00:15:42,399

but the area around the central part of

414
00:15:47,829 --> 00:15:45,440
the state where we are fairly clear with

415
00:15:50,389 --> 00:15:47,839
only some high cirrus clouds from a weak

416
00:15:52,550 --> 00:15:50,399
cold front that did move into the area

417
00:15:54,629 --> 00:15:52,560
and lower the temperatures here now the

418
00:15:56,629 --> 00:15:54,639
space launch delta 30 launch weather

419
00:15:59,110 --> 00:15:56,639
officer max rush says that this will

420
00:16:01,430 --> 00:15:59,120
bring elevated winds both on the ground

421
00:16:03,110 --> 00:16:01,440
and in the upper upper atmosphere so

422
00:16:05,590 --> 00:16:03,120
they are watching those closely but

423
00:16:09,189 --> 00:16:05,600
overall take a look at this launch day

424
00:16:12,870 --> 00:16:09,199
forecast it is nearly perfect 90 percent

425
00:16:15,590 --> 00:16:12,880
go the wind is 18 miles per hour that is

426
00:16:17,829 --> 00:16:15,600
the gust out of the north northwest

427
00:16:19,590 --> 00:16:17,839
temperature down to 48 degrees so it's a

428
00:16:22,550 --> 00:16:19,600
little chilly out there

429
00:16:24,470 --> 00:16:22,560
the concerns are winds and offshore

430
00:16:27,350 --> 00:16:24,480
clouds as you saw some of that cloud

431
00:16:29,269 --> 00:16:27,360
cover over the pacific now the space

432
00:16:31,189 --> 00:16:29,279
launch delta 30 weather team will be

433
00:16:34,150 --> 00:16:31,199
monitoring all of those winds and

434
00:16:35,990 --> 00:16:34,160
conditions as we move forward

435
00:16:37,990 --> 00:16:36,000
now the winds and the winds on the

436
00:16:40,230 --> 00:16:38,000
ground and the winds up in the upper

437
00:16:43,430 --> 00:16:40,240
levels of the atmosphere this is always

438
00:16:46,550 --> 00:16:43,440

being monitored by the space launch

439
00:16:47,990 --> 00:16:46,560
delta 30 team and to do that

440
00:16:50,150 --> 00:16:48,000
meteorologists will use a weather

441
00:16:52,710 --> 00:16:50,160
balloon and they invited us to watch and

442
00:16:55,189 --> 00:16:52,720
participate in that release that helps

443
00:16:57,290 --> 00:16:55,199
inform that launch weather forecast you

444
00:16:58,629 --> 00:16:57,300
just saw

445
00:17:01,350 --> 00:16:58,639
[Music]

446
00:17:02,949 --> 00:17:01,360
hey mike schmeiser daryl meteorologist

447
00:17:04,710 --> 00:17:02,959
with the space launch delta 30 good to

448
00:17:06,549 --> 00:17:04,720
see you again good to see you so what do

449
00:17:09,909 --> 00:17:06,559
you do here this is the nerve center for

450
00:17:11,669 --> 00:17:09,919
weather forecasting there's about 240

451
00:17:13,590 --> 00:17:11,679
sites just like this across the united

452
00:17:14,789 --> 00:17:13,600
states and every day

453
00:17:17,110 --> 00:17:14,799
twice a day

454
00:17:18,949 --> 00:17:17,120
all of those sites release a balloon

455
00:17:20,949 --> 00:17:18,959
so we're putting out the data for not

456
00:17:23,429 --> 00:17:20,959
only national weather service but also

457
00:17:24,309 --> 00:17:23,439
for our forecasters absolutely critical

458
00:17:26,470 --> 00:17:24,319
data

459
00:17:28,309 --> 00:17:26,480
can't do weather forecasting without it

460
00:17:30,549 --> 00:17:28,319
once you get the data then

461
00:17:32,549 --> 00:17:30,559
how do you look at it and study it so

462
00:17:34,710 --> 00:17:32,559
the data comes in 5000 foot blocks each

463
00:17:35,510 --> 00:17:34,720

one of these dotted lines shows 5 000

464
00:17:37,029 --> 00:17:35,520
feet

465
00:17:38,630 --> 00:17:37,039
as it comes in it takes about five

466
00:17:40,789 --> 00:17:38,640
minutes for that data to come in and

467
00:17:41,750 --> 00:17:40,799
this is the wind speed and direction

468
00:17:43,270 --> 00:17:41,760
so i understand you're going to be

469
00:17:45,510 --> 00:17:43,280
releasing a balloon in just a few

470
00:17:46,950 --> 00:17:45,520
minutes yeah absolutely in fact i've

471
00:17:49,270 --> 00:17:46,960
talked to the guys out there and they

472
00:17:51,190 --> 00:17:49,280
said you're good to go to be the guy to

473
00:17:52,549 --> 00:17:51,200
release it you trust me with the weather

474
00:18:01,750 --> 00:17:52,559
blog i trust colonels with weather

475
00:18:06,760 --> 00:18:03,669
10 seconds i feel like the biggest hit

476
00:18:14,630 --> 00:18:12,830
[Music]

477
00:18:16,310 --> 00:18:14,640
perfect

478
00:18:18,870 --> 00:18:16,320
interesting fact about that blooney just

479
00:18:20,390 --> 00:18:18,880
released when it gets up to 100 000 feet

480
00:18:22,150 --> 00:18:20,400
it'll be about the size of a greyhound

481
00:18:23,990 --> 00:18:22,160
bus that's incredible

482
00:18:25,590 --> 00:18:24,000
wow well mike thank you so much for

483
00:18:30,549 --> 00:18:25,600
having us out here really enjoyed it i'm

484
00:18:34,070 --> 00:18:31,990
took me back to being a kid and just

485
00:18:36,230 --> 00:18:34,080
releasing a balloon into the air

486
00:18:38,230 --> 00:18:36,240
thank you to the 30th for doing that now

487
00:18:40,150 --> 00:18:38,240
most of the spacecraft nasa builds are

488
00:18:42,950 --> 00:18:40,160

intended to operate for many years or

489
00:18:45,590 --> 00:18:42,960
even decades but not the dark spacecraft

490
00:18:47,990 --> 00:18:45,600
it was built to be destroyed let's check

491
00:18:50,230 --> 00:18:48,000
in now with raquel villanueva just uh

492
00:18:52,070 --> 00:18:50,240
about five miles away from us at a

493
00:18:53,750 --> 00:18:52,080
launch viewing location with more and

494
00:18:57,510 --> 00:18:53,760
raquel looks like you got a little bit

495
00:18:59,350 --> 00:18:57,520
of a crowd behind you that's right daryl

496
00:19:01,350 --> 00:18:59,360
there is a crowd of about a couple

497
00:19:03,029 --> 00:19:01,360
hundred people behind me getting ready

498
00:19:05,510 --> 00:19:03,039
and braving the chilly temperatures to

499
00:19:08,710 --> 00:19:05,520
watch this launch and right next to me

500
00:19:10,870 --> 00:19:08,720
is dart deputy mechanical engineer lisa

501
00:19:12,789 --> 00:19:10,880
wu to talk about how the spacecraft was

502
00:19:15,110 --> 00:19:12,799
built thank you so much for joining us

503
00:19:17,190 --> 00:19:15,120
today course thank you for having me so

504
00:19:19,590 --> 00:19:17,200
explain to us how dart was built and

505
00:19:22,230 --> 00:19:19,600
tested and designed that is a great

506
00:19:25,590 --> 00:19:22,240
question so dart was built from the

507
00:19:27,909 --> 00:19:25,600
inside out we started with components on

508
00:19:30,630 --> 00:19:27,919
the inside including boxes such as our

509
00:19:33,750 --> 00:19:30,640
avionics that had the smart nav system

510
00:19:35,029 --> 00:19:33,760
our algorithm built by apl

511
00:19:38,390 --> 00:19:35,039
that's basically what's going to

512
00:19:40,710 --> 00:19:38,400
autonomously take us to the asteroid so

513
00:19:42,549 --> 00:19:40,720

once we tested everything on the inside

514
00:19:44,390 --> 00:19:42,559
we closed up the box and we started

515
00:19:46,310 --> 00:19:44,400
doing everything on the outside so we

516
00:19:49,270 --> 00:19:46,320
installed and integrated our solar

517
00:19:52,390 --> 00:19:49,280
arrays our rosas

518
00:19:55,029 --> 00:19:52,400
as you will roll out solar arrays and

519
00:19:58,230 --> 00:19:55,039
then at that point afterwards

520
00:20:00,070 --> 00:19:58,240
we put on our nexi engine which you can

521
00:20:03,270 --> 00:20:00,080
see here in the video

522
00:20:04,630 --> 00:20:03,280
uh that is our nexi ion thruster which

523
00:20:07,110 --> 00:20:04,640
is pretty cool

524
00:20:09,190 --> 00:20:07,120
we closed up the spacecraft with

525
00:20:10,710 --> 00:20:09,200
blankets to keep the spacecraft nice and

526
00:20:12,549 --> 00:20:10,720
warm and from there we had to take it

527
00:20:15,190 --> 00:20:12,559
through a series of very vigorous

528
00:20:17,510 --> 00:20:15,200
testing including vibration testing and

529
00:20:19,430 --> 00:20:17,520
thermal vacuum chamber testing all this

530
00:20:21,750 --> 00:20:19,440
was really cool one of our last things

531
00:20:24,710 --> 00:20:21,760
we installed was our lycha cube from our

532
00:20:26,230 --> 00:20:24,720
italian friends and then we put it in

533
00:20:28,549 --> 00:20:26,240
our shipping container and shipped it

534
00:20:29,909 --> 00:20:28,559
from maryland all the way out here to

535
00:20:34,149 --> 00:20:29,919
california

536
00:20:35,990 --> 00:20:34,159
right now it is on our rocket and we are

537
00:20:37,990 --> 00:20:36,000
ready to launch

538
00:20:40,630 --> 00:20:38,000

and what was the biggest challenge the

539
00:20:42,470 --> 00:20:40,640
team faced when building the spacecraft

540
00:20:44,230 --> 00:20:42,480
you know i think the biggest challenge

541
00:20:46,549 --> 00:20:44,240
that we faced was definitely having to

542
00:20:49,909 --> 00:20:46,559
build a spacecraft under the constraints

543
00:20:51,750 --> 00:20:49,919
of a pandemic that was super difficult

544
00:20:54,390 --> 00:20:51,760
because building a spacecraft in itself

545
00:20:55,669 --> 00:20:54,400
is hard but with pandemic and all the

546
00:20:58,070 --> 00:20:55,679
restrictions

547
00:21:03,190 --> 00:20:58,080
it was really hard but you know the team

548
00:21:05,990 --> 00:21:03,200
adapted we did things very virtually we

549
00:21:08,070 --> 00:21:06,000
did procedures online we did shift work

550
00:21:10,230 --> 00:21:08,080
and in the end

551
00:21:12,789 --> 00:21:10,240
the awesome team we had made a

552
00:21:14,070 --> 00:21:12,799
spacecraft so hey that's why we're here

553
00:21:16,310 --> 00:21:14,080
today

554
00:21:17,669 --> 00:21:16,320
it's great to see you here now and i

555
00:21:20,149 --> 00:21:17,679
just like to thank you for your time

556
00:21:22,710 --> 00:21:20,159
today lisa and i will send it back to

557
00:21:23,590 --> 00:21:22,720
daryl kell and lisa thank you both so

558
00:21:25,750 --> 00:21:23,600
much

559
00:21:28,310 --> 00:21:25,760
dart will take flight on a pre-flown

560
00:21:30,789 --> 00:21:28,320
spacex falcon 9 rocket from space launch

561
00:21:33,510 --> 00:21:30,799
complex 4 here at the vandenberg space

562
00:21:35,510 --> 00:21:33,520
force base but once again this pre-flown

563
00:21:38,070 --> 00:21:35,520

booster will make another return from

564
00:21:41,029 --> 00:21:38,080
space for more on that here's spacex

565
00:21:43,909 --> 00:21:41,039
engineer jesse anderson

566
00:21:46,149 --> 00:21:43,919
it was almost exactly a year ago when

567
00:21:48,390 --> 00:21:46,159
the falcon 9 booster set to carry nasa's

568
00:21:51,590 --> 00:21:48,400
dart mission first took place

569
00:21:53,830 --> 00:21:51,600
on november 21st 2020 at 9 17 a.m

570
00:21:55,750 --> 00:21:53,840
pacific time falcon 9 lifted off from

571
00:21:57,990 --> 00:21:55,760
vandenberg space force base here in

572
00:22:00,149 --> 00:21:58,000
california carrying the sentinel 6

573
00:22:01,669 --> 00:22:00,159
michael frelick mission for nasa to its

574
00:22:03,270 --> 00:22:01,679
targeted orbit

575
00:22:05,270 --> 00:22:03,280
following that launch the falcon 9

576
00:22:07,350 --> 00:22:05,280
booster returned to earth for a land

577
00:22:09,029 --> 00:22:07,360
landing on the pad just adjacent to

578
00:22:10,549 --> 00:22:09,039
where it had lifted off from roughly

579
00:22:12,710 --> 00:22:10,559
eight minutes earlier

580
00:22:14,549 --> 00:22:12,720
the same booster recently flew a

581
00:22:16,950 --> 00:22:14,559
starlink mission in may of this year

582
00:22:19,190 --> 00:22:16,960
from our space launch complex 40 pad out

583
00:22:20,789 --> 00:22:19,200
in cape canaveral florida landing back

584
00:22:23,110 --> 00:22:20,799
on our drone ship just read the

585
00:22:24,870 --> 00:22:23,120
instructions in the atlantic ocean now

586
00:22:27,110 --> 00:22:24,880
today this booster will make its third

587
00:22:29,830 --> 00:22:27,120
flight from the pad where it all started

588
00:22:31,430 --> 00:22:29,840

with the launch of nasa's dart mission

589
00:22:33,830 --> 00:22:31,440
roughly two and a half minutes after

590
00:22:35,909 --> 00:22:33,840
liftoff today the falcon 9 first and

591
00:22:37,590 --> 00:22:35,919
second stages will separate and the

592
00:22:39,590 --> 00:22:37,600
second stage will ignite its single

593
00:22:41,350 --> 00:22:39,600
merlin vacuum engine to carry the dart

594
00:22:43,669 --> 00:22:41,360
spacecraft to an interplanetary

595
00:22:46,149 --> 00:22:43,679
trajectory the dart spacecraft will

596
00:22:47,830 --> 00:22:46,159
separate approximately 56 minutes into

597
00:22:50,630 --> 00:22:47,840
flight and spend the

598
00:22:51,909 --> 00:22:50,640
next 11 months cruising to its intended

599
00:22:53,510 --> 00:22:51,919
destination

600
00:22:55,190 --> 00:22:53,520
following stage separation the first

601
00:22:57,270 --> 00:22:55,200
stage will make its way back to our

602
00:22:59,190 --> 00:22:57,280
autonomous spaceport drone ship called

603
00:23:00,789 --> 00:22:59,200
of course i still love you which is

604
00:23:02,070 --> 00:23:00,799
currently stationed off the coast of

605
00:23:04,070 --> 00:23:02,080
california

606
00:23:05,990 --> 00:23:04,080
now keep in mind it can be tricky to

607
00:23:08,470 --> 00:23:06,000
maintain the video feed as the booster

608
00:23:10,950 --> 00:23:08,480
makes its way back to earth but fingers

609
00:23:13,590 --> 00:23:10,960
crossed will get some great views as it

610
00:23:15,669 --> 00:23:13,600
completes its third trip to space

611
00:23:17,590 --> 00:23:15,679
that's it from us here in hawthorne now

612
00:23:19,270 --> 00:23:17,600
back to you in vandenberg

613
00:23:20,870 --> 00:23:19,280

all right thank you very much jesse and

614
00:23:22,950 --> 00:23:20,880
now time to check back in with the

615
00:23:24,470 --> 00:23:22,960
launch team at the mission director's

616
00:23:26,870 --> 00:23:24,480
center to see how the countdown is

617
00:23:28,549 --> 00:23:26,880
progressing maria denton that booster

618
00:23:30,789 --> 00:23:28,559
looks very familiar i was out here a

619
00:23:33,590 --> 00:23:30,799
year ago and it looks great on the pad

620
00:23:35,510 --> 00:23:33,600
though you can tell it's been to space

621
00:23:37,669 --> 00:23:35,520
yeah you sure can and and that's what we

622
00:23:40,470 --> 00:23:37,679
like to see um you know the

623
00:23:41,909 --> 00:23:40,480
the reuse is is so exciting um and

624
00:23:43,350 --> 00:23:41,919
denton i know you talked about this

625
00:23:45,830 --> 00:23:43,360
already being a first for the launch

626
00:23:47,909 --> 00:23:45,840
services program uh but you really were

627
00:23:51,430 --> 00:23:47,919
able to get a lot of insight from the

628
00:23:53,110 --> 00:23:51,440
reuse that you saw with cargo missions

629
00:23:56,070 --> 00:23:53,120
and the commercial crew missions for

630
00:23:57,669 --> 00:23:56,080
nasa and so uh just building upon that

631
00:23:59,590 --> 00:23:57,679
and it's really great to see there's a

632
00:24:01,669 --> 00:23:59,600
live look again at the pad and now we

633
00:24:03,990 --> 00:24:01,679
can see the liquid oxygen venting off

634
00:24:06,789 --> 00:24:04,000
the side of the falcon 9 rocket uh

635
00:24:07,990 --> 00:24:06,799
fueling began about nine minutes ago and

636
00:24:10,149 --> 00:24:08,000
uh so

637
00:24:11,750 --> 00:24:10,159
the count has been uh really quiet these

638
00:24:13,110 --> 00:24:11,760

last few minutes and that's a good thing

639
00:24:14,630 --> 00:24:13,120
yeah absolutely i mean that's what you

640
00:24:16,549 --> 00:24:14,640
want you want an uneventful account that

641
00:24:19,430 --> 00:24:16,559
means everything is going well we're

642
00:24:20,789 --> 00:24:19,440
moving along in account progressing

643
00:24:22,549 --> 00:24:20,799
and being where actually we're supposed

644
00:24:24,390 --> 00:24:22,559
to be at this point in time so

645
00:24:25,350 --> 00:24:24,400
that's what we want to hear

646
00:24:32,149 --> 00:24:25,360
and

647
00:24:33,590 --> 00:24:32,159
seconds p.m pacific time so if you are

648
00:24:36,390 --> 00:24:33,600
watching from the east coast it's going

649
00:24:37,430 --> 00:24:36,400
to be uh already early uh the next

650
00:24:39,909 --> 00:24:37,440
morning

651
00:24:43,029 --> 00:24:39,919
and uh there's a special reason why

652
00:24:44,710 --> 00:24:43,039
spacex fuels this close to liftoff yeah

653
00:24:47,110 --> 00:24:44,720
and that's because they use densified

654
00:24:49,110 --> 00:24:47,120
repellents which are very very cold

655
00:24:51,269 --> 00:24:49,120
and so they feel this close because they

656
00:24:52,789 --> 00:24:51,279
don't want it to warm up too much um and

657
00:24:54,870 --> 00:24:52,799
you want to keep it down in those really

658
00:24:56,630 --> 00:24:54,880
cool cryogenic temperatures prior to

659
00:24:57,909 --> 00:24:56,640
lift off and spacex has gotten very good

660
00:24:59,350 --> 00:24:57,919
at that at

661
00:25:01,430 --> 00:24:59,360
fueling this late in the game they're

662
00:25:03,110 --> 00:25:01,440
very efficient at it and

663
00:25:04,630 --> 00:25:03,120

it's just normal part of the process at

664
00:25:06,950 --> 00:25:04,640
this point all right so we're going to

665
00:25:09,029 --> 00:25:06,960
continue to keep an ear on things uh

666
00:25:11,909 --> 00:25:09,039
next thing we'll be listening for is the

667
00:25:13,430 --> 00:25:11,919
space x launch conductor poll at t minus

668
00:25:15,750 --> 00:25:13,440
four minutes that's the next milestone

669
00:25:16,950 --> 00:25:15,760
you see on that progress bar on the

670
00:25:18,950 --> 00:25:16,960
bottom of your screen so we'll be

671
00:25:20,630 --> 00:25:18,960
listening in for that and for now we're

672
00:25:22,149 --> 00:25:20,640
going to toss it back over to daryl and

673
00:25:23,830 --> 00:25:22,159
kelly all right thank you very much

674
00:25:26,149 --> 00:25:23,840
marie and denton and now we want to get

675
00:25:27,830 --> 00:25:26,159
back to the science of this mission and

676
00:25:29,510 --> 00:25:27,840
talk a little bit about the what if

677
00:25:31,269 --> 00:25:29,520
kelly you know um

678
00:25:32,630 --> 00:25:31,279
this is a big deal a lot of people

679
00:25:34,630 --> 00:25:32,640
probably haven't heard of this like oh

680
00:25:37,430 --> 00:25:34,640
wait a second should i be worried about

681
00:25:39,029 --> 00:25:37,440
you know asteroids now but um it really

682
00:25:41,110 --> 00:25:39,039
comes down to all the documenting and

683
00:25:43,909 --> 00:25:41,120
cataloging that you guys are doing so

684
00:25:45,909 --> 00:25:43,919
how many asteroids uh are out there

685
00:25:47,750 --> 00:25:45,919
right well nasa funded telescopes are

686
00:25:50,789 --> 00:25:47,760
responsible for most of the nearest

687
00:25:53,029 --> 00:25:50,799
asteroid discoveries which now number

688
00:25:55,110 --> 00:25:53,039

twenty seven thousand five hundred

689
00:25:56,870 --> 00:25:55,120
thirty two according to the center for

690
00:25:58,390 --> 00:25:56,880
near earth object studies website that's

691
00:26:00,870 --> 00:25:58,400
right well and that's an up-to-date

692
00:26:02,549 --> 00:26:00,880
number it is so what about the asteroids

693
00:26:04,230 --> 00:26:02,559
that we don't know about

694
00:26:07,110 --> 00:26:04,240
well that's the thing of the

695
00:26:09,830 --> 00:26:07,120
the subset that are a larger size that

696
00:26:11,990 --> 00:26:09,840
could really do damage that the earth's

697
00:26:14,549 --> 00:26:12,000
atmosphere doesn't protect us from uh

698
00:26:17,350 --> 00:26:14,559
that larger population we've probably

699
00:26:19,350 --> 00:26:17,360
found about 40 percent of those only 40

700
00:26:21,750 --> 00:26:19,360
percent which means there's a lot more

701
00:26:24,149 --> 00:26:21,760
out there so we keep searching okay well

702
00:26:25,590 --> 00:26:24,159
we get keep our eyes to the skies and

703
00:26:28,549 --> 00:26:25,600
eventually get a telescope up there

704
00:26:30,470 --> 00:26:28,559
right to look at this right nasa funds

705
00:26:31,990 --> 00:26:30,480
these ground-based telescopes that uh

706
00:26:33,750 --> 00:26:32,000
search for near earth asteroids and

707
00:26:35,590 --> 00:26:33,760
they're doing a fabulous job but it is

708
00:26:38,230 --> 00:26:35,600
also developing the near-earth object

709
00:26:40,870 --> 00:26:38,240
surveyor mission uh which will be a

710
00:26:44,149 --> 00:26:40,880
space-based infrared telescope really

711
00:26:46,710 --> 00:26:44,159
designed to do this type of survey work

712
00:26:49,430 --> 00:26:46,720
and accelerate the rate of discoveries

713
00:26:51,029 --> 00:26:49,440

of narrow pathways space based telescope

714
00:26:52,310 --> 00:26:51,039
specifically purpose for looking for

715
00:26:54,070 --> 00:26:52,320
asteroids looking forward to that

716
00:26:55,909 --> 00:26:54,080
mission and so what if there wasn't

717
00:26:58,149 --> 00:26:55,919
enough time though to knock it off

718
00:27:00,310 --> 00:26:58,159
course well earlier nasa's raquel

719
00:27:01,990 --> 00:27:00,320
villanueva talked to two key people

720
00:27:05,830 --> 00:27:02,000
about how fema

721
00:27:07,430 --> 00:27:05,840
and nasa are working together on this

722
00:27:09,909 --> 00:27:07,440
there's currently no threat of an

723
00:27:11,669 --> 00:27:09,919
asteroid or comet heading toward earth

724
00:27:14,310 --> 00:27:11,679
there is plenty of work being done to

725
00:27:16,710 --> 00:27:14,320
prepare for a potential threat

726
00:27:19,029 --> 00:27:16,720
i'm here today with nasa planetary

727
00:27:21,669 --> 00:27:19,039
defense officer lynley johnson and

728
00:27:23,269 --> 00:27:21,679
leviticus lewis with fema to talk about

729
00:27:25,190 --> 00:27:23,279
some of the measures being taken

730
00:27:27,110 --> 00:27:25,200
leviticus lindley thank you for joining

731
00:27:28,230 --> 00:27:27,120
us today glad to be here yeah you're

732
00:27:31,350 --> 00:27:28,240
welcome

733
00:27:34,310 --> 00:27:31,360
now how do your agencies work together

734
00:27:36,710 --> 00:27:34,320
when it comes to planetary defense well

735
00:27:39,029 --> 00:27:36,720
we at nasa are tasked with

736
00:27:40,950 --> 00:27:39,039
trying to find any impact threat that

737
00:27:43,750 --> 00:27:40,960
might be out there any asteroid or comet

738
00:27:45,430 --> 00:27:43,760

that close close enough to earth

739
00:27:46,549 --> 00:27:45,440
that it could impact us

740
00:27:51,430 --> 00:27:46,559
and

741
00:27:53,990 --> 00:27:51,440
that impact might occur so that we can

742
00:27:55,669 --> 00:27:54,000
inform the emergency response community

743
00:27:58,389 --> 00:27:55,679
if we don't have enough time to do

744
00:28:01,029 --> 00:27:58,399
something about it in space fema is the

745
00:28:03,590 --> 00:28:01,039
federal interagency coordinator and also

746
00:28:05,430 --> 00:28:03,600
an all hazards organization so planetary

747
00:28:07,029 --> 00:28:05,440
defense is just one more thing on our

748
00:28:09,430 --> 00:28:07,039
list of hazards that we should be

749
00:28:10,950 --> 00:28:09,440
prepared for one of the many emergencies

750
00:28:13,750 --> 00:28:10,960
now lindley

751
00:28:15,590 --> 00:28:13,760
if there were to be a asteroid that

752
00:28:17,909 --> 00:28:15,600
posed a threat to earth

753
00:28:19,190 --> 00:28:17,919
what is being done to discover and track

754
00:28:21,110 --> 00:28:19,200
this

755
00:28:22,789 --> 00:28:21,120
well nasa and the planetary defense

756
00:28:24,230 --> 00:28:22,799
coordination office

757
00:28:25,909 --> 00:28:24,240
sponsors

758
00:28:28,549 --> 00:28:25,919
projects around the country at

759
00:28:31,190 --> 00:28:28,559
observatories and and universities space

760
00:28:32,789 --> 00:28:31,200
institutes that are searching the skies

761
00:28:35,190 --> 00:28:32,799
every night to

762
00:28:37,350 --> 00:28:35,200
find any asteroid or comet

763
00:28:39,830 --> 00:28:37,360

that could be an impact threat to the

764
00:28:41,830 --> 00:28:39,840
earth in the future we want to find them

765
00:28:44,149 --> 00:28:41,840
far enough in the future that we have a

766
00:28:46,310 --> 00:28:44,159
chance to do something about them like

767
00:28:47,190 --> 00:28:46,320
use dart to deflect them

768
00:28:49,990 --> 00:28:47,200
off

769
00:28:52,230 --> 00:28:50,000
of that impact trajectory but if the

770
00:28:53,029 --> 00:28:52,240
time is short and we're not able to do

771
00:28:53,830 --> 00:28:53,039
that

772
00:28:55,590 --> 00:28:53,840
then

773
00:28:57,350 --> 00:28:55,600
an asteroid impact is just like any

774
00:28:59,190 --> 00:28:57,360
other natural disaster and so the

775
00:29:01,350 --> 00:28:59,200
emergency response community needs to

776
00:29:02,630 --> 00:29:01,360
know when and where and what the effects

777
00:29:04,870 --> 00:29:02,640
could be

778
00:29:08,789 --> 00:29:04,880
and if an asteroid posed a significant

779
00:29:10,070 --> 00:29:08,799
threat what steps would be taken next

780
00:29:12,950 --> 00:29:10,080
well uh

781
00:29:15,590 --> 00:29:12,960
we collect uh as much information as we

782
00:29:17,350 --> 00:29:15,600
can about the asteroid through the

783
00:29:19,830 --> 00:29:17,360
remote observing and determining the

784
00:29:21,269 --> 00:29:19,840
composition and size uh it might be

785
00:29:23,350 --> 00:29:21,279
small enough that earth's atmosphere

786
00:29:24,870 --> 00:29:23,360
would disintegrate it but if not then

787
00:29:26,870 --> 00:29:24,880
there could be

788
00:29:28,870 --> 00:29:26,880

damage at the surface we want to be able

789
00:29:31,430 --> 00:29:28,880
to appraise the emergency response

790
00:29:34,070 --> 00:29:31,440
community how extensive those effects

791
00:29:36,389 --> 00:29:34,080
might be what kind of area

792
00:29:39,510 --> 00:29:36,399
might be impacted

793
00:29:40,389 --> 00:29:39,520
by by this natural disaster

794
00:29:43,110 --> 00:29:40,399
and

795
00:29:45,110 --> 00:29:43,120
leviticus how would fema work with nasa

796
00:29:46,789 --> 00:29:45,120
if this type of scenario were to happen

797
00:29:48,070 --> 00:29:46,799
so we're not going to be changing our

798
00:29:49,830 --> 00:29:48,080
procedures

799
00:29:51,430 --> 00:29:49,840
exactly but we want to make sure we

800
00:29:54,070 --> 00:29:51,440
account for the differences and the

801
00:29:56,230 --> 00:29:54,080
science and in this particular scenario

802
00:29:59,190 --> 00:29:56,240
so it'll be another emergency added to

803
00:30:01,269 --> 00:29:59,200
the list of things we handle every day

804
00:30:02,950 --> 00:30:01,279
leviticus lindy thank you so much for

805
00:30:04,950 --> 00:30:02,960
your time uh you're quite well you're

806
00:30:06,389 --> 00:30:04,960
welcome

807
00:30:08,470 --> 00:30:06,399
all right dart is the first time we've

808
00:30:10,950 --> 00:30:08,480
ever used a spacecraft as a kinetic

809
00:30:12,710 --> 00:30:10,960
impactor into an asteroid so we asked

810
00:30:15,110 --> 00:30:12,720
the astronauts on board the space

811
00:30:17,830 --> 00:30:15,120
station to demonstrate what a kinetic

812
00:30:19,990 --> 00:30:17,840
impact looks like in space

813
00:30:22,549 --> 00:30:20,000

hi everyone i'm thomas k and i'm with my

814
00:30:24,789 --> 00:30:22,559
favorite astronaut shane kimbrough uh up

815
00:30:27,269 --> 00:30:24,799
here on the space station uh today we're

816
00:30:29,669 --> 00:30:27,279
gonna talk about a very cool new nasa

817
00:30:31,750 --> 00:30:29,679
mission is called dart can you tell us

818
00:30:34,710 --> 00:30:31,760
and tell me a little bit more about what

819
00:30:37,669 --> 00:30:34,720
is nasa's dart mission

820
00:30:40,070 --> 00:30:37,679
okay yeah so dart is nasa's first

821
00:30:42,389 --> 00:30:40,080
planetary defense test

822
00:30:44,149 --> 00:30:42,399
um so we're gonna we're gonna try to do

823
00:30:45,909 --> 00:30:44,159
something we've never done before uh

824
00:30:47,350 --> 00:30:45,919
with the spacecraft and the now the

825
00:30:49,190 --> 00:30:47,360
purpose of this spacecraft in this

826
00:30:51,909 --> 00:30:49,200
mission it has one purpose that's to

827
00:30:53,669 --> 00:30:51,919
crash itself into an asteroid and try to

828
00:30:54,789 --> 00:30:53,679
redirect it or try to move it into a

829
00:30:56,310 --> 00:30:54,799
different orbit

830
00:30:57,190 --> 00:30:56,320
so today shane

831
00:30:59,269 --> 00:30:57,200
uh

832
00:31:01,669 --> 00:30:59,279
we're gonna demonstrate

833
00:31:03,430 --> 00:31:01,679
some of those principles that you laid

834
00:31:05,590 --> 00:31:03,440
out before

835
00:31:06,950 --> 00:31:05,600
but can you tell us exactly how we're

836
00:31:08,549 --> 00:31:06,960
going to do that

837
00:31:11,430 --> 00:31:08,559
we're going to try to demonstrate this

838
00:31:13,669 --> 00:31:11,440

this asteroid kinetic deflection method

839
00:31:15,590 --> 00:31:13,679
which is really the moment that that

840
00:31:16,710 --> 00:31:15,600
that spacecraft crashes into the

841
00:31:18,789 --> 00:31:16,720
asteroid

842
00:31:20,389 --> 00:31:18,799
so here we go shane is going to be the

843
00:31:21,909 --> 00:31:20,399
asteroid

844
00:31:23,990 --> 00:31:21,919
and i'm going to be the nasa dart

845
00:31:26,870 --> 00:31:24,000
mission i'm going to try to throw this

846
00:31:29,509 --> 00:31:26,880
ctb and we look at the effect of that

847
00:31:32,380 --> 00:31:29,519
mass coming at him in the kinetic energy

848
00:31:34,389 --> 00:31:32,390
transfer shane will be perfectly stable

849
00:31:46,470 --> 00:31:34,399
[Music]

850
00:31:50,950 --> 00:31:49,040
i've redirected shane successfully

851
00:31:53,830 --> 00:31:50,960
[Music]

852
00:31:57,750 --> 00:31:56,230
a while ago we we got out the door and

853
00:31:59,590 --> 00:31:57,760
we got some new solar arrays here on

854
00:32:01,509 --> 00:31:59,600
space station and so the same technology

855
00:32:03,269 --> 00:32:01,519
we have here now on the space station is

856
00:32:05,509 --> 00:32:03,279
going to be used to power the dart

857
00:32:08,070 --> 00:32:05,519
mission on its way to this asteroid

858
00:32:09,269 --> 00:32:08,080
irosa um in case you didn't know but you

859
00:32:11,669 --> 00:32:09,279
knew

860
00:32:13,269 --> 00:32:11,679
it stands for iss rollout solar arrays

861
00:32:15,430 --> 00:32:13,279
so we got a chance to go outside and

862
00:32:18,149 --> 00:32:15,440
install the very first two

863
00:32:20,149 --> 00:32:18,159

of these new irosas or roll out solar

864
00:32:22,549 --> 00:32:20,159
arrays on the very end of the space

865
00:32:23,990 --> 00:32:22,559
station out on the port side

866
00:32:26,070 --> 00:32:24,000
these are different because for one

867
00:32:28,149 --> 00:32:26,080
they're much lighter and smaller they're

868
00:32:29,990 --> 00:32:28,159
to me they look very fragile when we

869
00:32:31,430 --> 00:32:30,000
were picking them up and moving them but

870
00:32:33,509 --> 00:32:31,440
they're rolled up so they when they

871
00:32:35,110 --> 00:32:33,519
launch they're kind of rolled up into a

872
00:32:37,430 --> 00:32:35,120
compact cylinder

873
00:32:39,750 --> 00:32:37,440
which is great for launch conditions um

874
00:32:41,990 --> 00:32:39,760
and then once they get up on the space

875
00:32:43,350 --> 00:32:42,000
station or in space for a satellite or

876
00:32:45,909 --> 00:32:43,360
something they can then roll these

877
00:32:47,750 --> 00:32:45,919
things out to be useful and so the same

878
00:32:49,909 --> 00:32:47,760
technology we have here now on the space

879
00:32:52,630 --> 00:32:49,919
station is going to be used to power the

880
00:32:53,320 --> 00:32:52,640
dart mission on its way to crashing into

881
00:32:55,509 --> 00:32:53,330
an asteroid

882
00:32:56,870 --> 00:32:55,519
[Music]

883
00:32:58,549 --> 00:32:56,880
so that was pretty fun early in the

884
00:32:59,990 --> 00:32:58,559
piece watching shane get knocked into

885
00:33:02,230 --> 00:33:00,000
the side of the international space

886
00:33:05,190 --> 00:33:02,240
station but is that how kinetic impact

887
00:33:07,029 --> 00:33:05,200
will work on an asteroid that's in orbit

888
00:33:09,190 --> 00:33:07,039

well the nice thing is the laws of

889
00:33:10,789 --> 00:33:09,200
physics are the same in deep space as

890
00:33:14,310 --> 00:33:10,799
they are on the international space

891
00:33:15,669 --> 00:33:14,320
station uh the asteroid dimorphous might

892
00:33:18,310 --> 00:33:15,679
react a little differently from

893
00:33:20,310 --> 00:33:18,320
astronaut shane because uh in addition

894
00:33:22,149 --> 00:33:20,320
to being impacted uh you know by

895
00:33:23,590 --> 00:33:22,159
something uh there might be material

896
00:33:25,269 --> 00:33:23,600
thrown off from the surface that will

897
00:33:27,509 --> 00:33:25,279
affect that motion too so be a little

898
00:33:29,509 --> 00:33:27,519
different but again it's all physics i

899
00:33:31,190 --> 00:33:29,519
love it okay well a lot of careful

900
00:33:33,509 --> 00:33:31,200
consideration went into choosing the

901
00:33:35,669 --> 00:33:33,519
right asteroid to test the effectiveness

902
00:33:37,590 --> 00:33:35,679
of a kinetic impact with the dart

903
00:33:40,230 --> 00:33:37,600
spacecraft so let's go back to the

904
00:33:42,389 --> 00:33:40,240
spacecraft mission operations center in

905
00:33:43,909 --> 00:33:42,399
maryland where samson rainey is with one

906
00:33:45,110 --> 00:33:43,919
of the scientists who helped choose the

907
00:33:47,029 --> 00:33:45,120
asteroid

908
00:33:49,190 --> 00:33:47,039
but first sampson has the latest from

909
00:33:53,190 --> 00:33:49,200
the dart spacecraft team as they prepare

910
00:33:57,590 --> 00:33:55,350
hi daryl welcome back to the mock so

911
00:33:59,669 --> 00:33:57,600
right now the team continues to simply

912
00:34:02,870 --> 00:33:59,679
monitor all their subsystems to make

913
00:34:04,549 --> 00:34:02,880

sure they are um continue to be a go for

914
00:34:07,190 --> 00:34:04,559
launch and as you remember what i said

915
00:34:09,109 --> 00:34:07,200
earlier about uneventful

916
00:34:11,030 --> 00:34:09,119
equaling good well that's exactly what

917
00:34:13,190 --> 00:34:11,040
we want to continue in its final

918
00:34:14,950 --> 00:34:13,200
countdown to launch

919
00:34:17,589 --> 00:34:14,960
but of course we're only seeing the tail

920
00:34:19,829 --> 00:34:17,599
end of what has been a lot of work to

921
00:34:21,829 --> 00:34:19,839
get to this point tonight throughout the

922
00:34:24,710 --> 00:34:21,839
year the team era has been rehearsing

923
00:34:27,430 --> 00:34:24,720
for what are called anomalies which are

924
00:34:30,389 --> 00:34:27,440
instances where a problem arises so say

925
00:34:33,030 --> 00:34:30,399
a ground-based antenna goes down

926
00:34:35,750 --> 00:34:33,040
while the team has spent a lot of time

927
00:34:38,230 --> 00:34:35,760
flexing its responsive muscles

928
00:34:39,829 --> 00:34:38,240
to that in other scenarios

929
00:34:42,710 --> 00:34:39,839
these rehearsals were happening as

930
00:34:44,470 --> 00:34:42,720
recently as a few days ago

931
00:34:46,629 --> 00:34:44,480
to give the team an upper hand to tackle

932
00:34:49,190 --> 00:34:46,639
any challenges that may come its way so

933
00:34:52,230 --> 00:34:49,200
i just wanted to pay homage to all the

934
00:34:54,470 --> 00:34:52,240
engineers and technical experts that

935
00:34:56,389 --> 00:34:54,480
have been working hard to get us to the

936
00:34:59,270 --> 00:34:56,399
main event which we all know is impact

937
00:35:00,630 --> 00:34:59,280
with demorphos that said i want to

938
00:35:02,870 --> 00:35:00,640

switch gears a little bit and talk about

939
00:35:04,870 --> 00:35:02,880
the science behind the mission and here

940
00:35:06,790 --> 00:35:04,880
to talk with me is

941
00:35:09,109 --> 00:35:06,800
probably the best person for the job is

942
00:35:11,829 --> 00:35:09,119
andy chang which is darts

943
00:35:13,910 --> 00:35:11,839
investigation team lead andy why don't

944
00:35:17,510 --> 00:35:13,920
you tell us about our target asteroid

945
00:35:20,310 --> 00:35:17,520
and why we chose it yeah start is the

946
00:35:22,310 --> 00:35:20,320
double asteroid redirection test

947
00:35:23,910 --> 00:35:22,320
and it's a test of a kinetic impactor a

948
00:35:26,950 --> 00:35:23,920
double asteroid that looks like this

949
00:35:29,829 --> 00:35:26,960
model and what it is it's two asteroids

950
00:35:33,829 --> 00:35:29,839
in orbit around each other and dart will

951
00:35:35,750 --> 00:35:33,839
come and hit the moon of this system and

952
00:35:37,750 --> 00:35:35,760
change the orbit of the moon around its

953
00:35:40,230 --> 00:35:37,760
primary

954
00:35:42,870 --> 00:35:40,240
and it will do that because

955
00:35:45,109 --> 00:35:42,880
we can measure the change in this orbit

956
00:35:48,069 --> 00:35:45,119
with ground-based telescopes and that

957
00:35:49,589 --> 00:35:48,079
works like as follows when the two orbit

958
00:35:51,589 --> 00:35:49,599
in during the course of the orbit the

959
00:35:54,230 --> 00:35:51,599
two objects move in front of and behind

960
00:35:55,750 --> 00:35:54,240
each other and each time that happens

961
00:35:58,790 --> 00:35:55,760
the amount of light that you see from

962
00:36:01,030 --> 00:35:58,800
the system makes a dip and so we time

963
00:36:03,990 --> 00:36:01,040

these dips in the light very precisely

964
00:36:06,069 --> 00:36:04,000
to measure the orbit period

965
00:36:08,790 --> 00:36:06,079
great well thanks andy i heard you

966
00:36:11,270 --> 00:36:08,800
dreamt this up in your basement

967
00:36:13,030 --> 00:36:11,280
and you know two weeks ago i conquered a

968
00:36:14,550 --> 00:36:13,040
video game and i feel like we're on you

969
00:36:15,990 --> 00:36:14,560
know equal footing now so what do you

970
00:36:17,670 --> 00:36:16,000
think about that

971
00:36:19,190 --> 00:36:17,680
well

972
00:36:21,190 --> 00:36:19,200
i don't know how it feels to conquer

973
00:36:21,910 --> 00:36:21,200
video game i've rarely been able to do

974
00:36:26,150 --> 00:36:21,920
that

975
00:36:27,109 --> 00:36:26,160
big as you know thinking of this mission

976
00:36:30,390 --> 00:36:27,119
so

977
00:36:32,550 --> 00:36:30,400
back to you daryl thanks

978
00:36:34,870 --> 00:36:32,560
all right thank you both dart is one of

979
00:36:37,750 --> 00:36:34,880
a handful of asteroid missions launching

980
00:36:39,430 --> 00:36:37,760
this year and next to explore asteroids

981
00:36:42,390 --> 00:36:39,440
let's go back to our launch viewing

982
00:36:45,030 --> 00:36:42,400
location and join raquel villanueva who

983
00:36:46,790 --> 00:36:45,040
is with a special guest and i guess the

984
00:36:48,550 --> 00:36:46,800
crowds out there have grown a little bit

985
00:36:50,710 --> 00:36:48,560
raquel

986
00:36:52,310 --> 00:36:50,720
yeah that's right daryl the crowd is

987
00:36:54,069 --> 00:36:52,320
growing and you can hear the excitement

988
00:36:57,190 --> 00:36:54,079

building behind me as they get ready for

989
00:36:59,109 --> 00:36:57,200
launch and joining me now is nasa

990
00:37:01,430 --> 00:36:59,119
science associate administrator thomas

991
00:37:03,510 --> 00:37:01,440
zurbukin to talk about what darp means

992
00:37:05,510 --> 00:37:03,520
to the agency thank you for so much for

993
00:37:07,589 --> 00:37:05,520
joining us today good to be here

994
00:37:11,270 --> 00:37:07,599
good to be here exciting now can you

995
00:37:14,069 --> 00:37:11,280
tell us about dart as a nasa's first

996
00:37:15,750 --> 00:37:14,079
planetary defense test mission and how

997
00:37:16,950 --> 00:37:15,760
this mission will change how we explore

998
00:37:18,870 --> 00:37:16,960
space

999
00:37:21,589 --> 00:37:18,880
so first of all everybody should be sure

1000
00:37:24,069 --> 00:37:21,599
to know that this is not the first

1001
00:37:26,550 --> 00:37:24,079
not only the the first and only mission

1002
00:37:28,069 --> 00:37:26,560
but really the first of many missions

1003
00:37:30,069 --> 00:37:28,079
that we're gonna do in binary defense

1004
00:37:32,950 --> 00:37:30,079
the second one we're already working on

1005
00:37:34,790 --> 00:37:32,960
which is to find the other sixty percent

1006
00:37:36,710 --> 00:37:34,800
of threatening bodies what's also

1007
00:37:39,030 --> 00:37:36,720
exciting though is that this mission

1008
00:37:42,069 --> 00:37:39,040
carries technologies we're going to use

1009
00:37:44,790 --> 00:37:42,079
for exploration of the outer solar

1010
00:37:47,190 --> 00:37:44,800
system perhaps sample returns to comets

1011
00:37:49,510 --> 00:37:47,200
asteroids or visiting the moons out

1012
00:37:50,870 --> 00:37:49,520
there the amazing worlds that are there

1013
00:37:53,670 --> 00:37:50,880

and that kind of brings me to our second

1014
00:37:55,990 --> 00:37:53,680
question how is dart different from

1015
00:37:58,790 --> 00:37:56,000
other nasa asteroid missions like lucy

1016
00:38:00,630 --> 00:37:58,800
or osiris-rex so first and foremost

1017
00:38:03,109 --> 00:38:00,640
we're not crashing those

1018
00:38:05,510 --> 00:38:03,119
at all and certainly not intensely and

1019
00:38:08,870 --> 00:38:05,520
and actually no chance of that look the

1020
00:38:11,349 --> 00:38:08,880
other asteroid missions are all about

1021
00:38:13,589 --> 00:38:11,359
learning from these asteroids about our

1022
00:38:15,589 --> 00:38:13,599
history the history of the solar system

1023
00:38:17,910 --> 00:38:15,599
these primordial

1024
00:38:20,150 --> 00:38:17,920
bodies out there tell us about the

1025
00:38:22,310 --> 00:38:20,160
building blocks of the solar system and

1026
00:38:24,870 --> 00:38:22,320
we still have a lot to learn so

1027
00:38:27,349 --> 00:38:24,880
asteroids are really exciting that tell

1028
00:38:29,510 --> 00:38:27,359
us a part of our own history

1029
00:38:31,030 --> 00:38:29,520
and after dart launches what other

1030
00:38:33,589 --> 00:38:31,040
missions are you looking forward to in

1031
00:38:36,390 --> 00:38:33,599
the future well before the end of the

1032
00:38:39,430 --> 00:38:36,400
year we have two astrophysics missions a

1033
00:38:41,750 --> 00:38:39,440
small one focused on x-rays the violent

1034
00:38:44,069 --> 00:38:41,760
universe kind of black holes and

1035
00:38:45,670 --> 00:38:44,079
exploding stars and then the biggest

1036
00:38:49,190 --> 00:38:45,680
mission we've ever done the james webb

1037
00:38:52,390 --> 00:38:49,200
space telescope uh mission in the making

1038
00:38:54,870 --> 00:38:52,400

for 20 plus years and part of dreams of

1039
00:38:57,349 --> 00:38:54,880
thousands if not ten thousands of uh

1040
00:38:58,950 --> 00:38:57,359
astrophysicists worldwide that's still

1041
00:39:01,349 --> 00:38:58,960
before the end of the year and many more

1042
00:39:03,270 --> 00:39:01,359
next year it's a busy end of year ahead

1043
00:39:04,630 --> 00:39:03,280
thank you so much for joining us thomas

1044
00:39:06,630 --> 00:39:04,640
thanks to you

1045
00:39:09,270 --> 00:39:06,640
back to you daryl all right thank you

1046
00:39:10,630 --> 00:39:09,280
both for that and back inside the nasa

1047
00:39:12,150 --> 00:39:10,640
hangar here but by the way that's the

1048
00:39:13,510 --> 00:39:12,160
little box that dart came in i just want

1049
00:39:16,550 --> 00:39:13,520
to point that out back there isn't that

1050
00:39:18,630 --> 00:39:16,560
great that's awesome this is where we

1051
00:39:21,510 --> 00:39:18,640
keep the box for dart but we don't want

1052
00:39:23,510 --> 00:39:21,520
dart to come back into the box no no

1053
00:39:25,270 --> 00:39:23,520
hey talking about uh your office the

1054
00:39:27,190 --> 00:39:25,280
planetary defense coordination office

1055
00:39:28,630 --> 00:39:27,200
you got the little patch there

1056
00:39:30,470 --> 00:39:28,640
in fact i was observing a little latin

1057
00:39:31,510 --> 00:39:30,480
phrase that at the bottom what was what

1058
00:39:33,109 --> 00:39:31,520
does that say

1059
00:39:37,829 --> 00:39:33,119
um

1060
00:39:41,670 --> 00:39:40,870
right what is the team doing to save the

1061
00:39:43,670 --> 00:39:41,680
day

1062
00:39:46,550 --> 00:39:43,680
well i manage the near earth object

1063
00:39:49,910 --> 00:39:46,560

observations program which is involved

1064
00:39:52,310 --> 00:39:49,920
which funds projects to find and track

1065
00:39:54,790 --> 00:39:52,320
and characterize near earth asteroids so

1066
00:39:57,349 --> 00:39:54,800
uh like the at the university of hawaii

1067
00:39:59,270 --> 00:39:57,359
the pan-starrs and atlas

1068
00:40:01,109 --> 00:39:59,280
surveys and management of nasa's

1069
00:40:03,349 --> 00:40:01,119
infrared telescope facility or at the

1070
00:40:05,670 --> 00:40:03,359
university of arizona the catalina sky

1071
00:40:08,230 --> 00:40:05,680
survey and space watch and space watch

1072
00:40:10,230 --> 00:40:08,240
actually discovered ditamos the target

1073
00:40:11,670 --> 00:40:10,240
of the dart mission uh the center for

1074
00:40:13,829 --> 00:40:11,680
near earth object studies i know we're

1075
00:40:15,829 --> 00:40:13,839
gonna have a video from ryan park uh

1076
00:40:18,710 --> 00:40:15,839
about uh uh

1077
00:40:20,950 --> 00:40:18,720
calculating the orbits uh based on those

1078
00:40:22,470 --> 00:40:20,960
observations uh and from observations

1079
00:40:24,470 --> 00:40:22,480
around the world because if you don't

1080
00:40:25,990 --> 00:40:24,480
find the asteroids and you don't

1081
00:40:27,670 --> 00:40:26,000
find out where they're going to be in

1082
00:40:29,750 --> 00:40:27,680
the future by calculating their orbits

1083
00:40:32,069 --> 00:40:29,760
then you can't have you know a mission

1084
00:40:34,550 --> 00:40:32,079
like darts you have to know where the

1085
00:40:36,630 --> 00:40:34,560
asteroids are and so for people to

1086
00:40:39,349 --> 00:40:36,640
understand the difference i hear this a

1087
00:40:41,670 --> 00:40:39,359
lot you know okay what are asteroids and

1088
00:40:43,190 --> 00:40:41,680

how are they different from comets and

1089
00:40:44,790 --> 00:40:43,200
meteors

1090
00:40:46,710 --> 00:40:44,800
well and again that's something you know

1091
00:40:49,190 --> 00:40:46,720
maybe ryan can tell us about that if we

1092
00:40:51,349 --> 00:40:49,200
have the video but well we don't have

1093
00:40:53,190 --> 00:40:51,359
the video at the moment we only have you

1094
00:40:54,870 --> 00:40:53,200
oh darn okay well then i guess i'll have

1095
00:40:57,750 --> 00:40:54,880
to do that so

1096
00:40:59,430 --> 00:40:57,760
so asteroids are the objects in space

1097
00:41:02,470 --> 00:40:59,440
anything like larger than a meter in

1098
00:41:04,470 --> 00:41:02,480
size rocky object that's an asteroid

1099
00:41:07,030 --> 00:41:04,480
smaller they're meteoroids but those are

1100
00:41:09,670 --> 00:41:07,040
asteroids in space when asteroids or

1101
00:41:12,470 --> 00:41:09,680
meteoroids enter earth's atmosphere

1102
00:41:15,190 --> 00:41:12,480
and you see that that streak of light as

1103
00:41:17,190 --> 00:41:15,200
uh heats up in the atmosphere there uh

1104
00:41:19,349 --> 00:41:17,200
that phenomenon that visual phenomenon

1105
00:41:20,390 --> 00:41:19,359
is called a meteor and then the pieces

1106
00:41:23,270 --> 00:41:20,400
that survive

1107
00:41:24,790 --> 00:41:23,280
to the surface uh those are meteorites

1108
00:41:25,829 --> 00:41:24,800
that you can go and pick up and then go

1109
00:41:28,710 --> 00:41:25,839
studying

1110
00:41:29,750 --> 00:41:28,720
russia yes exactly some meteorites left

1111
00:41:33,430 --> 00:41:29,760
over

1112
00:41:35,270 --> 00:41:33,440
and then comets are the icy bodies

1113
00:41:37,430 --> 00:41:35,280

in the solar system creating those tails

1114
00:41:39,349 --> 00:41:37,440
as opposed to the asteroids thank you

1115
00:41:41,670 --> 00:41:39,359
for breaking that down we appreciate it

1116
00:41:44,069 --> 00:41:41,680
kelly and of course folks stay tuned

1117
00:41:46,069 --> 00:41:44,079
after liftoff for an entire hour-long

1118
00:41:48,470 --> 00:41:46,079
show we're gonna break down the dart

1119
00:41:50,470 --> 00:41:48,480
mission from a to z as well as the

1120
00:41:52,069 --> 00:41:50,480
spacecraft and then kelly will also help

1121
00:41:54,309 --> 00:41:52,079
us understand what a close approach

1122
00:41:55,910 --> 00:41:54,319
asteroid is if you kind of have heard

1123
00:41:57,589 --> 00:41:55,920
reports about it she really gives a

1124
00:41:59,109 --> 00:41:57,599
great visual we'll check that out a

1125
00:42:00,950 --> 00:41:59,119
little bit and we'll find out what other

1126
00:42:03,190 --> 00:42:00,960
missions are being planned for other

1127
00:42:05,430 --> 00:42:03,200
countries to protect this planet until

1128
00:42:07,829 --> 00:42:05,440
then let's join our commentators marie

1129
00:42:09,589 --> 00:42:07,839
lewis and den gibson inside the mission

1130
00:42:11,030 --> 00:42:09,599
director center to take us through

1131
00:42:14,150 --> 00:42:11,040
liftoff

1132
00:42:16,230 --> 00:42:14,160
all right thank you daryl it is now at t

1133
00:42:18,950 --> 00:42:16,240
minus eight minutes 12 seconds and

1134
00:42:21,670 --> 00:42:18,960
counting there is a live look at space

1135
00:42:24,390 --> 00:42:21,680
launch complex 4 east at vandenberg

1136
00:42:28,069 --> 00:42:24,400
space force base on the central coast of

1137
00:42:30,309 --> 00:42:28,079
california we can see white clouds

1138
00:42:33,990 --> 00:42:30,319

billowing around the falcon 9 rockets

1139
00:42:35,349 --> 00:42:34,000
standing 230 feet tall at the launch pad

1140
00:42:38,150 --> 00:42:35,359
the fairing

1141
00:42:38,950 --> 00:42:38,160
holding the dart spacecraft another 43

1142
00:42:41,270 --> 00:42:38,960
feet

1143
00:42:43,030 --> 00:42:41,280
on top of that the dark spacecraft only

1144
00:42:45,190 --> 00:42:43,040
the size of a vending machine tucked

1145
00:42:46,790 --> 00:42:45,200
safely inside that fairing and that

1146
00:42:49,430 --> 00:42:46,800
venting going on

1147
00:42:51,030 --> 00:42:49,440
is normal venting of liquid oxygen off

1148
00:42:54,150 --> 00:42:51,040
the side of the rocket

1149
00:42:56,870 --> 00:42:54,160
as we are well into the fueling process

1150
00:43:00,390 --> 00:42:56,880
and just t minus seven minutes 30

1151
00:43:03,589 --> 00:43:00,400
seconds away from liftoff of nasa's very

1152
00:43:05,670 --> 00:43:03,599
first planetary defense test yes and and

1153
00:43:07,349 --> 00:43:05,680
some of the the cloud you see coming off

1154
00:43:09,430 --> 00:43:07,359
of the vehicle there is because

1155
00:43:12,069 --> 00:43:09,440
the liquid oxygen in the tanks are just

1156
00:43:13,349 --> 00:43:12,079
so cold so it's really the air is really

1157
00:43:15,349 --> 00:43:13,359
condensing around it and that's what

1158
00:43:17,109 --> 00:43:15,359
you're seeing uh some of that that vapor

1159
00:43:18,069 --> 00:43:17,119
they're coming off of the vehicle

1160
00:43:19,750 --> 00:43:18,079
and

1161
00:43:22,069 --> 00:43:19,760
coming up very shortly we will be

1162
00:43:24,550 --> 00:43:22,079
hearing the call up for stage one engine

1163
00:43:27,670 --> 00:43:24,560

chill has started and basically what

1164
00:43:29,109 --> 00:43:27,680
that is it's it's basically getting the

1165
00:43:30,069 --> 00:43:29,119
engines ready

1166
00:43:31,990 --> 00:43:30,079
for

1167
00:43:33,430 --> 00:43:32,000
engine start it's going to reduce some

1168
00:43:34,790 --> 00:43:33,440
of the thermal stress on the engines and

1169
00:43:35,829 --> 00:43:34,800
that's really what that what's happening

1170
00:43:37,670 --> 00:43:35,839
there

1171
00:43:39,109 --> 00:43:37,680
and uh that should be coming up shortly

1172
00:43:47,670 --> 00:43:39,119
here

1173
00:43:51,430 --> 00:43:49,349
and we just heard that call up engine

1174
00:43:53,270 --> 00:43:51,440
chill it just started and the next event

1175
00:43:54,870 --> 00:43:53,280
that'll be coming up will be the stage

1176
00:43:56,309 --> 00:43:54,880
one rp

1177
00:43:58,390 --> 00:43:56,319
one load complete and that's basically

1178
00:44:00,309 --> 00:43:58,400
they're just topping off the fuel tank

1179
00:44:03,910 --> 00:44:00,319
on the state on the first stage of the

1180
00:44:08,230 --> 00:44:05,910
shortly after that

1181
00:44:09,670 --> 00:44:08,240
the dart spacecraft will transition to

1182
00:44:12,150 --> 00:44:09,680
internal power

1183
00:44:16,790 --> 00:44:12,160
that happens right around t minus five

1184
00:44:21,430 --> 00:44:19,910
and liftoff time tonight is at 10 21

1185
00:44:32,069 --> 00:44:21,440
and two seconds

1186
00:44:35,349 --> 00:44:34,470
and we're still progressing towards t

1187
00:44:39,910 --> 00:44:35,359
zero

1188
00:44:43,990 --> 00:44:41,030

everything is

1189
00:44:47,750 --> 00:44:46,309
and at this stage in the game

1190
00:44:50,069 --> 00:44:47,760
soon coming up soon another thing you

1191
00:44:52,309 --> 00:44:50,079
will start to hear discussion about the

1192
00:44:53,750 --> 00:44:52,319
strongback and basically the strongback

1193
00:44:55,030 --> 00:44:53,760
is that

1194
00:44:57,109 --> 00:44:55,040
fixture you see on the side of the

1195
00:44:58,790 --> 00:44:57,119
falcon 9 there

1196
00:45:02,470 --> 00:44:58,800
that is basically supporting the falcon

1197
00:45:03,510 --> 00:45:02,480
9 leading into launch it provides the

1198
00:45:08,230 --> 00:45:03,520
power

1199
00:45:17,510 --> 00:45:08,240
into the falcon 9 while standing on the

1200
00:45:21,430 --> 00:45:19,109
and we should be spacecraft is on

1201
00:45:23,750 --> 00:45:21,440
internal power

1202
00:45:27,190 --> 00:45:23,760
we just heard a call out for spacecraft

1203
00:45:31,190 --> 00:45:28,870
it's good news exactly what we want to

1204
00:45:33,990 --> 00:45:31,200
hear our view a little bit obstructed

1205
00:45:36,230 --> 00:45:34,000
right now by the venting off the side of

1206
00:45:38,150 --> 00:45:36,240
the rocket and that structure you see

1207
00:45:39,349 --> 00:45:38,160
just to the right is the transporter

1208
00:45:42,550 --> 00:45:39,359
erector

1209
00:45:44,630 --> 00:45:42,560
um and that is uh this strongback it's

1210
00:45:47,349 --> 00:45:44,640
hard to see uh behind the venting but

1211
00:45:49,829 --> 00:45:47,359
there are a couple of arms kind of

1212
00:45:51,910 --> 00:45:49,839
clamped around the top of the second

1213
00:45:54,470 --> 00:45:51,920

stage of falcon 9 that will be

1214
00:45:56,470 --> 00:45:54,480
opening shortly as that strong back

1215
00:45:58,829 --> 00:45:56,480
begins to recline just a couple of

1216
00:46:01,270 --> 00:45:58,839
degrees in preparation for

1217
00:46:03,270 --> 00:46:01,280
liftoff yeah and one of the call-outs

1218
00:46:04,950 --> 00:46:03,280
you may have heard is the the tanks are

1219
00:46:07,270 --> 00:46:04,960
pressurizing for strongbacker track and

1220
00:46:09,030 --> 00:46:07,280
that's really just the pressurizing the

1221
00:46:10,870 --> 00:46:09,040
tanks to make sure it's the vehicle is

1222
00:46:12,630 --> 00:46:10,880
structurally sound so they can remove

1223
00:46:16,550 --> 00:46:12,640
that support

1224
00:46:19,990 --> 00:46:17,829
and it may be a little bit difficult to

1225
00:46:21,750 --> 00:46:20,000
see the retraction here because of the

1226
00:46:27,990 --> 00:46:21,760
the fog that's around the vehicle right

1227
00:46:33,030 --> 00:46:31,030
nlm ld on countdown one

1228
00:46:34,390 --> 00:46:33,040
ld this is nlm

1229
00:46:35,990 --> 00:46:34,400
we're going to confirm you and your team

1230
00:46:40,150 --> 00:46:36,000
our go for launch

1231
00:46:44,230 --> 00:46:41,670
all right so we just heard that

1232
00:46:45,750 --> 00:46:44,240
confirmation that the nasa team is go

1233
00:46:47,589 --> 00:46:45,760
for launch

1234
00:46:51,910 --> 00:46:47,599
and we can see that strong back uh

1235
00:46:56,630 --> 00:46:53,750
and basically that was the last

1236
00:46:58,390 --> 00:46:56,640
confirmation from the between the nasa

1237
00:47:04,790 --> 00:46:58,400
team and the

1238
00:47:08,390 --> 00:47:06,390

go ahead and next milestone you hear

1239
00:47:10,150 --> 00:47:08,400
coming up would be the stage one locks

1240
00:47:11,349 --> 00:47:10,160
load complete and that's basically

1241
00:47:15,829 --> 00:47:11,359
topping off the

1242
00:47:18,630 --> 00:47:17,349
and that should be coming up here

1243
00:47:20,549 --> 00:47:18,640
shortly

1244
00:47:22,630 --> 00:47:20,559
and you can see a little bit better on

1245
00:47:24,630 --> 00:47:22,640
your screen now that the stage one locks

1246
00:47:26,870 --> 00:47:24,640
load complete yup just heard that

1247
00:47:28,309 --> 00:47:26,880
confirmation so the stage one is

1248
00:47:30,230 --> 00:47:28,319
completely topped off a fuel and

1249
00:47:32,230 --> 00:47:30,240
oxidizer so we're looking good on stage

1250
00:47:34,069 --> 00:47:32,240
one right now and shortly coming up

1251
00:47:37,349 --> 00:47:34,079
you'll hear them talking off the stage

1252
00:47:41,910 --> 00:47:39,030
there's a wider view now of the

1253
00:47:43,030 --> 00:47:41,920
transporter erector you can see uh that

1254
00:47:45,349 --> 00:47:43,040
recline

1255
00:47:47,190 --> 00:47:45,359
um and as we get into those final

1256
00:47:49,670 --> 00:47:47,200
seconds before liftoff we will see that

1257
00:47:52,309 --> 00:47:49,680
recline even further all the way to 45

1258
00:47:54,950 --> 00:47:52,319
degrees uh just before liftoff clearing

1259
00:47:56,790 --> 00:47:54,960
the way for dart to take flight

1260
00:47:59,190 --> 00:47:56,800
yeah and as you see the strong back is

1261
00:48:00,630 --> 00:47:59,200
is tilted back with a little bit you see

1262
00:48:02,309 --> 00:48:00,640
some cables that are still connected to

1263
00:48:03,190 --> 00:48:02,319

the falcon 9 those are the umbilicals

1264
00:48:05,510 --> 00:48:03,200
that are

1265
00:48:06,950 --> 00:48:05,520
still providing

1266
00:48:08,150 --> 00:48:06,960
power and fluids

1267
00:48:10,790 --> 00:48:08,160
to the

1268
00:48:13,190 --> 00:48:10,800
falcon 9. and at liftoff they will

1269
00:48:14,950 --> 00:48:13,200
disconnect and the tromback will move

1270
00:48:22,470 --> 00:48:14,960
even further out of the way and to give

1271
00:48:26,950 --> 00:48:24,950
we'll have a series of rapid events uh

1272
00:48:29,430 --> 00:48:26,960
after liftoff that will guide you

1273
00:48:31,910 --> 00:48:29,440
through with that progress bar

1274
00:48:38,710 --> 00:48:31,920
and falcon 9 will have two burns for

1275
00:48:42,309 --> 00:48:40,790
stage two locks load complete

1276
00:48:43,990 --> 00:48:42,319
we just got that confirmation the stage

1277
00:48:45,910 --> 00:48:44,000
two locks load complete at this point in

1278
00:48:47,510 --> 00:48:45,920
time all of the propellants are have

1279
00:48:49,430 --> 00:48:47,520
been loaded onto the launch vehicle and

1280
00:48:51,829 --> 00:48:49,440
everything's looking good

1281
00:48:53,829 --> 00:48:51,839
and in the meantime the spacex drone

1282
00:48:55,109 --> 00:48:53,839
ship of course i still love you is

1283
00:48:57,829 --> 00:48:55,119
standing by

1284
00:49:00,230 --> 00:48:57,839
in the pacific ocean ready to receive

1285
00:49:03,349 --> 00:49:00,240
the first stage uh booster

1286
00:49:06,150 --> 00:49:03,359
uh that will be landing a little more

1287
00:49:08,390 --> 00:49:06,160
than nine minutes uh after liftoff on

1288
00:49:11,670 --> 00:49:08,400

the drone ship we don't expect to uh

1289
00:49:14,150 --> 00:49:11,680
hear sonic booms here on land uh because

1290
00:49:16,390 --> 00:49:14,160
it's it's uh coming down in the pacific

1291
00:49:18,309 --> 00:49:16,400
ocean so if you were here for sentinel 6

1292
00:49:19,990 --> 00:49:18,319
you probably heard those a couple of

1293
00:49:22,150 --> 00:49:20,000
sonic booms uh that was because the

1294
00:49:24,069 --> 00:49:22,160
booster was landing on land uh not the

1295
00:49:25,430 --> 00:49:24,079
case this time

1296
00:49:27,829 --> 00:49:25,440
yeah it would be awesome to hear it

1297
00:49:29,589 --> 00:49:27,839
though it's a falcon 9's and startup

1298
00:49:30,950 --> 00:49:29,599
it's awesome to see we just heard a call

1299
00:49:32,549 --> 00:49:30,960
out that is falconized in startup that

1300
00:49:35,270 --> 00:49:32,559
means it's going through its its startup

1301
00:49:36,630 --> 00:49:35,280
sequences the play computer is taken

1302
00:49:41,750 --> 00:49:36,640
over and it's

1303
00:49:47,670 --> 00:49:45,430
falcon 9 dart go for launch

1304
00:49:51,349 --> 00:49:47,680
we just heard that final call that

1305
00:49:54,549 --> 00:49:51,359
falcon 9 and dart are go for launch

1306
00:50:07,030 --> 00:49:54,559
t minus 35 seconds and counting

1307
00:50:14,870 --> 00:50:09,510
t minus 20 seconds

1308
00:50:16,870 --> 00:50:15,910
10

1309
00:50:17,750 --> 00:50:16,880
9

1310
00:50:18,630 --> 00:50:17,760
8

1311
00:50:19,589 --> 00:50:18,640
7

1312
00:50:20,630 --> 00:50:19,599
6

1313
00:50:21,589 --> 00:50:20,640

5

1314
00:50:22,549 --> 00:50:21,599
4

1315
00:50:23,589 --> 00:50:22,559
3

1316
00:50:26,230 --> 00:50:23,599
2

1317
00:50:27,349 --> 00:50:26,240
1.

1318
00:50:33,349 --> 00:50:27,359
and

1319
00:50:40,870 --> 00:50:33,359
nasa's first planetary defense test to

1320
00:50:44,630 --> 00:50:42,710
so we're getting a nice view of the

1321
00:50:46,950 --> 00:50:44,640
onboard cameras from the falcon 9 so you

1322
00:50:48,710 --> 00:50:46,960
can see it looking towards the

1323
00:50:50,309 --> 00:50:48,720
first the

1324
00:50:53,510 --> 00:50:50,319
aft end of the first stage and you can

1325
00:50:53,990 --> 00:50:53,520
see those engines coming to

1326
00:50:57,109 --> 00:50:54,000
stage life

1327
00:51:01,349 --> 00:50:59,670
and falcon 9 will be reaching max q in

1328
00:51:03,910 --> 00:51:01,359
just seconds the moment of peak

1329
00:51:05,589 --> 00:51:03,920
mechanical stress on the rocket

1330
00:51:07,589 --> 00:51:05,599
and and here in the mission data center

1331
00:51:08,870 --> 00:51:07,599
we can feel the rumble from the falcon 9

1332
00:51:11,109 --> 00:51:08,880
and it's

1333
00:51:15,750 --> 00:51:11,119
always amazing to hear and feel power

1334
00:51:19,270 --> 00:51:17,349
everything looks good right now it's

1335
00:51:22,390 --> 00:51:19,280
really shaking the building where we are

1336
00:51:25,270 --> 00:51:22,400
vehicles supersonic

1337
00:51:32,150 --> 00:51:25,280
just heard that call out for supersonic

1338
00:51:41,750 --> 00:51:33,750

max q

1339
00:51:44,390 --> 00:51:42,870
and everything's looking good we're

1340
00:51:47,910 --> 00:51:44,400
still getting some nice views of the

1341
00:51:59,750 --> 00:51:50,150
and we should be coming up on main

1342
00:52:04,710 --> 00:52:01,990
so far everything's looking good

1343
00:52:07,349 --> 00:52:04,720
uh our reports are nominal and that

1344
00:52:09,109 --> 00:52:07,359
killer started

1345
00:52:10,549 --> 00:52:09,119
we just heard the

1346
00:52:12,630 --> 00:52:10,559
call off and back chills that's where

1347
00:52:17,349 --> 00:52:12,640
it's getting ready prepared uh second

1348
00:52:22,710 --> 00:52:19,670
now that main engine cutoff or miko we

1349
00:52:24,790 --> 00:52:22,720
expect at t plus two minutes 30 seconds

1350
00:52:26,790 --> 00:52:24,800
and then almost immediately after that

1351
00:52:28,150 --> 00:52:26,800
the first and second stage of falcon 9

1352
00:52:31,190 --> 00:52:28,160
will separate

1353
00:52:32,390 --> 00:52:31,200
followed by uh the stage two first

1354
00:52:34,470 --> 00:52:32,400
ignition

1355
00:52:37,109 --> 00:52:34,480
and then shortly thereafter the jettison

1356
00:52:43,750 --> 00:52:37,119
fairing at about t plus three minutes

1357
00:52:48,470 --> 00:52:47,030
so far nominal liftoff and as if you

1358
00:52:50,549 --> 00:52:48,480
notice the the

1359
00:52:51,910 --> 00:52:50,559
the plume or the the flame coming from

1360
00:52:54,390 --> 00:52:51,920
the engines have gotten bigger that

1361
00:52:56,950 --> 00:52:54,400
means it's high in the atmosphere where

1362
00:53:12,630 --> 00:52:56,960
the atmosphere isn't compressing the

1363
00:53:18,309 --> 00:53:15,109

in recognition

1364
00:53:21,670 --> 00:53:18,319
so we just got confirmation of

1365
00:53:26,390 --> 00:53:21,680
mikko stage separation and stage two

1366
00:53:31,270 --> 00:53:29,030
and so this is a view of the

1367
00:53:34,790 --> 00:53:31,280
stage one falcon 9 booster you can see

1368
00:53:36,790 --> 00:53:34,800
those uh hypersonic grid fins uh

1369
00:53:39,750 --> 00:53:36,800
beginning to extend the the shot is a

1370
00:53:41,750 --> 00:53:39,760
little bit dark but you can see them uh

1371
00:53:43,349 --> 00:53:41,760
extended out from the base separation

1372
00:53:45,030 --> 00:53:43,359
confirmed

1373
00:53:49,109 --> 00:53:45,040
the booster we just heard confirmation

1374
00:53:50,950 --> 00:53:49,119
that uh the jettison fairing is complete

1375
00:53:53,750 --> 00:53:50,960
and those hypersonic grid fins help

1376
00:53:55,510 --> 00:53:53,760
guide the falcon 9 booster back down

1377
00:53:57,510 --> 00:53:55,520
towards earth again it's heading towards

1378
00:53:59,670 --> 00:53:57,520
the of course i still love you

1379
00:54:02,470 --> 00:53:59,680
drone ship

1380
00:54:04,069 --> 00:54:02,480
stage two on nominal trajectory

1381
00:54:06,069 --> 00:54:04,079
so we just heard everything's looking

1382
00:54:07,990 --> 00:54:06,079
good for stage two you heard the

1383
00:54:08,950 --> 00:54:08,000
positive confirmation of

1384
00:54:12,390 --> 00:54:08,960
fairing

1385
00:54:14,309 --> 00:54:12,400
jettison and um the

1386
00:54:15,510 --> 00:54:14,319
falcon 9 booster will be coming back

1387
00:54:17,829 --> 00:54:15,520
they'll be doing two burns they'll be

1388
00:54:19,510 --> 00:54:17,839

doing a boost back burn to get it closer

1389
00:54:20,390 --> 00:54:19,520
to the of course i still love you that's

1390
00:54:22,230 --> 00:54:20,400
sitting

1391
00:54:24,390 --> 00:54:22,240
about 400 miles south of where we are

1392
00:54:26,150 --> 00:54:24,400
off the coast of baja california and

1393
00:54:31,190 --> 00:54:26,160
then they'll do another burning for when

1394
00:54:37,589 --> 00:54:33,750
we're at t plus four minutes six seconds

1395
00:54:39,670 --> 00:54:37,599
and so far uh nominal ascent of the dart

1396
00:54:42,710 --> 00:54:39,680
mission nasa's first planetary defense

1397
00:54:46,549 --> 00:54:45,510
falcon 9 booster will begin its reentry

1398
00:54:49,349 --> 00:54:46,559
burn

1399
00:54:52,309 --> 00:54:49,359
in a little over three minutes

1400
00:54:54,069 --> 00:54:52,319
so so far everything's looking great and

1401
00:54:55,349 --> 00:54:54,079
that's exactly what we wanted to hear it

1402
00:54:57,109 --> 00:54:55,359
was

1403
00:54:58,710 --> 00:54:57,119
it's awesome to hear it and feel

1404
00:55:00,470 --> 00:54:58,720
launched while we're sitting here in the

1405
00:55:01,910 --> 00:55:00,480
mission data center yeah that rumble

1406
00:55:04,630 --> 00:55:01,920
never gets old

1407
00:55:07,349 --> 00:55:04,640
and hard to believe in

1408
00:55:09,510 --> 00:55:07,359
about 11 months from now that

1409
00:55:13,030 --> 00:55:09,520
that dart spacecraft the size of a

1410
00:55:14,630 --> 00:55:13,040
vending machine is going to

1411
00:55:15,670 --> 00:55:14,640
crash head-on

1412
00:55:18,710 --> 00:55:15,680
into

1413
00:55:20,470 --> 00:55:18,720

dimorphous at the speed of 15 000 miles

1414
00:55:23,030 --> 00:55:20,480
per hour yeah

1415
00:55:25,750 --> 00:55:23,040
and as we were talking about before how

1416
00:55:28,390 --> 00:55:25,760
fast is 15 000 miles an hour i mean it's

1417
00:55:29,589 --> 00:55:28,400
like going from new york city to los

1418
00:55:30,710 --> 00:55:29,599
angeles

1419
00:55:48,549 --> 00:55:30,720
in

1420
00:55:50,630 --> 00:55:48,559
video um

1421
00:55:51,510 --> 00:55:50,640
that's looking at

1422
00:55:54,069 --> 00:55:51,520
the

1423
00:55:56,230 --> 00:55:54,079
interstage

1424
00:55:58,309 --> 00:55:56,240
we're obviously having some technical

1425
00:56:02,069 --> 00:55:58,319
issues with some of our video feeds page

1426
00:56:04,549 --> 00:56:02,079
two on nominal trajectory

1427
00:56:06,069 --> 00:56:04,559
to get those feeds uh

1428
00:56:07,910 --> 00:56:06,079
get those kinks worked out so we can get

1429
00:56:09,750 --> 00:56:07,920
those views back for you but in the

1430
00:56:11,589 --> 00:56:09,760
meantime we will continue to talk you

1431
00:56:12,630 --> 00:56:11,599
through everything that we're hearing uh

1432
00:56:15,030 --> 00:56:12,640
we can't

1433
00:56:18,230 --> 00:56:15,040
see those views but we are hearing that

1434
00:56:20,549 --> 00:56:18,240
everything is nominal and on track yeah

1435
00:56:22,710 --> 00:56:20,559
and as we and as you've heard before we

1436
00:56:24,150 --> 00:56:22,720
it may be difficult sometimes to get the

1437
00:56:27,190 --> 00:56:24,160
video from the

1438
00:56:29,270 --> 00:56:27,200

stage one landing um it's coming in very

1439
00:56:38,870 --> 00:56:29,280
fast and sometimes it's hard to get that

1440
00:56:43,109 --> 00:56:41,030
okay we can see uh and we see a view

1441
00:56:52,150 --> 00:56:43,119
there it's just uh it's just very dark

1442
00:57:04,950 --> 00:56:53,910
okay so look how we're getting some good

1443
00:57:04,960 --> 00:57:09,589
stage one fts is safe

1444
00:57:18,230 --> 00:57:13,349
stage one entry burn startup all right

1445
00:57:32,069 --> 00:57:19,670
now you've got a better look at those

1446
00:57:38,630 --> 00:57:35,430
it's always amazing to see

1447
00:57:42,150 --> 00:57:38,640
stage one coming back in for a landing

1448
00:57:42,160 --> 00:57:45,990
all right this is

1449
00:58:03,829 --> 00:57:48,230
okay we've got a beautiful shot of stage

1450
00:58:03,839 --> 00:58:13,910
terminal guidance

1451
00:58:18,870 --> 00:58:16,870
and with what we're looking at is the

1452
00:58:23,670 --> 00:58:18,880
nozzle of stage two and you see it glow

1453
00:58:30,870 --> 00:58:24,870
at this point in time everything's

1454
00:58:35,510 --> 00:58:33,270
and what you're seeing is that uh mvac

1455
00:58:37,430 --> 00:58:35,520
engine on the falcon 9 second stage

1456
00:58:41,109 --> 00:58:37,440
glowing

1457
00:58:42,710 --> 00:58:41,119
engine

1458
00:58:44,710 --> 00:58:42,720
shut down

1459
00:58:45,510 --> 00:58:44,720
so stage two just completed its first

1460
00:58:52,630 --> 00:58:45,520
burn

1461
00:58:54,549 --> 00:58:52,640
helping to circularize the orbit after

1462
00:58:57,510 --> 00:58:54,559
it's nominal or the launch vehicle has

1463
00:58:58,870 --> 00:58:57,520

gotten off of stage 1 the surface of the

1464
00:59:00,470 --> 00:58:58,880
earth

1465
00:59:01,910 --> 00:59:00,480
and then you would and then there's a

1466
00:59:03,270 --> 00:59:01,920
second burn that'll be coming up but

1467
00:59:04,870 --> 00:59:03,280
right now

1468
00:59:07,109 --> 00:59:04,880
we're getting the landing burn from the

1469
00:59:08,789 --> 00:59:07,119
stage one

1470
00:59:11,349 --> 00:59:08,799
it's coming in for his landing looks

1471
00:59:14,069 --> 00:59:11,359
like we're getting some good video

1472
00:59:15,510 --> 00:59:14,079
stage one landing leg deploy

1473
00:59:23,109 --> 00:59:15,520
you can see just you can see the drone

1474
00:59:26,870 --> 00:59:24,470
alright so we're back we're getting

1475
00:59:31,270 --> 00:59:26,880
another view of stage two

1476
00:59:37,270 --> 00:59:33,589
and we just heard positive confirmation

1477
00:59:41,430 --> 00:59:39,109
yeah it's tricky to uh maintain that

1478
00:59:42,710 --> 00:59:41,440
feed from the the drone ship uh at the

1479
00:59:45,430 --> 00:59:42,720
moment of landing but we do have

1480
00:59:48,309 --> 00:59:45,440
confirmation that uh the first stage

1481
00:59:50,069 --> 00:59:48,319
booster has landed uh safely and

1482
00:59:51,829 --> 00:59:50,079
successfully on the of course i still

1483
00:59:54,789 --> 00:59:51,839
love you

1484
00:59:56,390 --> 00:59:54,799
off the coast of baja california

1485
00:59:58,549 --> 00:59:56,400
and so now

1486
01:00:01,510 --> 00:59:58,559
uh we are in the first

1487
01:00:03,030 --> 01:00:01,520
coast phase of the falcon 9 second stage

1488
01:00:05,270 --> 01:00:03,040

of course still attached to the dart

1489
01:00:06,069 --> 01:00:05,280
spacecraft so it's going to be coasting

1490
01:00:08,150 --> 01:00:06,079
for

1491
01:00:10,470 --> 01:00:08,160
uh the next

1492
01:00:13,270 --> 01:00:10,480
uh 20 minutes or so give or take and

1493
01:00:14,710 --> 01:00:13,280
then a second burn we'll get started so

1494
01:00:17,349 --> 01:00:14,720
we're going to keep an ear on things but

1495
01:00:19,670 --> 01:00:17,359
for now uh we want to learn a little bit

1496
01:00:22,150 --> 01:00:19,680
more about darts mission and to kick us

1497
01:00:24,230 --> 01:00:22,160
off we want to hear from the director of

1498
01:00:26,710 --> 01:00:24,240
a new hollywood movie about a

1499
01:00:28,470 --> 01:00:26,720
cataclysmic comet

1500
01:00:30,870 --> 01:00:28,480
i heard there's an asteroid tell me

1501
01:00:35,750 --> 01:00:33,109
hi i'm adam mckay director of don't look

1502
01:00:40,549 --> 01:00:37,750
our movie is about three scientists who

1503
01:00:43,030 --> 01:00:40,559
tried desperately to warn the planet of

1504
01:00:45,270 --> 01:00:43,040
an impending doomsday comet and are

1505
01:00:48,390 --> 01:00:45,280
ignored our movie's made up it's a

1506
01:00:51,349 --> 01:00:48,400
comedy but in fact the brilliant

1507
01:00:54,309 --> 01:00:51,359
scientists at nasa are actually

1508
01:00:57,589 --> 01:00:54,319
launching a mission it's called dart the

1509
01:00:59,109 --> 01:00:57,599
double asteroid redirection test

1510
01:01:02,069 --> 01:00:59,119
and what they're going to test is can

1511
01:01:04,870 --> 01:01:02,079
you send up a mission that can deflect

1512
01:01:07,670 --> 01:01:04,880
an asteroid and steer it away from earth

1513
01:01:08,950 --> 01:01:07,680

if god forbid something like that were

1514
01:01:10,630 --> 01:01:08,960
ever to happen

1515
01:01:16,870 --> 01:01:10,640
remember to keep an eye out for it it's

1516
01:01:21,190 --> 01:01:19,190
thanks to adam mckay of the soon to be

1517
01:01:23,750 --> 01:01:21,200
released science fiction comedy don't

1518
01:01:26,630 --> 01:01:23,760
look up folks we are back inside the

1519
01:01:28,950 --> 01:01:26,640
nasa hangar and though the movie is not

1520
01:01:31,750 --> 01:01:28,960
real the double asteroid redirection

1521
01:01:34,470 --> 01:01:31,760
test or dart is real and we are ready to

1522
01:01:37,109 --> 01:01:34,480
show you every aspect of this mission

1523
01:01:39,430 --> 01:01:37,119
with the experts who know so welcome up

1524
01:01:42,309 --> 01:01:39,440
back everyone i'm daryl nail and with me

1525
01:01:45,030 --> 01:01:42,319
is kelly fast program scientist with the

1526
01:01:46,390 --> 01:01:45,040
planetary defense coordination office we

1527
01:01:48,789 --> 01:01:46,400
hope you really enjoyed watching the

1528
01:01:50,950 --> 01:01:48,799
launch i know kelly did because as it

1529
01:01:52,870 --> 01:01:50,960
was going up you were going go go pump

1530
01:01:55,109 --> 01:01:52,880
in your fist

1531
01:01:56,470 --> 01:01:55,119
that was so exciting to hear the rumble

1532
01:01:57,750 --> 01:01:56,480
of the uh

1533
01:01:59,510 --> 01:01:57,760
of the rocket noise come through the

1534
01:02:01,190 --> 01:01:59,520
hangar here but then just again being so

1535
01:02:03,430 --> 01:02:01,200
excited for the team that has worked so

1536
01:02:05,589 --> 01:02:03,440
hard on this i know they are partying it

1537
01:02:07,349 --> 01:02:05,599
up uh wherever they're watching from and

1538
01:02:09,109 --> 01:02:07,359

so i'm so excited for that yes

1539
01:02:10,230 --> 01:02:09,119
especially that launch viewing location

1540
01:02:11,990 --> 01:02:10,240
out there i heard that it was a

1541
01:02:13,910 --> 01:02:12,000
fantastic view

1542
01:02:15,029 --> 01:02:13,920
and that was pretty neat to see at least

1543
01:02:17,190 --> 01:02:15,039
the first part of the landing where it

1544
01:02:19,349 --> 01:02:17,200
was coming down illuminated the ship but

1545
01:02:21,349 --> 01:02:19,359
even more so to see that dart spacecraft

1546
01:02:23,349 --> 01:02:21,359
and the fairing come come out there it

1547
01:02:24,870 --> 01:02:23,359
is go into space oh

1548
01:02:26,309 --> 01:02:24,880
it's i know we're not out of the woods

1549
01:02:28,950 --> 01:02:26,319
yet we still got to get that all the way

1550
01:02:31,029 --> 01:02:28,960
out to demorphos but this is a huge step

1551
01:02:32,470 --> 01:02:31,039
along the way absolutely that is very

1552
01:02:34,150 --> 01:02:32,480
important because there is a lot more

1553
01:02:36,470 --> 01:02:34,160
work to do to get this and of course

1554
01:02:38,470 --> 01:02:36,480
we're going to be tracking all of that

1555
01:02:40,549 --> 01:02:38,480
um you know going back to that movie

1556
01:02:43,029 --> 01:02:40,559
trailer you know hollywood's always had

1557
01:02:45,910 --> 01:02:43,039
fun with asteroids and you know ending

1558
01:02:48,309 --> 01:02:45,920
the earth with one of them but um the

1559
01:02:49,750 --> 01:02:48,319
movie's called don't look up but really

1560
01:02:51,910 --> 01:02:49,760
you're kind of evidence that we're

1561
01:02:53,510 --> 01:02:51,920
looking up more now than ever

1562
01:02:55,430 --> 01:02:53,520
i like that adam mckay kind of put it

1563
01:02:57,190 --> 01:02:55,440

into context that it's fiction it's a

1564
01:02:58,789 --> 01:02:57,200
comedy but you know in the real world

1565
01:03:01,349 --> 01:02:58,799
there's a lot of work going on with a

1566
01:03:03,430 --> 01:03:01,359
lot of scientists

1567
01:03:06,150 --> 01:03:03,440
looking for near earth asteroids getting

1568
01:03:07,990 --> 01:03:06,160
them cataloged uh there's an interac

1569
01:03:09,510 --> 01:03:08,000
international asteroid warning network

1570
01:03:11,510 --> 01:03:09,520
there's astronomers around the world

1571
01:03:13,109 --> 01:03:11,520
doing this and it's it's a big focus at

1572
01:03:14,950 --> 01:03:13,119
nasa and so

1573
01:03:17,510 --> 01:03:14,960
it's the only natural disaster that we

1574
01:03:19,750 --> 01:03:17,520
could prevent an asteroid impact and so

1575
01:03:22,230 --> 01:03:19,760
why not use your capabilities to look

1576
01:03:24,549 --> 01:03:22,240
you know to the extent that you can

1577
01:03:26,870 --> 01:03:24,559
rack those up and then do something like

1578
01:03:29,190 --> 01:03:26,880
darts that you've got a tool in in the

1579
01:03:31,190 --> 01:03:29,200
toolbox there absolutely and there's so

1580
01:03:33,029 --> 01:03:31,200
much more to talk about

1581
01:03:34,390 --> 01:03:33,039
you know there are other ways i've heard

1582
01:03:36,309 --> 01:03:34,400
that we could do this this is one we're

1583
01:03:38,630 --> 01:03:36,319
testing we'll talk to lori glaze about

1584
01:03:40,710 --> 01:03:38,640
that and then we'll also uh have your

1585
01:03:42,230 --> 01:03:40,720
close approach demonstration which we're

1586
01:03:43,829 --> 01:03:42,240
look really looking forward to so that's

1587
01:03:45,670 --> 01:03:43,839
coming up in just a bit so in the next

1588
01:03:47,910 --> 01:03:45,680

hour we are going to tell you everything

1589
01:03:49,829 --> 01:03:47,920
you ever wanted to know about asteroids

1590
01:03:51,990 --> 01:03:49,839
and break down the dart mission from a

1591
01:03:55,829 --> 01:03:52,000
to z and we're going to start with an

1592
01:03:59,589 --> 01:03:57,670
in case there was an asteroid coming

1593
01:04:02,069 --> 01:03:59,599
towards earth and you're there you can

1594
01:04:04,870 --> 01:04:02,079
actually stop it i mean that's kind of

1595
01:04:07,190 --> 01:04:04,880
fantastic nasa is crashing a spacecraft

1596
01:04:09,510 --> 01:04:07,200
into an asteroid what you think science

1597
01:04:11,910 --> 01:04:09,520
fiction but this is real never in my

1598
01:04:13,670 --> 01:04:11,920
life would i have thought i would take a

1599
01:04:16,470 --> 01:04:13,680
couple hundred million dollar spacecraft

1600
01:04:18,789 --> 01:04:16,480
and crash it into an asteroid

1601
01:04:20,950 --> 01:04:18,799
my name is michelle chen i'm lena adams

1602
01:04:23,109 --> 01:04:20,960
my name is kelly fast i'm andy rifkind

1603
01:04:24,950 --> 01:04:23,119
i'm justina srovitz and i help tell the

1604
01:04:27,750 --> 01:04:24,960
story of the dart mission i'm a

1605
01:04:29,430 --> 01:04:27,760
planetary defender and i study how the

1606
01:04:31,510 --> 01:04:29,440
orbits of asteroids change after we hit

1607
01:04:33,270 --> 01:04:31,520
them the spacecraft my job is primarily

1608
01:04:34,789 --> 01:04:33,280
to make sure all the systems on the

1609
01:04:38,230 --> 01:04:34,799
spacecraft work together the dart

1610
01:04:40,069 --> 01:04:38,240
mission is nasa's first test of a

1611
01:04:42,150 --> 01:04:40,079
planetary defense technique called

1612
01:04:44,230 --> 01:04:42,160
kinetic impactor dart is the double

1613
01:04:46,870 --> 01:04:44,240

asteroid redirection test it's just a

1614
01:04:49,510 --> 01:04:46,880
spacecraft that is going to go and smack

1615
01:04:51,990 --> 01:04:49,520
an asteroid the moonlit dimorphose which

1616
01:04:54,230 --> 01:04:52,000
orbits the asteroid dynamos and see if

1617
01:04:56,150 --> 01:04:54,240
we can change his trajectory just a

1618
01:04:58,390 --> 01:04:56,160
little bit in order to show that we can

1619
01:05:00,549 --> 01:04:58,400
deflect incoming asteroids if we need to

1620
01:05:03,750 --> 01:05:00,559
dart will only be changing the period of

1621
01:05:06,150 --> 01:05:03,760
the orbit of dimorphose by a tiny amount

1622
01:05:08,150 --> 01:05:06,160
but in space just a little bit is just

1623
01:05:10,069 --> 01:05:08,160
enough to make an asteroid actually miss

1624
01:05:13,349 --> 01:05:10,079
us in the event that an asteroid is

1625
01:05:15,829 --> 01:05:13,359
discovered well ahead of time before it

1626
01:05:17,990 --> 01:05:15,839
might impact earth behind me you see the

1627
01:05:19,910 --> 01:05:18,000
spacecraft it's really cool to see it

1628
01:05:22,390 --> 01:05:19,920
coming together in real life it is

1629
01:05:25,430 --> 01:05:22,400
fantastic to see it in real life to see

1630
01:05:28,549 --> 01:05:25,440
it turn from ideas into real pieces that

1631
01:05:30,710 --> 01:05:28,559
are gonna go into space the solar arrays

1632
01:05:32,789 --> 01:05:30,720
will actually roll out to 28 feet in

1633
01:05:34,150 --> 01:05:32,799
length once the solar rays are deployed

1634
01:05:36,549 --> 01:05:34,160
it's going to be the size of a school

1635
01:05:38,710 --> 01:05:36,559
bus as the solar array opens up it's

1636
01:05:40,390 --> 01:05:38,720
going to swing out in this direction the

1637
01:05:42,950 --> 01:05:40,400
asteroid's only two football fields

1638
01:05:45,750 --> 01:05:42,960

inside we're flying at over six

1639
01:05:47,510 --> 01:05:45,760
kilometers a second 30 days out we see

1640
01:05:49,190 --> 01:05:47,520
one pixel on our field of view you can

1641
01:05:51,349 --> 01:05:49,200
see the dynamos and demorphos is one

1642
01:05:53,190 --> 01:05:51,359
point of light about four hours out our

1643
01:05:55,029 --> 01:05:53,200
spacecraft becomes autonomous and then

1644
01:05:57,430 --> 01:05:55,039
that's where everything gets really

1645
01:06:00,630 --> 01:05:57,440
exciting you actually are seeing

1646
01:06:02,230 --> 01:06:00,640
impact we're super excited and nervous

1647
01:06:04,710 --> 01:06:02,240
as well i feel really honored and

1648
01:06:08,470 --> 01:06:04,720
humbled to be working in an area of

1649
01:06:10,950 --> 01:06:08,480
science that has such a broader impact

1650
01:06:13,589 --> 01:06:10,960
figuratively and literally

1651
01:06:15,750 --> 01:06:13,599
so dark the dinosaurs are made

1652
01:06:18,630 --> 01:06:15,760
completely extinct by an asteroid impact

1653
01:06:20,630 --> 01:06:18,640
so many years ago here we are we can

1654
01:06:26,870 --> 01:06:20,640
actually do something about it i think

1655
01:06:31,990 --> 01:06:28,710
and as was mentioned in there this is

1656
01:06:33,430 --> 01:06:32,000
the first planetary defense mission and

1657
01:06:35,589 --> 01:06:33,440
this is your office we're talking about

1658
01:06:37,430 --> 01:06:35,599
kelly so for the audience out there that

1659
01:06:39,029 --> 01:06:37,440
that doesn't understand or hasn't heard

1660
01:06:40,549 --> 01:06:39,039
of this before what is the planetary

1661
01:06:41,270 --> 01:06:40,559
defense coordination office what do you

1662
01:06:42,870 --> 01:06:41,280
do

1663
01:06:45,829 --> 01:06:42,880

well right well nasa's actually been

1664
01:06:47,910 --> 01:06:45,839
working on near earth asteroid research

1665
01:06:49,990 --> 01:06:47,920
since 1998 so this has been going on a

1666
01:06:53,829 --> 01:06:50,000
long time but

1667
01:06:55,829 --> 01:06:53,839
in 2016 it was really formalized more in

1668
01:06:57,430 --> 01:06:55,839
the creation of this planetary defense

1669
01:06:59,109 --> 01:06:57,440
coordination office which is in the

1670
01:07:01,990 --> 01:06:59,119
planetary science division at nasa

1671
01:07:03,990 --> 01:07:02,000
headquarters and it takes that legacy

1672
01:07:06,150 --> 01:07:04,000
near earth object observations program

1673
01:07:07,990 --> 01:07:06,160
all the you know the finding them

1674
01:07:09,750 --> 01:07:08,000
part of the program and then combines

1675
01:07:11,430 --> 01:07:09,760
that with these other activities like

1676
01:07:13,670 --> 01:07:11,440
dart like the development of the near

1677
01:07:17,349 --> 01:07:13,680
earth object surveyor space telescope

1678
01:07:19,670 --> 01:07:17,359
like our interagency collaborations like

1679
01:07:22,390 --> 01:07:19,680
we saw with fema there

1680
01:07:24,309 --> 01:07:22,400
are international collaborations and

1681
01:07:26,950 --> 01:07:24,319
formalizing all of that

1682
01:07:29,510 --> 01:07:26,960
and leading the planetary defense

1683
01:07:31,990 --> 01:07:29,520
coordination office uh lindley johnson

1684
01:07:34,630 --> 01:07:32,000
we say he's got the coolest title in the

1685
01:07:35,910 --> 01:07:34,640
solar system as nasa's planetary defense

1686
01:07:38,150 --> 01:07:35,920
officer

1687
01:07:39,910 --> 01:07:38,160
all right and he sure does and i enjoy

1688
01:07:41,589 --> 01:07:39,920

listening to him in that interview

1689
01:07:43,750 --> 01:07:41,599
earlier now throughout the show we will

1690
01:07:46,069 --> 01:07:43,760
be taking the most popular questions

1691
01:07:48,789 --> 01:07:46,079
nasa gets about asteroids and posing

1692
01:07:51,190 --> 01:07:48,799
them to experts like kelly this next

1693
01:07:52,390 --> 01:07:51,200
question is for nasa expert marina

1694
01:07:55,109 --> 01:07:52,400
brosovich

1695
01:07:57,430 --> 01:07:55,119
when was the last time an asteroid hit

1696
01:07:59,190 --> 01:07:57,440
earth

1697
01:08:00,789 --> 01:07:59,200
well the answer depends on whether

1698
01:08:03,670 --> 01:08:00,799
you're asking about small or large

1699
01:08:05,990 --> 01:08:03,680
impacts because earth gets hit all the

1700
01:08:08,630 --> 01:08:06,000
time but luckily for us the vast

1701
01:08:10,470 --> 01:08:08,640
majority of these impactors are small

1702
01:08:13,109 --> 01:08:10,480
and they just burn in the atmosphere

1703
01:08:15,349 --> 01:08:13,119
the most significant fireball event in

1704
01:08:18,550 --> 01:08:15,359
over 100 years occurred over russia in

1705
01:08:20,390 --> 01:08:18,560
2013. we actually got hit by an asteroid

1706
01:08:22,309 --> 01:08:20,400
that was the size of a small building

1707
01:08:24,950 --> 01:08:22,319
and that one disintegrated about 20

1708
01:08:26,550 --> 01:08:24,960
kilometers above the city of chelyabinsk

1709
01:08:28,709 --> 01:08:26,560
and it deposited a fair number of

1710
01:08:30,630 --> 01:08:28,719
meteorites on the ground and i happen to

1711
01:08:32,870 --> 01:08:30,640
have a piece of that chiama skin factor

1712
01:08:35,430 --> 01:08:32,880
right here in my hand but what about big

1713
01:08:37,910 --> 01:08:35,440

impacts the ones that lead craters tens

1714
01:08:40,470 --> 01:08:37,920
of kilometers wide and cause huge amount

1715
01:08:42,550 --> 01:08:40,480
of devastation we have to go far back in

1716
01:08:44,870 --> 01:08:42,560
time for such an event and those old

1717
01:08:46,550 --> 01:08:44,880
craters are not easy to spot because by

1718
01:08:48,309 --> 01:08:46,560
now they're heavily loaded they're

1719
01:08:50,390 --> 01:08:48,319
filled with sediments or they can be at

1720
01:08:52,550 --> 01:08:50,400
the bottom of the ocean but to keep the

1721
01:08:54,550 --> 01:08:52,560
long story short small effects they

1722
01:08:57,590 --> 01:08:54,560
happen all the time especially given

1723
01:09:00,229 --> 01:08:57,600
that about 15 000 tons of space dust get

1724
01:09:01,749 --> 01:09:00,239
earth every year and large impacts are

1725
01:09:04,149 --> 01:09:01,759
rare and we are talking millions of

1726
01:09:06,870 --> 01:09:04,159
years rare so when was the last time an

1727
01:09:08,709 --> 01:09:06,880
asteroid hit earth probably today but

1728
01:09:11,430 --> 01:09:08,719
the odds are very small and just

1729
01:09:13,749 --> 01:09:11,440
according to the atmosphere

1730
01:09:15,990 --> 01:09:13,759
the binary asteroid system dart is

1731
01:09:18,470 --> 01:09:16,000
taking aim at was chosen for many

1732
01:09:20,630 --> 01:09:18,480
reasons let's join raquel villanueva

1733
01:09:23,349 --> 01:09:20,640
with a special guest to explain that but

1734
01:09:26,390 --> 01:09:23,359
first raquel you saw the launch in

1735
01:09:29,110 --> 01:09:26,400
person live what was that like

1736
01:09:32,229 --> 01:09:29,120
oh it was chilly with lots of excitement

1737
01:09:35,749 --> 01:09:32,239
and lots of cheers lots of fun and i

1738
01:09:37,829 --> 01:09:35,759

am here with dart program scientist tom

1739
01:09:39,189 --> 01:09:37,839
stadler to talk about the double

1740
01:09:40,950 --> 01:09:39,199
asteroid mission like what did you think

1741
01:09:43,030 --> 01:09:40,960
of launch tom oh racquel it was a

1742
01:09:44,070 --> 01:09:43,040
beautiful beautiful lunch tremendously

1743
01:09:45,510 --> 01:09:44,080
exciting

1744
01:09:46,309 --> 01:09:45,520
now can you tell me

1745
01:09:49,110 --> 01:09:46,319
why

1746
01:09:51,189 --> 01:09:49,120
uh the asteroid was chosen oh well a

1747
01:09:53,669 --> 01:09:51,199
binary asteroid system and the dita most

1748
01:09:55,430 --> 01:09:53,679
binary asteroid system is the perfect

1749
01:09:58,550 --> 01:09:55,440
natural laboratory for the double

1750
01:10:01,110 --> 01:09:58,560
asteroid redirection test for one thing

1751
01:10:03,189 --> 01:10:01,120
the larger asteroid makes sure that the

1752
01:10:04,950 --> 01:10:03,199
smaller asteroid is held in orbit around

1753
01:10:07,189 --> 01:10:04,960
it so there's absolutely nothing that we

1754
01:10:09,910 --> 01:10:07,199
can do that would make this asteroid a

1755
01:10:11,910 --> 01:10:09,920
danger to the earth but more important

1756
01:10:14,550 --> 01:10:11,920
it's about the measurement we need to be

1757
01:10:16,709 --> 01:10:14,560
able to measure how efficiently dart

1758
01:10:18,870 --> 01:10:16,719
deflects the asteroid and we're using

1759
01:10:20,870 --> 01:10:18,880
that binary orbit of the little asteroid

1760
01:10:23,430 --> 01:10:20,880
around the big one to do that we're

1761
01:10:25,350 --> 01:10:23,440
going to change the period of that orbit

1762
01:10:27,590 --> 01:10:25,360
by just a few minutes and we're going to

1763
01:10:29,750 --> 01:10:27,600

be able to measure the size of that

1764
01:10:32,630 --> 01:10:29,760
change using telescopes on earth in the

1765
01:10:34,870 --> 01:10:32,640
weeks and months after impact and

1766
01:10:37,430 --> 01:10:34,880
precisely determine exactly what it was

1767
01:10:40,630 --> 01:10:37,440
we did now dart is called a kinetic

1768
01:10:44,470 --> 01:10:40,640
impactor which is intended to change the

1769
01:10:47,590 --> 01:10:44,480
orbit of an asteroid so what kind of

1770
01:10:50,149 --> 01:10:47,600
mass and speed is needed to alter the

1771
01:10:52,470 --> 01:10:50,159
orbit of this particular asteroid

1772
01:10:56,390 --> 01:10:52,480
well the dart spacecraft weighs about

1773
01:10:58,550 --> 01:10:56,400
500 kilograms uh which uh andy rivkin

1774
01:11:00,229 --> 01:10:58,560
one of the it one of the investigation

1775
01:11:02,709 --> 01:11:00,239
team leads said the other day is about

1776
01:11:03,510 --> 01:11:02,719
the mass of a small cow which is i guess

1777
01:11:05,030 --> 01:11:03,520
true

1778
01:11:07,990 --> 01:11:05,040
and it's going to be impacting the

1779
01:11:10,070 --> 01:11:08,000
asteroid at a speed of about 15 000

1780
01:11:12,870 --> 01:11:10,080
miles an hour so at that speed it covers

1781
01:11:14,790 --> 01:11:12,880
the last four miles to impact in one

1782
01:11:17,910 --> 01:11:14,800
second now that's going to deliver

1783
01:11:20,470 --> 01:11:17,920
enough of a push to the asteroid to

1784
01:11:22,870 --> 01:11:20,480
change its motion by a fraction of a

1785
01:11:25,590 --> 01:11:22,880
millimeter per second but it is more

1786
01:11:27,830 --> 01:11:25,600
than just the push of the spacecraft

1787
01:11:30,149 --> 01:11:27,840
it's also the energy released in that

1788
01:11:32,070 --> 01:11:30,159

tremendous collision at 15 000 miles an

1789
01:11:34,070 --> 01:11:32,080
hour uh now we can envision the small

1790
01:11:36,070 --> 01:11:34,080
cow now really quickly how do you

1791
01:11:38,630 --> 01:11:36,080
measure success for this mission well

1792
01:11:40,550 --> 01:11:38,640
success is of course first we want to

1793
01:11:42,550 --> 01:11:40,560
execute the kinetic impact and and

1794
01:11:44,630 --> 01:11:42,560
strike the asteroid but success is

1795
01:11:46,950 --> 01:11:44,640
really being able to see the magnitude

1796
01:11:49,430 --> 01:11:46,960
of that change and at the end when the

1797
01:11:51,350 --> 01:11:49,440
observations are done a few months after

1798
01:11:54,229 --> 01:11:51,360
impact having that measurement and

1799
01:11:56,550 --> 01:11:54,239
knowing exactly how much how efficiently

1800
01:11:58,070 --> 01:11:56,560
we deflected the asteroid and then later

1801
01:12:00,630 --> 01:11:58,080
with additional data being able to put

1802
01:12:03,110 --> 01:12:00,640
that in context and knowing what we

1803
01:12:05,110 --> 01:12:03,120
might have to do for a similar asteroid

1804
01:12:07,430 --> 01:12:05,120
or a different asteroid in the future if

1805
01:12:08,950 --> 01:12:07,440
we ever do need to deflect one tom thank

1806
01:12:11,110 --> 01:12:08,960
you so much for answering our questions

1807
01:12:13,750 --> 01:12:11,120
today my pleasure ricko i'll send it

1808
01:12:15,590 --> 01:12:13,760
back to daryl thank you raquel and tom

1809
01:12:19,030 --> 01:12:15,600
and so now i have a clear picture of the

1810
01:12:21,350 --> 01:12:19,040
size vending machine golf cart and cow

1811
01:12:22,950 --> 01:12:21,360
that's great crystal clear now

1812
01:12:25,430 --> 01:12:22,960
well from time to time you'll hear a

1813
01:12:28,070 --> 01:12:25,440

report about an asteroid making a close

1814
01:12:29,910 --> 01:12:28,080
approach to earth as my co-host kelly

1815
01:12:32,310 --> 01:12:29,920
fast shows us a simple demonstration

1816
01:12:34,070 --> 01:12:32,320
with a basketball an orange and a tiny

1817
01:12:35,990 --> 01:12:34,080
pebble can help us get a better

1818
01:12:39,430 --> 01:12:36,000
understanding of what's a really close

1819
01:12:42,870 --> 01:12:41,510
well and here we are here we are a big

1820
01:12:44,790 --> 01:12:42,880
open field you know we're just talking

1821
01:12:46,310 --> 01:12:44,800
about how uh sometimes you hear about

1822
01:12:47,350 --> 01:12:46,320
asteroids that pass close to the earth

1823
01:12:49,189 --> 01:12:47,360
and maybe the

1824
01:12:50,790 --> 01:12:49,199
news will say oh there's an asteroid

1825
01:12:52,470 --> 01:12:50,800
passing you know 10 times the distance

1826
01:12:54,390 --> 01:12:52,480
from the earth to the moon and i think

1827
01:12:56,070 --> 01:12:54,400
well man that's close well yeah it sure

1828
01:12:57,750 --> 01:12:56,080
sounds like it but what does that mean

1829
01:12:59,590 --> 01:12:57,760
and and you found this basketball that

1830
01:13:01,430 --> 01:12:59,600
looks like the earth and so we can do a

1831
01:13:03,030 --> 01:13:01,440
scale model here so if the earth was

1832
01:13:05,830 --> 01:13:03,040
that size the moon would be the size

1833
01:13:07,030 --> 01:13:05,840
like this orange and so what i'm going

1834
01:13:09,030 --> 01:13:07,040
to do is i'm going to move it out to

1835
01:13:11,030 --> 01:13:09,040
where the moon would be if it were this

1836
01:13:14,709 --> 01:13:11,040
size oh okay here we go probably about

1837
01:13:16,709 --> 01:13:14,719
25 feet which i paced out earlier

1838
01:13:19,270 --> 01:13:16,719

and so if the earth were the size of a

1839
01:13:21,110 --> 01:13:19,280
basketball then the moon would be out

1840
01:13:22,790 --> 01:13:21,120
here and so if an asteroid were passing

1841
01:13:24,870 --> 01:13:22,800
like at 10 times the distance from the

1842
01:13:26,950 --> 01:13:24,880
earth to the moon you know it would be

1843
01:13:28,550 --> 01:13:26,960
10 times out that way right even

1844
01:13:30,790 --> 01:13:28,560
probably past the building but on a

1845
01:13:32,950 --> 01:13:30,800
cosmic scale not that far we still want

1846
01:13:35,910 --> 01:13:32,960
to keep an eye on asteroids that could

1847
01:13:37,669 --> 01:13:35,920
come this close

1848
01:13:39,110 --> 01:13:37,679
but as asteroids pass closer to the

1849
01:13:41,110 --> 01:13:39,120
earth again they're not they're not

1850
01:13:43,110 --> 01:13:41,120
impacting as we get to maybe this

1851
01:13:45,270 --> 01:13:43,120
distance this is about like the distance

1852
01:13:46,630 --> 01:13:45,280
of the the weather satellites that's

1853
01:13:48,709 --> 01:13:46,640
really starting to get close we don't

1854
01:13:49,510 --> 01:13:48,719
want to go that close what do you have

1855
01:13:51,990 --> 01:13:49,520
to

1856
01:13:54,630 --> 01:13:52,000
show for the asteroid well you know if

1857
01:13:57,270 --> 01:13:54,640
you had this type of a scale an asteroid

1858
01:14:00,070 --> 01:13:57,280
might be about in fact this is too big

1859
01:14:01,990 --> 01:14:00,080
this pebble is even too big uh to

1860
01:14:03,590 --> 01:14:02,000
represent uh the

1861
01:14:06,470 --> 01:14:03,600
even asteroid that took out the

1862
01:14:08,310 --> 01:14:06,480
dinosaurs um yeah it would probably be

1863
01:14:09,590 --> 01:14:08,320

smaller than a grain of salt but we

1864
01:14:11,990 --> 01:14:09,600
wouldn't be able to see it very well

1865
01:14:13,669 --> 01:14:12,000
here so is this a close approach um yeah

1866
01:14:16,470 --> 01:14:13,679
we would call that a close approach but

1867
01:14:18,709 --> 01:14:16,480
it's not an impact and so so we're good

1868
01:14:20,630 --> 01:14:18,719
um and it seems very small relative to

1869
01:14:22,149 --> 01:14:20,640
the earth but it's the speed and they're

1870
01:14:23,110 --> 01:14:22,159
going very fast like you know if you've

1871
01:14:25,270 --> 01:14:23,120
ever been at the beach you get

1872
01:14:28,950 --> 01:14:25,280
sandblasted when it's windy it's the

1873
01:14:31,189 --> 01:14:28,960
speed that uh

1874
01:14:33,830 --> 01:14:31,199
and that's why you get craters on

1875
01:14:35,830 --> 01:14:33,840
surfaces when uh when they impact our

1876
01:14:36,709 --> 01:14:35,840
atmosphere does a good job of protecting

1877
01:14:40,550 --> 01:14:36,719
us

1878
01:14:41,910 --> 01:14:40,560
disrupting asteroids on the way in but

1879
01:14:43,430 --> 01:14:41,920
if they're large enough then they can

1880
01:14:45,110 --> 01:14:43,440
reach the surface and do even more

1881
01:14:46,950 --> 01:14:45,120
damage and so that's why

1882
01:14:49,270 --> 01:14:46,960
you don't want to find them early

1883
01:14:50,870 --> 01:14:49,280
then you could do something like the

1884
01:14:53,110 --> 01:14:50,880
dart mission where you could deflect

1885
01:14:56,070 --> 01:14:53,120
that asteroid just a small amount and

1886
01:14:58,470 --> 01:14:56,080
then it would miss the earth as you spun

1887
01:15:00,149 --> 01:14:58,480
the solar system into the future right

1888
01:15:02,790 --> 01:15:00,159

well can you take this little asteroid

1889
01:15:05,030 --> 01:15:02,800
and go out there past the moon sure

1890
01:15:07,030 --> 01:15:05,040
because that just makes us feel better

1891
01:15:10,950 --> 01:15:07,040
now it's way out

1892
01:15:12,950 --> 01:15:10,960
keeping where it should be out here

1893
01:15:14,790 --> 01:15:12,960
i enjoyed that that was fun that was a

1894
01:15:16,070 --> 01:15:14,800
lot of fun i can't believe you found a

1895
01:15:18,070 --> 01:15:16,080
basketball that looked like the earth

1896
01:15:20,070 --> 01:15:18,080
that was perfect specifically for this

1897
01:15:21,750 --> 01:15:20,080
demonstration great job kelly most

1898
01:15:23,590 --> 01:15:21,760
scientific spacecraft have lots of

1899
01:15:25,669 --> 01:15:23,600
instruments on board but for dart

1900
01:15:27,910 --> 01:15:25,679
there's only one it's the camera on the

1901
01:15:30,550 --> 01:15:27,920
front and it's called draco or

1902
01:15:32,870 --> 01:15:30,560
didimos reconnaissance an asteroid

1903
01:15:34,709 --> 01:15:32,880
camera for operational navigation for

1904
01:15:37,030 --> 01:15:34,719
more about how this camera will help

1905
01:15:42,550 --> 01:15:37,040
steer dart into the asteroid let's go

1906
01:15:48,550 --> 01:15:45,350
hey daryl joining me right now is tarik

1907
01:15:50,149 --> 01:15:48,560
daly who is draco's deputy instrument

1908
01:15:51,990 --> 01:15:50,159
scientist

1909
01:15:53,830 --> 01:15:52,000
first eric i'd be remiss if i didn't

1910
01:15:56,070 --> 01:15:53,840
acknowledge that fantastic launch it

1911
01:15:58,550 --> 01:15:56,080
never gets old to watch a nasa launch

1912
01:16:00,149 --> 01:15:58,560
does it it's a stunning experience

1913
01:16:01,910 --> 01:16:00,159

absolutely beautiful samson

1914
01:16:03,910 --> 01:16:01,920
congratulations on that first major step

1915
01:16:05,590 --> 01:16:03,920
of the mission to the whole team

1916
01:16:08,229 --> 01:16:05,600
all right so i'm going to take us out

1917
01:16:09,110 --> 01:16:08,239
way out to about a month before impact

1918
01:16:11,669 --> 01:16:09,120
say

1919
01:16:14,149 --> 01:16:11,679
and draco is you know first detecting

1920
01:16:16,630 --> 01:16:14,159
that first spec of light that is in the

1921
01:16:18,790 --> 01:16:16,640
blackness of space and it's our target

1922
01:16:20,630 --> 01:16:18,800
binary asteroid system right can you

1923
01:16:22,709 --> 01:16:20,640
tell us what is going to happen with

1924
01:16:24,790 --> 01:16:22,719
draco at that moment up until impact

1925
01:16:27,830 --> 01:16:24,800
what is it going to do so draco is the

1926
01:16:31,030 --> 01:16:27,840
eyes of the spacecraft the images draco

1927
01:16:34,070 --> 01:16:31,040
takes provide the data needed to guide

1928
01:16:36,550 --> 01:16:34,080
the spacecraft to hit the asteroid so

1929
01:16:38,470 --> 01:16:36,560
beginning about 30 days out we'll take

1930
01:16:40,470 --> 01:16:38,480
images every few hours that get

1931
01:16:42,870 --> 01:16:40,480
processed on the ground for optical

1932
01:16:44,870 --> 01:16:42,880
navigation we'll also measure how the

1933
01:16:47,030 --> 01:16:44,880
brightness of the asteroid changes over

1934
01:16:48,550 --> 01:16:47,040
a period of several hours because that

1935
01:16:50,709 --> 01:16:48,560
will tell us more about the relative

1936
01:16:52,870 --> 01:16:50,719
sizes and shapes of the bodies

1937
01:16:55,430 --> 01:16:52,880
things get really interesting about four

1938
01:16:57,830 --> 01:16:55,440

hours before impact that's when this

1939
01:16:59,990 --> 01:16:57,840
spacecraft transitions to autonomous

1940
01:17:01,590 --> 01:17:00,000
navigation at this point something

1941
01:17:03,910 --> 01:17:01,600
called smart nav takes over which was

1942
01:17:06,070 --> 01:17:03,920
developed here at johns hopkins apl and

1943
01:17:07,669 --> 01:17:06,080
the spacecraft now drives itself to the

1944
01:17:09,910 --> 01:17:07,679
asteroid the asteroid system at this

1945
01:17:11,990 --> 01:17:09,920
point is less than a pixel across

1946
01:17:15,189 --> 01:17:12,000
it's actually not until an hour before

1947
01:17:17,270 --> 01:17:15,199
impact that the camera can actually see

1948
01:17:19,669 --> 01:17:17,280
the secondary asteroid the moon

1949
01:17:21,830 --> 01:17:19,679
separately from the primary asteroid and

1950
01:17:24,149 --> 01:17:21,840
it's not even until just 20 seconds

1951
01:17:25,430 --> 01:17:24,159
before impact that you can see things on

1952
01:17:27,990 --> 01:17:25,440
the surface

1953
01:17:30,310 --> 01:17:28,000
the size of the spacecraft and all this

1954
01:17:32,310 --> 01:17:30,320
navigation is happening using algorithms

1955
01:17:34,149 --> 01:17:32,320
onboard the spacecraft

1956
01:17:35,430 --> 01:17:34,159
wow that's incredible

1957
01:17:37,270 --> 01:17:35,440
um well

1958
01:17:39,430 --> 01:17:37,280
we are looking forward to those picks

1959
01:17:41,030 --> 01:17:39,440
when they come next year so

1960
01:17:42,550 --> 01:17:41,040
good luck on that derek thank you so

1961
01:17:45,750 --> 01:17:42,560
much samson

1962
01:17:47,750 --> 01:17:45,760
tossing it back to you daryl

1963
01:17:49,669 --> 01:17:47,760

all right thank you samson and tarek the

1964
01:17:51,910 --> 01:17:49,679
dart spacecraft is still flying through

1965
01:17:53,510 --> 01:17:51,920
space and we have an important flight

1966
01:17:55,030 --> 01:17:53,520
operation happening in just a few

1967
01:17:58,950 --> 01:17:55,040
minutes so let's check in with marie and

1968
01:18:00,790 --> 01:17:58,960
denton for the latest on that

1969
01:18:03,669 --> 01:18:00,800
all right thank you daryl and kelly we

1970
01:18:06,630 --> 01:18:03,679
are getting ready uh for the second burn

1971
01:18:08,709 --> 01:18:06,640
of the second stage of falcon 9.

1972
01:18:10,790 --> 01:18:08,719
yeah and basically what this was

1973
01:18:12,070 --> 01:18:10,800
happening here is after the coast

1974
01:18:13,430 --> 01:18:12,080
it the engine going to fire up and it's

1975
01:18:15,510 --> 01:18:13,440
going to be a shorter burn and this

1976
01:18:17,350 --> 01:18:15,520
basically going to give us the velocity

1977
01:18:20,470 --> 01:18:17,360
to get out of earth orbit and and

1978
01:18:23,189 --> 01:18:20,480
heading towards the digimon system

1979
01:18:26,550 --> 01:18:23,199
and so uh we expect that uh second burn

1980
01:18:27,669 --> 01:18:26,560
to begin at t plus uh 28 minutes 31

1981
01:18:30,149 --> 01:18:27,679
seconds

1982
01:18:32,149 --> 01:18:30,159
so we have a view there now of

1983
01:18:35,430 --> 01:18:32,159
that is the merlin

1984
01:18:40,070 --> 01:18:35,440
the merlin mvac engine on the falcon 9

1985
01:18:42,630 --> 01:18:41,189
that uh

1986
01:18:47,510 --> 01:18:42,640
second ignition

1987
01:18:52,630 --> 01:18:50,310
and as we approach the ground station

1988
01:18:54,630 --> 01:18:52,640

we're getting better telemetry and video

1989
01:18:56,149 --> 01:18:54,640
from the vehicle

1990
01:18:57,910 --> 01:18:56,159
and from there you can kind of see the

1991
01:19:00,229 --> 01:18:57,920
trajectory of where we are heading

1992
01:19:02,229 --> 01:19:00,239
towards right now

1993
01:19:05,110 --> 01:19:02,239
all right well right now we're near the

1994
01:19:07,110 --> 01:19:05,120
the southern tip of south america

1995
01:19:09,030 --> 01:19:07,120
in back ignition

1996
01:19:10,149 --> 01:19:09,040
and we just got confirmation of mvac

1997
01:19:11,510 --> 01:19:10,159
ignition

1998
01:19:12,709 --> 01:19:11,520
and you can see the video there you can

1999
01:19:16,790 --> 01:19:12,719
see the engine

2000
01:19:20,950 --> 01:19:18,630
and so we are uh

2001
01:19:24,149 --> 01:19:20,960
right now dart is near the southern tip

2002
01:19:29,910 --> 01:19:24,159
of chile near the capital city of the

2003
01:19:34,870 --> 01:19:32,630
and so this next burn

2004
01:19:37,830 --> 01:19:34,880
lasts just under a minute

2005
01:19:41,910 --> 01:19:37,840
and then we expect to hear a

2006
01:19:43,110 --> 01:19:41,920
second cut off at t plus 29 minutes 27

2007
01:19:44,709 --> 01:19:43,120
seconds so

2008
01:19:48,870 --> 01:19:44,719
in just a few

2009
01:19:52,310 --> 01:19:51,110
you can see that mvac engine glowing red

2010
01:20:00,149 --> 01:19:52,320
hot

2011
01:20:05,030 --> 01:20:01,669
everything's looking good

2012
01:20:06,870 --> 01:20:05,040
in fact shut down

2013
01:20:10,709 --> 01:20:06,880

and we just got confirmation of engine

2014
01:20:15,189 --> 01:20:12,950
all right so that was a that was pretty

2015
01:20:16,950 --> 01:20:15,199
quick burn yeah yeah and all that and

2016
01:20:18,629 --> 01:20:16,960
that was the just a short burn needed to

2017
01:20:20,870 --> 01:20:18,639
give it that velocity so we can head

2018
01:20:23,510 --> 01:20:20,880
towards the dynamo system

2019
01:20:26,950 --> 01:20:23,520
okay so now we are in a coast phase

2020
01:20:28,790 --> 01:20:26,960
again nominal escape burn

2021
01:20:30,229 --> 01:20:28,800
okay so confirmation everything nominal

2022
01:20:32,709 --> 01:20:30,239
up there is a

2023
01:20:36,870 --> 01:20:32,719
view of the of course i still love you

2024
01:20:39,110 --> 01:20:38,229
the booster

2025
01:20:40,629 --> 01:20:39,120
uh

2026
01:20:42,629 --> 01:20:40,639
safely landed there

2027
01:20:45,590 --> 01:20:42,639
that is the third landing of this

2028
01:20:49,110 --> 01:20:45,600
booster so congratulations to spacex on

2029
01:20:50,950 --> 01:20:49,120
yet another one in the meantime uh dart

2030
01:20:52,229 --> 01:20:50,960
is in a coast phase with the second

2031
01:20:56,070 --> 01:20:52,239
stage for

2032
01:20:57,669 --> 01:20:56,080
uh about another 26 minutes or so

2033
01:20:59,590 --> 01:20:57,679
and uh during this coast phase the

2034
01:21:01,189 --> 01:20:59,600
spacecraft will fly over

2035
01:21:03,750 --> 01:21:01,199
the south pole

2036
01:21:09,510 --> 01:21:03,760
and by the time of spacecraft separation

2037
01:21:10,950 --> 01:21:09,520
at uh roughly t plus 55 56 minutes

2038
01:21:12,830 --> 01:21:10,960

dart will be

2039
01:21:15,189 --> 01:21:12,840
near the southern tip of

2040
01:21:17,669 --> 01:21:15,199
madagascar so we'll be continuing to

2041
01:21:19,990 --> 01:21:17,679
keep an ear on things so far this has

2042
01:21:23,270 --> 01:21:20,000
been a beautiful

2043
01:21:25,430 --> 01:21:23,280
start to dart's journey it's got 11

2044
01:21:27,990 --> 01:21:25,440
months roughly to make it to

2045
01:21:29,590 --> 01:21:28,000
the dynamos system where it will impact

2046
01:21:32,550 --> 01:21:29,600
dimorphous

2047
01:21:36,550 --> 01:21:32,560
in late september or early october of

2048
01:21:39,910 --> 01:21:36,560
2022. for now uh daryl and kelly

2049
01:21:43,189 --> 01:21:39,920
actually no we are going to go over to

2050
01:21:44,950 --> 01:21:43,199
nasa's megan cruz she spoke to

2051
01:21:47,830 --> 01:21:44,960
the launch services program flight

2052
01:21:51,030 --> 01:21:47,840
design expert about what it takes to

2053
01:21:53,830 --> 01:21:51,040
design a trajectory uh as complex and as

2054
01:21:56,149 --> 01:21:53,840
unique as this one in order to get dart

2055
01:21:58,629 --> 01:21:56,159
to its very precise destination to

2056
01:22:01,830 --> 01:21:58,639
impact that asteroid so let's go over

2057
01:22:03,189 --> 01:22:01,840
now to megan cruz

2058
01:22:04,550 --> 01:22:03,199
bill thank you so much for joining us

2059
01:22:06,870 --> 01:22:04,560
today you know i know that you're a

2060
01:22:09,189 --> 01:22:06,880
flight design expert with nasa's launch

2061
01:22:11,030 --> 01:22:09,199
services program and you lead the team

2062
01:22:12,709 --> 01:22:11,040
who designed dart's flight path can you

2063
01:22:14,629 --> 01:22:12,719

tell me about that flight path and was

2064
01:22:17,430 --> 01:22:14,639
it difficult to plot out unlike a lot of

2065
01:22:19,030 --> 01:22:17,440
missions where you have a single

2066
01:22:20,870 --> 01:22:19,040
trajectory that's going to get you to

2067
01:22:22,790 --> 01:22:20,880
some point in earth orbit we're

2068
01:22:24,870 --> 01:22:22,800
designing a new set of targets for the

2069
01:22:25,669 --> 01:22:24,880
launch vehicle to hit on every single

2070
01:22:28,629 --> 01:22:25,679
day

2071
01:22:29,830 --> 01:22:28,639
up to 90 targets in this case so

2072
01:22:31,750 --> 01:22:29,840
a fair bit of

2073
01:22:32,629 --> 01:22:31,760
trajectory analysis a lot of computer

2074
01:22:35,430 --> 01:22:32,639
time

2075
01:22:37,430 --> 01:22:35,440
and a lot of work by the combined team

2076
01:22:39,990 --> 01:22:37,440
both here at nasa lsp

2077
01:22:42,310 --> 01:22:40,000
and our spacecraft partners uh at jpl

2078
01:22:44,390 --> 01:22:42,320
and apl and of course you know spacex

2079
01:22:45,990 --> 01:22:44,400
why the instantaneous window and not the

2080
01:22:47,830 --> 01:22:46,000
longer window we typically see for

2081
01:22:50,310 --> 01:22:47,840
scientific missions when we talk about

2082
01:22:53,030 --> 01:22:50,320
launch opportunity that is actually like

2083
01:22:54,470 --> 01:22:53,040
the number of days that we can launch

2084
01:22:56,149 --> 01:22:54,480
and when we talk about launch window

2085
01:22:58,709 --> 01:22:56,159
that is the amount of time on a

2086
01:23:00,470 --> 01:22:58,719
particular day that we can launch so

2087
01:23:02,709 --> 01:23:00,480
given the fact that we had 90 days to

2088
01:23:03,990 --> 01:23:02,719

potentially launch this mission and the

2089
01:23:05,510 --> 01:23:04,000
fact that

2090
01:23:07,669 --> 01:23:05,520
you know spacex has a pretty good

2091
01:23:09,910 --> 01:23:07,679
history of launching on the first or

2092
01:23:11,990 --> 01:23:09,920
second day in the opportunity we decided

2093
01:23:13,910 --> 01:23:12,000
that uh it was more efficient and a

2094
01:23:16,229 --> 01:23:13,920
better use of the uh the again the

2095
01:23:18,310 --> 01:23:16,239
limited resources uh that we all have to

2096
01:23:20,310 --> 01:23:18,320
to do these kinds of missions to focus

2097
01:23:22,790 --> 01:23:20,320
on having the best launch trajectory for

2098
01:23:24,709 --> 01:23:22,800
each day and if if for whatever reason

2099
01:23:26,470 --> 01:23:24,719
we weren't able to launch that day we've

2100
01:23:28,149 --> 01:23:26,480
got another day right behind it and why

2101
01:23:30,310 --> 01:23:28,159
did you guys ultimately decide to launch

2102
01:23:31,750 --> 01:23:30,320
from the central coast of california not

2103
01:23:33,189 --> 01:23:31,760
here in florida

2104
01:23:34,950 --> 01:23:33,199
great question

2105
01:23:36,470 --> 01:23:34,960
three typically uh for a lot of our

2106
01:23:38,709 --> 01:23:36,480
interplanetary missions the most

2107
01:23:40,709 --> 01:23:38,719
important thing is to get as much energy

2108
01:23:42,709 --> 01:23:40,719
out of the launch vehicle uh and that's

2109
01:23:44,790 --> 01:23:42,719
not no different for dart however

2110
01:23:46,950 --> 01:23:44,800
usually the best way to do that is to

2111
01:23:49,030 --> 01:23:46,960
launch as close to the equator and on an

2112
01:23:50,950 --> 01:23:49,040
easterly trajectory

2113
01:23:52,550 --> 01:23:50,960

so kennedy space center or cape

2114
01:23:54,550 --> 01:23:52,560
canaveral space force station are the

2115
01:23:57,830 --> 01:23:54,560
ideal locations for that

2116
01:24:00,070 --> 01:23:57,840
as it turns out though this particular

2117
01:24:01,350 --> 01:24:00,080
outbound trajectory requires that

2118
01:24:02,390 --> 01:24:01,360
outbound

2119
01:24:04,790 --> 01:24:02,400
ground track

2120
01:24:06,310 --> 01:24:04,800
to be more in a north-south direction

2121
01:24:09,510 --> 01:24:06,320
and so we're going to launch from the

2122
01:24:11,350 --> 01:24:09,520
west coast of california and uh and fly

2123
01:24:12,709 --> 01:24:11,360
out on a basically a southerly

2124
01:24:15,030 --> 01:24:12,719
trajectory

2125
01:24:17,910 --> 01:24:15,040
and that is a much better way to launch

2126
01:24:19,750 --> 01:24:17,920
to avoid uh overflights of populated

2127
01:24:21,110 --> 01:24:19,760
land masses yeah absolutely and where

2128
01:24:22,790 --> 01:24:21,120
will you be and what will you be doing

2129
01:24:24,550 --> 01:24:22,800
during the launch so i'll actually be

2130
01:24:27,110 --> 01:24:24,560
here at kennedy space center uh

2131
01:24:29,189 --> 01:24:27,120
typically pre-covered

2132
01:24:31,270 --> 01:24:29,199
my role i would be traveling out to the

2133
01:24:33,510 --> 01:24:31,280
west coast i'll be monitoring the

2134
01:24:35,990 --> 01:24:33,520
progress of the vehicle during ascent

2135
01:24:38,629 --> 01:24:36,000
and making regular updates to the nasa

2136
01:24:40,229 --> 01:24:38,639
chief engineer and uh

2137
01:24:41,510 --> 01:24:40,239
right up to spacecraft separation and

2138
01:24:43,030 --> 01:24:41,520

then i'll be looking at the data from

2139
01:24:44,550 --> 01:24:43,040
the rocket and

2140
01:24:46,070 --> 01:24:44,560
making a determination of how well we

2141
01:24:48,149 --> 01:24:46,080
did and i'm very confident that we're

2142
01:24:49,590 --> 01:24:48,159
going to hit that orbit very accurately

2143
01:24:50,950 --> 01:24:49,600
bill it sounds like you'll be very busy

2144
01:24:52,870 --> 01:24:50,960
during lunch i hope you find some time

2145
01:24:55,590 --> 01:24:52,880
to enjoy what you guys have worked so

2146
01:24:57,430 --> 01:24:55,600
hard to do thank you so much thank you

2147
01:24:59,669 --> 01:24:57,440
all right thank you megan and bill

2148
01:25:02,390 --> 01:24:59,679
planetary defense takes planetary

2149
01:25:04,709 --> 01:25:02,400
participation here's a message now from

2150
01:25:07,910 --> 01:25:04,719
administrator bill nelson about nasa's

2151
01:25:11,990 --> 01:25:07,920
leadership in this global effort

2152
01:25:14,390 --> 01:25:12,000
at nasa we are always looking upward

2153
01:25:18,070 --> 01:25:14,400
keeping an eye on the sky for potential

2154
01:25:20,550 --> 01:25:18,080
hazards and exploring asteroids

2155
01:25:22,229 --> 01:25:20,560
to help us unlock the secrets of the

2156
01:25:24,629 --> 01:25:22,239
formation

2157
01:25:26,950 --> 01:25:24,639
of not only our solar system but the

2158
01:25:29,270 --> 01:25:26,960
universe

2159
01:25:30,390 --> 01:25:29,280
well we have a new mission

2160
01:25:34,310 --> 01:25:30,400
nasa's

2161
01:25:36,310 --> 01:25:34,320
double asteroid redirection test it's

2162
01:25:38,709 --> 01:25:36,320
known as dart

2163
01:25:41,510 --> 01:25:38,719

and it's going to help us learn

2164
01:25:43,189 --> 01:25:41,520
if by intentionally crashing a

2165
01:25:46,470 --> 01:25:43,199
spacecraft

2166
01:25:49,270 --> 01:25:46,480
into an asteroid to see

2167
01:25:51,189 --> 01:25:49,280
if there's any slight change

2168
01:25:55,350 --> 01:25:51,199
in its trajectory and

2169
01:25:57,430 --> 01:25:55,360
this collision will change the asteroid

2170
01:25:59,270 --> 01:25:57,440
ever so slightly

2171
01:26:01,990 --> 01:25:59,280
so that if you got it

2172
01:26:03,910 --> 01:26:02,000
way way away from earth if it was

2173
01:26:06,950 --> 01:26:03,920
inbound to earth

2174
01:26:08,950 --> 01:26:06,960
you could change that trajectory and it

2175
01:26:11,189 --> 01:26:08,960
would escape earth

2176
01:26:15,750 --> 01:26:11,199
and what dart's going to do it's going

2177
01:26:18,870 --> 01:26:15,760
to ram this asteroid that is an asteroid

2178
01:26:22,390 --> 01:26:18,880
revolving around another asteroid it's

2179
01:26:24,950 --> 01:26:22,400
going to ram it at 15 000 miles an hour

2180
01:26:27,590 --> 01:26:24,960
and see if we can change that trajectory

2181
01:26:29,110 --> 01:26:27,600
just a little bit

2182
01:26:31,350 --> 01:26:29,120
and dart

2183
01:26:32,709 --> 01:26:31,360
is not going to help nasa but indeed the

2184
01:26:35,390 --> 01:26:32,719
world

2185
01:26:38,709 --> 01:26:35,400
prepare in the event that an

2186
01:26:41,030 --> 01:26:38,719
earth-threatening asteroid

2187
01:26:43,189 --> 01:26:41,040
were to be discovered and we thought it

2188
01:26:44,629 --> 01:26:43,199

was coming to earth

2189
01:26:46,870 --> 01:26:44,639
so this

2190
01:26:49,510 --> 01:26:46,880
is important

2191
01:26:52,070 --> 01:26:49,520
go dart

2192
01:26:54,390 --> 01:26:52,080
thank you administrator nelson joining

2193
01:26:56,629 --> 01:26:54,400
us now is the director of nasa's science

2194
01:26:59,110 --> 01:26:56,639
mission directorates planetary science

2195
01:27:01,669 --> 01:26:59,120
division let's welcome lori glaze to the

2196
01:27:03,750 --> 01:27:01,679
nasa hangar who just came from the

2197
01:27:05,110 --> 01:27:03,760
mission control center watch the whole

2198
01:27:06,310 --> 01:27:05,120
launch you get to see all the cameras in

2199
01:27:08,870 --> 01:27:06,320
the computers and everything so first of

2200
01:27:11,350 --> 01:27:08,880
all i want to ask you how was that

2201
01:27:13,430 --> 01:27:11,360
it was really incredible i have to say

2202
01:27:15,030 --> 01:27:13,440
sitting there in the room

2203
01:27:17,750 --> 01:27:15,040
with the headphones on and you can

2204
01:27:19,350 --> 01:27:17,760
listen to the spacecraft team as they go

2205
01:27:20,790 --> 01:27:19,360
through all of their checks and making

2206
01:27:23,510 --> 01:27:20,800
sure that they've got everything ready

2207
01:27:25,350 --> 01:27:23,520
to go and all the go for fuel and then

2208
01:27:27,590 --> 01:27:25,360
watching the monitors you can see the

2209
01:27:29,830 --> 01:27:27,600
fuel tanks filling up on both of the

2210
01:27:31,590 --> 01:27:29,840
main booster and on the second stage and

2211
01:27:33,110 --> 01:27:31,600
then the final pole

2212
01:27:34,629 --> 01:27:33,120
when you get you know the spacecraft

2213
01:27:36,390 --> 01:27:34,639

teams go for launch and then you hear

2214
01:27:38,149 --> 01:27:36,400
the launch team say is nasa ready for

2215
01:27:41,110 --> 01:27:38,159
launch and that's the launch manager

2216
01:27:43,510 --> 01:27:41,120
says nasa is go for launch and then i'm

2217
01:27:45,830 --> 01:27:43,520
going to admit that i snuck outside

2218
01:27:47,830 --> 01:27:45,840
and watched he's got to go out and it

2219
01:27:49,110 --> 01:27:47,840
was amazing clear sky you could see the

2220
01:27:51,830 --> 01:27:49,120
whole sky

2221
01:27:53,990 --> 01:27:51,840
lit up behind the hill there gorgeous oh

2222
01:27:55,830 --> 01:27:54,000
it's so fabulous this is so fun lori

2223
01:27:57,750 --> 01:27:55,840
because you're my boss and i get to ask

2224
01:28:00,070 --> 01:27:57,760
you questions

2225
01:28:01,669 --> 01:28:00,080
well and as part of your division uh

2226
01:28:02,709 --> 01:28:01,679
planetary defense coordination office is

2227
01:28:05,510 --> 01:28:02,719
in there and you've got now you've got

2228
01:28:08,550 --> 01:28:05,520
the dart mission what other missions are

2229
01:28:11,430 --> 01:28:08,560
under the planetary defense portfolio so

2230
01:28:13,590 --> 01:28:11,440
great question um in addition to uh the

2231
01:28:15,590 --> 01:28:13,600
dart mission which we now just launched

2232
01:28:16,550 --> 01:28:15,600
uh we actually also have a mission i

2233
01:28:18,070 --> 01:28:16,560
know you've been talking about the

2234
01:28:20,149 --> 01:28:18,080
importance of detecting and

2235
01:28:22,229 --> 01:28:20,159
characterizing asteroids we have a

2236
01:28:24,709 --> 01:28:22,239
mission that's called the neo-wise

2237
01:28:26,629 --> 01:28:24,719
mission or the near-earth object

2238
01:28:28,470 --> 01:28:26,639

wise mission which is a repurposing of

2239
01:28:30,870 --> 01:28:28,480
the old wise mission

2240
01:28:32,629 --> 01:28:30,880
that we actually use to uh to do some

2241
01:28:34,470 --> 01:28:32,639
detection of asteroids but also a lot of

2242
01:28:35,830 --> 01:28:34,480
characterization so that we know what

2243
01:28:38,070 --> 01:28:35,840
the asteroids look like what they're

2244
01:28:39,350 --> 01:28:38,080
made of and what their their orbits are

2245
01:28:41,189 --> 01:28:39,360
and then we have a new mission that

2246
01:28:43,510 --> 01:28:41,199
we've just started developing that we're

2247
01:28:45,910 --> 01:28:43,520
hoping to launch in the next few years

2248
01:28:48,790 --> 01:28:45,920
that's called the near earth object

2249
01:28:50,550 --> 01:28:48,800
surveyor mission or neo surveyor

2250
01:28:53,830 --> 01:28:50,560
and and that mission is going to be

2251
01:28:56,149 --> 01:28:53,840
really dedicated to looking for those

2252
01:28:58,470 --> 01:28:56,159
near-earth objects that will be its sole

2253
01:29:00,390 --> 01:28:58,480
purpose we're going to send it out to a

2254
01:29:02,790 --> 01:29:00,400
stable orbit called the lagrangian point

2255
01:29:05,189 --> 01:29:02,800
l-one should be an amazing mission we'll

2256
01:29:07,669 --> 01:29:05,199
have the eyes in space besides just the

2257
01:29:09,510 --> 01:29:07,679
telescope which is pretty neat exactly i

2258
01:29:11,590 --> 01:29:09,520
got to wondering you know with this

2259
01:29:13,270 --> 01:29:11,600
kinetic impactor we're testing that

2260
01:29:15,669 --> 01:29:13,280
we'll find out about that in about 10

2261
01:29:17,510 --> 01:29:15,679
months but do we have any other ways

2262
01:29:19,590 --> 01:29:17,520
that we're looking at to to move an

2263
01:29:21,830 --> 01:29:19,600

asteroid off course yeah that's a great

2264
01:29:23,189 --> 01:29:21,840
question um so there are multiple ideas

2265
01:29:25,030 --> 01:29:23,199
that have been thought about in

2266
01:29:27,510 --> 01:29:25,040
different techniques that have been

2267
01:29:29,270 --> 01:29:27,520
developed and studied uh the kinetic

2268
01:29:31,430 --> 01:29:29,280
impactor is the most mature that's why

2269
01:29:32,790 --> 01:29:31,440
we're testing it first but other cool

2270
01:29:35,510 --> 01:29:32,800
ideas that are out there are things

2271
01:29:38,550 --> 01:29:35,520
called like a gravity tractor uh which

2272
01:29:40,790 --> 01:29:38,560
would um you know essentially uh adjust

2273
01:29:42,709 --> 01:29:40,800
the the mass of the uh object by either

2274
01:29:44,070 --> 01:29:42,719
adding or subtracting and then you have

2275
01:29:46,310 --> 01:29:44,080
uh the

2276
01:29:49,270 --> 01:29:46,320
changing the gravity gravitational pull

2277
01:29:51,910 --> 01:29:49,280
another idea which is out there is to

2278
01:29:55,350 --> 01:29:51,920
potentially detect or i'm sorry detonate

2279
01:29:56,470 --> 01:29:55,360
a nuclear uh device not on the you don't

2280
01:29:58,629 --> 01:29:56,480
want to blow up the assets well it

2281
01:29:59,590 --> 01:29:58,639
sounds like armageddon no no no no no no

2282
01:30:01,189 --> 01:29:59,600
you don't want to do that you want to

2283
01:30:03,110 --> 01:30:01,199
detonate it near the asteroid you just

2284
01:30:04,790 --> 01:30:03,120
give it a push how about that

2285
01:30:06,550 --> 01:30:04,800
fascinating all technologies you're

2286
01:30:07,910 --> 01:30:06,560
working on lori grays

2287
01:30:09,510 --> 01:30:07,920
director of nasa science mission

2288
01:30:12,310 --> 01:30:09,520

directorate's planetary science division

2289
01:30:14,709 --> 01:30:12,320
thank you for being here my pleasure

2290
01:30:17,510 --> 01:30:14,719
all right so with that it's time to ask

2291
01:30:19,910 --> 01:30:17,520
the expert scientists at nasa another

2292
01:30:21,189 --> 01:30:19,920
question about the asteroids and this

2293
01:30:22,870 --> 01:30:21,199
one folks

2294
01:30:26,310 --> 01:30:22,880
this one's for

2295
01:30:28,070 --> 01:30:26,320
nasa asteroid expert davide farnocchia

2296
01:30:30,390 --> 01:30:28,080
we're going to ask him the question is

2297
01:30:32,950 --> 01:30:30,400
nasa aware of any earth-threatening

2298
01:30:35,590 --> 01:30:32,960
asteroids

2299
01:30:37,669 --> 01:30:35,600
no there is no aspirate that we know of

2300
01:30:40,470 --> 01:30:37,679
that is concerning in terms of impact

2301
01:30:42,310 --> 01:30:40,480
hazard now we know that asteroid impacts

2302
01:30:44,229 --> 01:30:42,320
have happened in the past and can

2303
01:30:46,149 --> 01:30:44,239
certainly happen in the future but we

2304
01:30:48,550 --> 01:30:46,159
should keep in mind that those are rare

2305
01:30:50,870 --> 01:30:48,560
events an asteroid impact that could

2306
01:30:52,629 --> 01:30:50,880
cause serious regional damage only

2307
01:30:55,110 --> 01:30:52,639
happens every few thousand years or

2308
01:30:57,110 --> 01:30:55,120
longer still it's a good idea to protect

2309
01:30:59,510 --> 01:30:57,120
us against that possibility and the rule

2310
01:31:00,790 --> 01:30:59,520
of the game is find asteroids before

2311
01:31:03,990 --> 01:31:00,800
they find us

2312
01:31:05,750 --> 01:31:04,000
and that's why for over 20 years nasa

2313
01:31:08,070 --> 01:31:05,760

has been funding search programs to

2314
01:31:11,830 --> 01:31:08,080
observe the sky pretty much every single

2315
01:31:13,189 --> 01:31:11,840
night to find and track asteroids and

2316
01:31:15,430 --> 01:31:13,199
we've been doing a pretty good job at

2317
01:31:18,390 --> 01:31:15,440
that so far we've discovered more than a

2318
01:31:20,149 --> 01:31:18,400
million asteroids including 95 percent

2319
01:31:22,070 --> 01:31:20,159
of the asteroids that are greater than

2320
01:31:23,830 --> 01:31:22,080
one kilometer and that could come close

2321
01:31:26,390 --> 01:31:23,840
to the earth once we discover an

2322
01:31:28,390 --> 01:31:26,400
asteroid we project its motion into the

2323
01:31:30,390 --> 01:31:28,400
future to assess the possibility of an

2324
01:31:33,110 --> 01:31:30,400
impact with earth we have a scale called

2325
01:31:34,950 --> 01:31:33,120
torino scale that helps us rank the risk

2326
01:31:37,510 --> 01:31:34,960
coming from each asteroid it goes from

2327
01:31:40,149 --> 01:31:37,520
zero which is lowest risk to 10 which is

2328
01:31:41,830 --> 01:31:40,159
highest risk the good news is that for

2329
01:31:44,870 --> 01:31:41,840
all the asterisks that we've discovered

2330
01:31:46,950 --> 01:31:44,880
so far the 3in scale is zero so lowest

2331
01:31:48,870 --> 01:31:46,960
risk for the next hundred years

2332
01:31:51,030 --> 01:31:48,880
so is nasa aware of any earth

2333
01:31:55,510 --> 01:31:51,040
threatening asteroids no but we will

2334
01:31:59,910 --> 01:31:58,070
and that's good news we now heard about

2335
01:32:02,390 --> 01:31:59,920
the instrument on board a little further

2336
01:32:04,709 --> 01:32:02,400
back the draco camera now let's discuss

2337
01:32:06,790 --> 01:32:04,719
the computer that will use draco's

2338
01:32:10,149 --> 01:32:06,800

camera and the images from it to

2339
01:32:11,990 --> 01:32:10,159
autonomously fly dart into its target

2340
01:32:13,430 --> 01:32:12,000
samson rainey is back now with us from

2341
01:32:15,350 --> 01:32:13,440
the mission operations center in

2342
01:32:19,270 --> 01:32:15,360
maryland with a special guest to tell us

2343
01:32:24,149 --> 01:32:21,990
hey daryl joining me right now is smart

2344
01:32:26,149 --> 01:32:24,159
nav leave michelle chen

2345
01:32:28,149 --> 01:32:26,159
michelle give us some insights into what

2346
01:32:30,229 --> 01:32:28,159
you call the brains of the spacecraft

2347
01:32:32,229 --> 01:32:30,239
how will smart nav allow dart to

2348
01:32:34,070 --> 01:32:32,239
identify its target and stay on the

2349
01:32:36,629 --> 01:32:34,080
target for the whole four hours before

2350
01:32:38,629 --> 01:32:36,639
long before impact right so

2351
01:32:40,390 --> 01:32:38,639
at four hours is when smart nav starts

2352
01:32:42,229 --> 01:32:40,400
controlling the spacecraft

2353
01:32:43,510 --> 01:32:42,239
and if you imagine that you're the

2354
01:32:45,830 --> 01:32:43,520
spacecraft and you're looking at the

2355
01:32:48,870 --> 01:32:45,840
dytamo system you're going to see the

2356
01:32:52,149 --> 01:32:48,880
the dynamo system and dynamos itself

2357
01:32:54,070 --> 01:32:52,159
and at about an hour to go is when

2358
01:32:56,870 --> 01:32:54,080
the little guy demorphus starts

2359
01:32:59,350 --> 01:32:56,880
eclipsing and coming out from eclipse

2360
01:33:00,870 --> 01:32:59,360
and it is at that point that we start

2361
01:33:02,870 --> 01:33:00,880
guiding towards

2362
01:33:05,669 --> 01:33:02,880
demorphus

2363
01:33:07,030 --> 01:33:05,679

so why did you choose this um method for

2364
01:33:08,390 --> 01:33:07,040
the mission as opposed to other

2365
01:33:10,709 --> 01:33:08,400
alternatives

2366
01:33:13,110 --> 01:33:10,719
um so this method

2367
01:33:15,030 --> 01:33:13,120
it's we kind of need it because if you

2368
01:33:18,709 --> 01:33:15,040
everyone's been talking about the 15 000

2369
01:33:19,830 --> 01:33:18,719
miles per hour so that's 250 miles in

2370
01:33:22,709 --> 01:33:19,840
one minute

2371
01:33:24,629 --> 01:33:22,719
and for us to joystick that from the

2372
01:33:27,110 --> 01:33:24,639
ground with the

2373
01:33:29,189 --> 01:33:27,120
one-minute round-trip light delay for

2374
01:33:31,510 --> 01:33:29,199
communications it would be impossible so

2375
01:33:32,870 --> 01:33:31,520
we needed something autonomous on board

2376
01:33:34,310 --> 01:33:32,880
that's incredible

2377
01:33:36,470 --> 01:33:34,320
um so how are you feeling right now and

2378
01:33:38,470 --> 01:33:36,480
how are you gonna feel you know when we

2379
01:33:41,830 --> 01:33:38,480
approach those four hours before impact

2380
01:33:44,430 --> 01:33:41,840
right yeah so apl has a lot of

2381
01:33:47,750 --> 01:33:44,440
experience on maturing guiding

2382
01:33:49,030 --> 01:33:47,760
technology and smart nav is an irad that

2383
01:33:53,110 --> 01:33:49,040
we started

2384
01:33:53,910 --> 01:33:53,120
in eight years ago and um

2385
01:33:58,149 --> 01:33:53,920
we

2386
01:34:00,550 --> 01:33:58,159
spent the past eight years training and

2387
01:34:02,470 --> 01:34:00,560
teaching this child to basically drive

2388
01:34:04,550 --> 01:34:02,480

the spacecraft on its own

2389
01:34:05,430 --> 01:34:04,560
and like a parent would say you know

2390
01:34:06,470 --> 01:34:05,440
doing

2391
01:34:09,430 --> 01:34:06,480
we're going to be sitting in the

2392
01:34:11,430 --> 01:34:09,440
passenger seat watching our child drive

2393
01:34:13,350 --> 01:34:11,440
and we're going to be really excited and

2394
01:34:14,709 --> 01:34:13,360
nervous as all heck

2395
01:34:17,030 --> 01:34:14,719
well we are

2396
01:34:20,149 --> 01:34:17,040
rooting for your kid to do really well

2397
01:34:21,430 --> 01:34:20,159
when the time comes thank you awesome

2398
01:34:23,990 --> 01:34:21,440
thanks michelle

2399
01:34:26,070 --> 01:34:24,000
back to you daryl

2400
01:34:28,470 --> 01:34:26,080
all right thank you both and we have a

2401
01:34:30,709 --> 01:34:28,480
fun way now a little separation from the

2402
01:34:32,790 --> 01:34:30,719
serious science for you to participate

2403
01:34:35,430 --> 01:34:32,800
in our mission today and it's by signing

2404
01:34:36,390 --> 01:34:35,440
up to be a planetary defender just like

2405
01:34:37,910 --> 01:34:36,400
kelly

2406
01:34:43,830 --> 01:34:37,920
here's a look at some of the people who

2407
01:34:49,030 --> 01:34:46,950
i am a sanitary defender

2408
01:34:50,709 --> 01:34:49,040
i love space

2409
01:34:52,390 --> 01:34:50,719
and my dog is also appointed to our

2410
01:35:00,570 --> 01:34:52,400
defender

2411
01:35:35,510 --> 01:35:02,149
[Music]

2412
01:35:39,270 --> 01:35:37,750
love the kid with the rocket engines it

2413
01:35:40,550 --> 01:35:39,280

was great

2414
01:35:42,149 --> 01:35:40,560
if you would like to participate in

2415
01:35:43,910 --> 01:35:42,159
being a planetary defender there's a

2416
01:35:47,910 --> 01:35:43,920
website we're going to put it up on the

2417
01:35:50,149 --> 01:35:47,920
screen it's at dart dot j h u

2418
01:35:53,830 --> 01:35:50,159
a p l dot edu

2419
01:35:57,109 --> 01:35:53,840
forward slash planetary hyphen defender

2420
01:36:00,629 --> 01:35:57,119
again that's dart dot jhu

2421
01:36:02,550 --> 01:36:00,639
forward slash planetary hyphen defender

2422
01:36:04,550 --> 01:36:02,560
and there's a five question quiz and

2423
01:36:06,390 --> 01:36:04,560
then if you do well you'll receive a

2424
01:36:08,790 --> 01:36:06,400
digital certificate so you can share it

2425
01:36:11,030 --> 01:36:08,800
on social media or you know hang it on

2426
01:36:14,149 --> 01:36:11,040
your wall so guess what

2427
01:36:15,830 --> 01:36:14,159
daryl and kelly took the quiz

2428
01:36:17,669 --> 01:36:15,840
we have our certificates

2429
01:36:19,990 --> 01:36:17,679
look at that

2430
01:36:21,669 --> 01:36:20,000
oh yeah i am officially declared a

2431
01:36:23,910 --> 01:36:21,679
planetary defender on nasa's double

2432
01:36:25,750 --> 01:36:23,920
asteroid redirection test i am proud of

2433
01:36:28,149 --> 01:36:25,760
you daryl

2434
01:36:30,709 --> 01:36:28,159
thank you kelly that means a lot

2435
01:36:33,830 --> 01:36:30,719
so i mean uh you took the quiz right and

2436
01:36:36,950 --> 01:36:35,109
that was kind of funny because i started

2437
01:36:38,310 --> 01:36:36,960
working my way through the quiz and

2438
01:36:39,590 --> 01:36:38,320

i knew what the answer to the question

2439
01:36:40,790 --> 01:36:39,600
was but i wanted to make sure that i

2440
01:36:42,950 --> 01:36:40,800
knew what they thought the answer the

2441
01:36:45,750 --> 01:36:42,960
question was so i clicked on a hint and

2442
01:36:47,990 --> 01:36:45,760
a video of me popped up so

2443
01:36:50,390 --> 01:36:48,000
and and by the way our planetary defense

2444
01:36:52,390 --> 01:36:50,400
officer lindley johnson he also took it

2445
01:36:53,750 --> 01:36:52,400
and he passed that is great to hear that

2446
01:36:55,590 --> 01:36:53,760
it was great to hear actually like i

2447
01:36:56,870 --> 01:36:55,600
needed a hit oh there's me

2448
01:37:00,310 --> 01:36:56,880
what's up

2449
01:37:02,310 --> 01:37:00,320
all right thank you so much well

2450
01:37:04,390 --> 01:37:02,320
we have um dart is scheduled to make an

2451
01:37:06,950 --> 01:37:04,400
impact with its uh target asteroid in

2452
01:37:08,550 --> 01:37:06,960
the fall of 2022 after that happens

2453
01:37:10,470 --> 01:37:08,560
scientists and astronomers around the

2454
01:37:12,470 --> 01:37:10,480
world will work to verify if the

2455
01:37:14,870 --> 01:37:12,480
redirection tests work let's go back out

2456
01:37:16,709 --> 01:37:14,880
to raquel villanueva for more on this

2457
01:37:18,390 --> 01:37:16,719
raquel

2458
01:37:20,229 --> 01:37:18,400
thanks daryl i'm here with dark

2459
01:37:22,149 --> 01:37:20,239
coordination lead nancy chabot to find

2460
01:37:23,990 --> 01:37:22,159
out what is next thanks for joining us

2461
01:37:26,310 --> 01:37:24,000
nancy oh thanks for having me great

2462
01:37:27,750 --> 01:37:26,320
launch huh it's beautiful

2463
01:37:29,830 --> 01:37:27,760

so what is the first thing your team

2464
01:37:32,070 --> 01:37:29,840
will do after impact

2465
01:37:34,390 --> 01:37:32,080
we will be doing so much i mean first

2466
01:37:36,550 --> 01:37:34,400
thing will be the draco images that are

2467
01:37:37,910 --> 01:37:36,560
streaming back one per second and this

2468
01:37:40,229 --> 01:37:37,920
is the first time we get to see what

2469
01:37:42,149 --> 01:37:40,239
this asteroid looks like and so i

2470
01:37:43,990 --> 01:37:42,159
guarantee the team at apl is going to

2471
01:37:45,590 --> 01:37:44,000
have these images up on the big screen

2472
01:37:47,910 --> 01:37:45,600
seeing what the shape is seeing what the

2473
01:37:49,189 --> 01:37:47,920
geology is seeing where we actually hit

2474
01:37:50,950 --> 01:37:49,199
you know but then there's more there's

2475
01:37:52,950 --> 01:37:50,960
leachia cube and those images are

2476
01:37:54,390 --> 01:37:52,960
actually going to take a few days or

2477
01:37:56,470 --> 01:37:54,400
weeks to come back and they're going to

2478
01:37:57,910 --> 01:37:56,480
show us the ejecta from the collision

2479
01:37:59,350 --> 01:37:57,920
and the telescopes are going to get

2480
01:38:00,950 --> 01:37:59,360
right to work too here on the earth

2481
01:38:02,310 --> 01:38:00,960
they're going to be turning their gaze

2482
01:38:04,070 --> 01:38:02,320
and trying to figure out how much we

2483
01:38:05,990 --> 01:38:04,080
actually deflected this asteroid and

2484
01:38:07,669 --> 01:38:06,000
that's going to go on for months

2485
01:38:09,270 --> 01:38:07,679
and then we've got a bunch of people

2486
01:38:11,270 --> 01:38:09,280
with state of the art models who are

2487
01:38:13,430 --> 01:38:11,280
going to model the impact model the

2488
01:38:15,350 --> 01:38:13,440

objective model the dynamics and they're

2489
01:38:16,870 --> 01:38:15,360
going to use the inputs from the images

2490
01:38:18,629 --> 01:38:16,880
and the observations and all come

2491
01:38:21,750 --> 01:38:18,639
together it's going to be a really

2492
01:38:24,310 --> 01:38:21,760
really busy time sounds like it and can

2493
01:38:26,390 --> 01:38:24,320
you tell me why the impact the timing of

2494
01:38:28,709 --> 01:38:26,400
the impact is important yeah it's really

2495
01:38:31,590 --> 01:38:28,719
interesting because september 2022 is

2496
01:38:33,990 --> 01:38:31,600
the perfect time to do this so dynamos

2497
01:38:35,910 --> 01:38:34,000
and uh and the earth they both go around

2498
01:38:37,590 --> 01:38:35,920
the sun right but it actually takes

2499
01:38:39,189 --> 01:38:37,600
about a little over two years for

2500
01:38:41,109 --> 01:38:39,199
dynamos so sometimes the earth and

2501
01:38:42,870 --> 01:38:41,119
dynamos are on like the opposite sides

2502
01:38:45,590 --> 01:38:42,880
of the sun and really far away from each

2503
01:38:46,950 --> 01:38:45,600
other but in september 2022 it's

2504
01:38:49,430 --> 01:38:46,960
actually minimized they're going to be

2505
01:38:50,870 --> 01:38:49,440
the closest that they are for 40 years

2506
01:38:52,709 --> 01:38:50,880
and that's going to let the telescopes

2507
01:38:54,390 --> 01:38:52,719
here on the earth get the best data

2508
01:38:57,830 --> 01:38:54,400
possible of how much we deflected this

2509
01:39:00,550 --> 01:38:57,840
asteroid wow and scientists around the

2510
01:39:02,950 --> 01:39:00,560
world will they be able to confirm your

2511
01:39:04,149 --> 01:39:02,960
results yeah i mean i'm actually super

2512
01:39:06,550 --> 01:39:04,159
happy we've got scientists around the

2513
01:39:08,310 --> 01:39:06,560

world on the dart team um and so this is

2514
01:39:10,229 --> 01:39:08,320
an international team for an

2515
01:39:12,070 --> 01:39:10,239
international issue right like planetary

2516
01:39:13,830 --> 01:39:12,080
defense is our whole planet we're all on

2517
01:39:16,390 --> 01:39:13,840
it together and that's there we've got

2518
01:39:18,470 --> 01:39:16,400
obviously the lycha cube contributed by

2519
01:39:20,229 --> 01:39:18,480
the italian space agency

2520
01:39:22,790 --> 01:39:20,239
we're also really working closely with

2521
01:39:24,550 --> 01:39:22,800
the european space agency's hera mission

2522
01:39:27,109 --> 01:39:24,560
which is going to rendezvous with the

2523
01:39:29,350 --> 01:39:27,119
dittomo system in 2026 and it's going to

2524
01:39:30,950 --> 01:39:29,360
be able to see the crater get the mass

2525
01:39:32,709 --> 01:39:30,960
and it's really exciting because you

2526
01:39:34,070 --> 01:39:32,719
know dart is just the start and then

2527
01:39:36,390 --> 01:39:34,080
hera will get there and these two

2528
01:39:38,070 --> 01:39:36,400
missions combined will show us even more

2529
01:39:40,149 --> 01:39:38,080
than anyone could do on their own and

2530
01:39:41,750 --> 01:39:40,159
it's just really a great example of

2531
01:39:43,510 --> 01:39:41,760
international collaboration for this

2532
01:39:45,430 --> 01:39:43,520
international issue it really is and

2533
01:39:47,910 --> 01:39:45,440
what was it like seeing the launch today

2534
01:39:49,590 --> 01:39:47,920
uh it was really spectacular i you know

2535
01:39:51,350 --> 01:39:49,600
i didn't really know what to expect so

2536
01:39:52,950 --> 01:39:51,360
much um but then when you just saw it

2537
01:39:54,870 --> 01:39:52,960
like light up through the sky and sort

2538
01:39:57,669 --> 01:39:54,880

of change the things and everybody

2539
01:39:59,910 --> 01:39:57,679
erupts in the cheers it's a it's really

2540
01:40:01,510 --> 01:39:59,920
real you know and but in some ways this

2541
01:40:03,109 --> 01:40:01,520
is just getting dart onto this next

2542
01:40:05,189 --> 01:40:03,119
phase i'm looking forward to these 10

2543
01:40:07,270 --> 01:40:05,199
months and then the collision and then

2544
01:40:08,870 --> 01:40:07,280
everything i just described starts and

2545
01:40:10,550 --> 01:40:08,880
we've got so much to look forward to

2546
01:40:12,950 --> 01:40:10,560
busy time ahead thank you so much for

2547
01:40:15,030 --> 01:40:12,960
joining us thank you this is great back

2548
01:40:17,270 --> 01:40:15,040
to you daryl all right and as she

2549
01:40:19,669 --> 01:40:17,280
mentioned when dart impacts the asteroid

2550
01:40:21,910 --> 01:40:19,679
the spacecraft and the onboard camera

2551
01:40:24,070 --> 01:40:21,920
will be completely destroyed but we will

2552
01:40:26,629 --> 01:40:24,080
see dart's last maneuver thanks to an

2553
01:40:29,350 --> 01:40:26,639
italian cubesat that will jettison from

2554
01:40:32,070 --> 01:40:29,360
dart 10 days before impact for more on

2555
01:40:34,629 --> 01:40:32,080
this we are joined by simone perada of

2556
01:40:36,709 --> 01:40:34,639
the italian space agency and we're going

2557
01:40:39,510 --> 01:40:36,719
to talk about lychee cube which stands

2558
01:40:42,070 --> 01:40:39,520
for light italian cubesat for imaging

2559
01:40:45,109 --> 01:40:42,080
asteroids so how did this idea for a

2560
01:40:46,550 --> 01:40:45,119
dark cubesat actually come about

2561
01:40:50,149 --> 01:40:46,560
uh thank you

2562
01:40:53,109 --> 01:40:50,159
so the idea of cubesat came about in the

2563
01:40:55,910 --> 01:40:53,119

time frame of 2017 at the time the

2564
01:40:58,709 --> 01:40:55,920
italian space agency was already running

2565
01:41:01,430 --> 01:40:58,719
a project that is called argo moon and

2566
01:41:03,430 --> 01:41:01,440
there's a similar cubesat that will fly

2567
01:41:05,910 --> 01:41:03,440
on the artemis one mission

2568
01:41:08,550 --> 01:41:05,920
so uh this cubesat will provide

2569
01:41:09,590 --> 01:41:08,560
important information and images of the

2570
01:41:11,990 --> 01:41:09,600
launcher

2571
01:41:14,390 --> 01:41:12,000
so we thought why don't we propose a

2572
01:41:17,350 --> 01:41:14,400
similar cubesat that will uh support

2573
01:41:20,390 --> 01:41:17,360
dart mission anyway we were somehow you

2574
01:41:23,109 --> 01:41:20,400
know contacted by nasa and then the idea

2575
01:41:24,790 --> 01:41:23,119
came in this way and we started this new

2576
01:41:26,470 --> 01:41:24,800
challenging project and we are very

2577
01:41:28,470 --> 01:41:26,480
excited to be here yeah it's like dark

2578
01:41:29,830 --> 01:41:28,480
throwing out a a cell phone to take a

2579
01:41:31,350 --> 01:41:29,840
selfie right before it rams into an

2580
01:41:32,470 --> 01:41:31,360
asteroid

2581
01:41:33,669 --> 01:41:32,480
yeah i don't know if it's okay we still

2582
01:41:36,310 --> 01:41:33,679
kind of sometimes refer to it as a

2583
01:41:38,550 --> 01:41:36,320
selfie set but but but in uh or

2584
01:41:41,590 --> 01:41:38,560
seriously what um can you tell us more

2585
01:41:43,990 --> 01:41:41,600
about lucia cube's scientific objectives

2586
01:41:47,350 --> 01:41:44,000
all right we will support that we are

2587
01:41:50,310 --> 01:41:47,360
kind of witness of the immediate effect

2588
01:41:51,109 --> 01:41:50,320

of the impact because later on you know

2589
01:41:59,750 --> 01:41:51,119
the

2590
01:42:01,990 --> 01:41:59,760
but we will provide unique images yeah

2591
01:42:03,510 --> 01:42:02,000
this is lucha cube it's going to

2592
01:42:05,030 --> 01:42:03,520
has been just

2593
01:42:08,709 --> 01:42:05,040
deployed from

2594
01:42:11,510 --> 01:42:08,719
dart so while dart is targeting and then

2595
01:42:14,470 --> 01:42:11,520
impacting the asteroids we will maneuver

2596
01:42:17,270 --> 01:42:14,480
in a way that will allow us to pass in a

2597
01:42:19,750 --> 01:42:17,280
safe distance so not to be impacted by

2598
01:42:22,229 --> 01:42:19,760
ejectors but at the proper distance to

2599
01:42:25,109 --> 01:42:22,239
have a good resolution of our images

2600
01:42:27,270 --> 01:42:25,119
that is super cool yeah so the plumes is

2601
01:42:29,669 --> 01:42:27,280
important information and we will also

2602
01:42:31,750 --> 01:42:29,679
provide information on the other side of

2603
01:42:33,830 --> 01:42:31,760
uh the asteroid that is not visible by

2604
01:42:37,030 --> 01:42:33,840
dart it is coming from just one

2605
01:42:39,350 --> 01:42:37,040
direction so ask can i use a small model

2606
01:42:41,430 --> 01:42:39,360
that is uh sure what do you have i have

2607
01:42:42,790 --> 01:42:41,440
with me just a small toy that my

2608
01:42:45,030 --> 01:42:42,800
daughter did

2609
01:42:47,030 --> 01:42:45,040
uh with the lego bricks

2610
01:42:48,870 --> 01:42:47,040
yes they are legos but in particular

2611
01:42:49,990 --> 01:42:48,880
they are the legos that i received when

2612
01:42:53,510 --> 01:42:50,000
i was a kid

2613
01:42:55,750 --> 01:42:53,520

they were stored for 30 years and now my

2614
01:42:57,030 --> 01:42:55,760
daughter she's using so we're all legos

2615
01:42:58,950 --> 01:42:57,040
repurposed

2616
01:43:01,590 --> 01:42:58,960
you can see from the color yeah

2617
01:43:04,149 --> 01:43:01,600
they're not properly white okay anyway

2618
01:43:05,030 --> 01:43:04,159
while lychee cube is approaching the

2619
01:43:06,709 --> 01:43:05,040
scene

2620
01:43:07,590 --> 01:43:06,719
it's maneuvering

2621
01:43:10,229 --> 01:43:07,600
and

2622
01:43:11,189 --> 01:43:10,239
the velocity is uh is an issue because

2623
01:43:12,070 --> 01:43:11,199
dark

2624
01:43:14,149 --> 01:43:12,080
dart

2625
01:43:15,830 --> 01:43:14,159
is intentionally very fast against the

2626
01:43:18,310 --> 01:43:15,840
asteroids

2627
01:43:21,830 --> 01:43:18,320
so and we have limited resources on

2628
01:43:24,310 --> 01:43:21,840
board as a cubesat so we cannot modify

2629
01:43:26,950 --> 01:43:24,320
our velocity so much so we'll be very

2630
01:43:29,510 --> 01:43:26,960
fast while we are approaching the scene

2631
01:43:31,750 --> 01:43:29,520
okay and we will try to be out of the

2632
01:43:34,229 --> 01:43:31,760
plane have a good illumination of the

2633
01:43:35,990 --> 01:43:34,239
scene and then we will look at the plume

2634
01:43:38,950 --> 01:43:36,000
that will be generated

2635
01:43:41,270 --> 01:43:38,960
and we will maneuver change the attitude

2636
01:43:43,270 --> 01:43:41,280
in order to image the other side of the

2637
01:43:45,430 --> 01:43:43,280
asteroids that's fantastic not just

2638
01:43:47,350 --> 01:43:45,440

getting the impact but the other side

2639
01:43:49,270 --> 01:43:47,360
and we we showed that with legos it's my

2640
01:43:50,470 --> 01:43:49,280
favorite part well and as is great with

2641
01:43:52,149 --> 01:43:50,480
the legos

2642
01:43:54,470 --> 01:43:52,159
using that can you tell us what are the

2643
01:43:58,310 --> 01:43:54,480
main components of lucia cube and how do

2644
01:44:01,189 --> 01:43:58,320
they work sure lichicube is a 6u cubesat

2645
01:44:03,030 --> 01:44:01,199
in size and it's a complete spacecraft

2646
01:44:05,590 --> 01:44:03,040
and you can see it's equipped with all

2647
01:44:08,790 --> 01:44:05,600
subsystems

2648
01:44:11,669 --> 01:44:08,800
the core is made by the two instruments

2649
01:44:13,669 --> 01:44:11,679
the two cameras one is with a narrow

2650
01:44:15,830 --> 01:44:13,679
field of view and the other has a wider

2651
01:44:17,990 --> 01:44:15,840
field of view so they have complementary

2652
01:44:20,390 --> 01:44:18,000
functions in the in the you know in the

2653
01:44:23,189 --> 01:44:20,400
action and real quickly how close will

2654
01:44:25,910 --> 01:44:23,199
uh lychee cube come to the asteroid

2655
01:44:28,550 --> 01:44:25,920
well we had a trade-off on this decision

2656
01:44:31,669 --> 01:44:28,560
and in the end the this property

2657
01:44:34,870 --> 01:44:31,679
distance at the closest approach will be

2658
01:44:37,189 --> 01:44:34,880
around 55 kilometers that is again a

2659
01:44:39,590 --> 01:44:37,199
safe distance but is good enough to have

2660
01:44:41,189 --> 01:44:39,600
a resolution on the surface of about one

2661
01:44:43,030 --> 01:44:41,199
meter per pixel

2662
01:44:45,910 --> 01:44:43,040
that will allow us to have good

2663
01:44:47,350 --> 01:44:45,920

information on uh also on the morphology

2664
01:44:50,149 --> 01:44:47,360
of the surface

2665
01:44:52,310 --> 01:44:50,159
maybe the crater treader is not

2666
01:44:55,109 --> 01:44:52,320
completely sure that we can image

2667
01:44:57,189 --> 01:44:55,119
because the plume can cover it we can

2668
01:44:59,750 --> 01:44:57,199
when we need the proper time to allow

2669
01:45:03,109 --> 01:44:59,760
the plume to be developed enough

2670
01:45:05,109 --> 01:45:03,119
so while we are having our flyby we can

2671
01:45:07,750 --> 01:45:05,119
have a complete

2672
01:45:10,070 --> 01:45:07,760
modeling of how the materials will be uh

2673
01:45:11,669 --> 01:45:10,080
released that's fantastic simone pirado

2674
01:45:13,270 --> 01:45:11,679
from the italian space agency thank you

2675
01:45:14,709 --> 01:45:13,280
so much for that thank you for bringing

2676
01:45:17,910 --> 01:45:14,719
your legos

2677
01:45:20,790 --> 01:45:17,920
that was great it is like a kind of uh

2678
01:45:22,629 --> 01:45:20,800
lucky charm for us and um my daughter

2679
01:45:23,990 --> 01:45:22,639
wants this back so i take it back to

2680
01:45:25,510 --> 01:45:24,000
italy all right let's check in with

2681
01:45:29,350 --> 01:45:25,520
marie and denton to find out more about

2682
01:45:33,830 --> 01:45:31,109
all right thanks uh daryl and kelly it

2683
01:45:37,030 --> 01:45:33,840
was a very interesting uh conversation

2684
01:45:39,270 --> 01:45:37,040
we are about uh 45 seconds or so from

2685
01:45:41,910 --> 01:45:39,280
spacecraft separation when the falcon 9

2686
01:45:44,390 --> 01:45:41,920
second stage and dart will be over the

2687
01:45:46,310 --> 01:45:44,400
indian ocean near madagascar

2688
01:45:48,229 --> 01:45:46,320

and then the job of the falcon 9 rocket

2689
01:45:50,550 --> 01:45:48,239
will be officially complete for this

2690
01:45:53,189 --> 01:45:50,560
mission yeah absolutely i mean

2691
01:45:55,430 --> 01:45:53,199
the job of falcon 9 was to get

2692
01:45:56,870 --> 01:45:55,440
dart on its way to the dynamo system at

2693
01:46:00,550 --> 01:45:56,880
this point we

2694
01:46:02,790 --> 01:46:00,560
gotten enough velocity enough speed to

2695
01:46:04,870 --> 01:46:02,800
send dart off towards the general system

2696
01:46:06,310 --> 01:46:04,880
and right now well we're in range of the

2697
01:46:08,550 --> 01:46:06,320
ground station so we can get all the

2698
01:46:11,030 --> 01:46:08,560
data from and so we can make sure we can

2699
01:46:12,709 --> 01:46:11,040
actually capture this separation

2700
01:46:14,550 --> 01:46:12,719
and we just heard the call out for

2701
01:46:15,590 --> 01:46:14,560
spacecraft separation you can see the

2702
01:46:16,950 --> 01:46:15,600
video

2703
01:46:18,709 --> 01:46:16,960
of the

2704
01:46:20,310 --> 01:46:18,719
dart spacecraft

2705
01:46:23,830 --> 01:46:20,320
on its way heading on its way to the

2706
01:46:26,709 --> 01:46:23,840
digimon system what a spectacular view

2707
01:46:28,709 --> 01:46:26,719
of dart yep just floating away from the

2708
01:46:30,870 --> 01:46:28,719
falcon 9 second stage

2709
01:46:33,510 --> 01:46:30,880
and you can see the

2710
01:46:35,270 --> 01:46:33,520
sun off to the side there as dart drifts

2711
01:46:37,350 --> 01:46:35,280
away from the

2712
01:46:40,550 --> 01:46:37,360
falcon 9 second stage

2713
01:46:44,149 --> 01:46:40,560

and so this officially begins uh almost

2714
01:46:45,990 --> 01:46:44,159
a year of cruise for the dart spacecraft

2715
01:46:48,629 --> 01:46:46,000
flying through

2716
01:46:51,510 --> 01:46:48,639
on its way to the ditimo system

2717
01:46:55,669 --> 01:46:51,520
and at the time that it impacts

2718
01:46:56,709 --> 01:46:55,679
dimorphose in late september 2022 is

2719
01:46:57,830 --> 01:46:56,719
what we

2720
01:47:00,149 --> 01:46:57,840
expect

2721
01:47:02,790 --> 01:47:00,159
the ditimo system will be within 11

2722
01:47:05,910 --> 01:47:02,800
million kilometers of earth

2723
01:47:07,990 --> 01:47:05,920
again to remind folks this this

2724
01:47:08,870 --> 01:47:08,000
system is does not pose any kind of

2725
01:47:12,149 --> 01:47:08,880
threat

2726
01:47:15,270 --> 01:47:12,159
to earth this is purely a test

2727
01:47:18,310 --> 01:47:15,280
and so dart when it approaches

2728
01:47:22,149 --> 01:47:18,320
will smash into dimorphous the small

2729
01:47:24,790 --> 01:47:22,159
moonlit of dytamos at 15 000 miles per

2730
01:47:26,229 --> 01:47:24,800
hour just astonishing rate of speed yeah

2731
01:47:28,550 --> 01:47:26,239
absolutely

2732
01:47:30,310 --> 01:47:28,560
now the next thing that uh we have to

2733
01:47:33,430 --> 01:47:30,320
get through obviously spacecraft

2734
01:47:35,750 --> 01:47:33,440
separation is is a huge milestone but we

2735
01:47:38,070 --> 01:47:35,760
are we're not out of the woods yet we

2736
01:47:40,550 --> 01:47:38,080
still have to get acquisition of signal

2737
01:47:42,629 --> 01:47:40,560
from the dart spacecraft and that takes

2738
01:47:43,590 --> 01:47:42,639

a little bit more time right dutton yeah

2739
01:47:45,430 --> 01:47:43,600
and

2740
01:47:47,189 --> 01:47:45,440
at this point the launch vehicle has

2741
01:47:49,910 --> 01:47:47,199
done its job and we just want to make

2742
01:47:51,430 --> 01:47:49,920
sure we get we basically hear from the

2743
01:47:53,430 --> 01:47:51,440
dart spacecraft make sure it's doing

2744
01:47:54,629 --> 01:47:53,440
well and you think you think about it's

2745
01:47:56,709 --> 01:47:54,639
kind of like getting off of roller

2746
01:47:58,070 --> 01:47:56,719
coaster right you know you step off the

2747
01:47:59,350 --> 01:47:58,080
roller coaster you know you kind of

2748
01:48:00,950 --> 01:47:59,360
steady yourself you want to check your

2749
01:48:03,030 --> 01:48:00,960
pockets make sure you didn't lose

2750
01:48:04,390 --> 01:48:03,040
anything along along the way make sure

2751
01:48:05,910 --> 01:48:04,400
you're okay

2752
01:48:07,910 --> 01:48:05,920
and that's basically what we're looking

2753
01:48:09,830 --> 01:48:07,920
for from the dart spacecraft once it

2754
01:48:11,669 --> 01:48:09,840
gets that acquisition the signal because

2755
01:48:13,510 --> 01:48:11,679
it's gonna kind of go through itself

2756
01:48:14,870 --> 01:48:13,520
checks make sure everything's okay and

2757
01:48:16,390 --> 01:48:14,880
then it's gonna send

2758
01:48:17,510 --> 01:48:16,400
send word back to home basically saying

2759
01:48:19,750 --> 01:48:17,520
hey i'm doing all right and that's what

2760
01:48:21,350 --> 01:48:19,760
we're looking for right now and that's

2761
01:48:22,629 --> 01:48:21,360
i mean because if we don't get that then

2762
01:48:24,310 --> 01:48:22,639
it's kind of all for nothing right you

2763
01:48:26,629 --> 01:48:24,320

want to make sure that the spacecraft is

2764
01:48:28,470 --> 01:48:26,639
doing well after it's gone um you know

2765
01:48:30,310 --> 01:48:28,480
separated away from the launch vehicle

2766
01:48:33,750 --> 01:48:30,320
and you've got grounds uh ground

2767
01:48:35,669 --> 01:48:33,760
stations uh all over the planet that are

2768
01:48:38,070 --> 01:48:35,679
looking for this signal from dart and

2769
01:48:40,229 --> 01:48:38,080
we'll be trying to start picking that up

2770
01:48:42,629 --> 01:48:40,239
very soon right and sometimes it's not

2771
01:48:44,709 --> 01:48:42,639
an exact s not exactly sometimes the

2772
01:48:46,229 --> 01:48:44,719
timing may vary once you get in range of

2773
01:48:48,070 --> 01:48:46,239
certain ground stations you know they

2774
01:48:49,830 --> 01:48:48,080
could be where they're kind of impacting

2775
01:48:51,590 --> 01:48:49,840
that signal strength etc so there are

2776
01:48:54,310 --> 01:48:51,600
there's various factors that come into

2777
01:48:55,910 --> 01:48:54,320
play so but we're expecting to get it

2778
01:48:58,390 --> 01:48:55,920
coming up in a few minutes but hopefully

2779
01:49:00,310 --> 01:48:58,400
we'll get that so we can

2780
01:49:03,030 --> 01:49:00,320
get good word that dart is doing well

2781
01:49:04,629 --> 01:49:03,040
okay and so there's a range uh that

2782
01:49:06,470 --> 01:49:04,639
we're look that we're expecting um

2783
01:49:10,149 --> 01:49:06,480
acquisition of signal could be as early

2784
01:49:11,750 --> 01:49:10,159
as around uh t plus an hour and seven

2785
01:49:13,910 --> 01:49:11,760
minutes so that's

2786
01:49:17,430 --> 01:49:13,920
nine or so minutes from now

2787
01:49:19,189 --> 01:49:17,440
it could be as late as t plus 1 hour 34

2788
01:49:22,390 --> 01:49:19,199

minutes like you said it's not an exact

2789
01:49:24,550 --> 01:49:22,400
science uh we'll know when it happens uh

2790
01:49:26,629 --> 01:49:24,560
and we'll give confirmation as as soon

2791
01:49:28,870 --> 01:49:26,639
as we hear it but for now we're going to

2792
01:49:30,470 --> 01:49:28,880
keep an ear on things and daryl and

2793
01:49:32,149 --> 01:49:30,480
kelly we will send it back to you all

2794
01:49:34,229 --> 01:49:32,159
right marie and denton thank you so much

2795
01:49:37,109 --> 01:49:34,239
what beautiful imagery seeing that dart

2796
01:49:39,109 --> 01:49:37,119
spacecraft sailing off well dart will be

2797
01:49:41,830 --> 01:49:39,119
destroyed after it smashes into its

2798
01:49:44,390 --> 01:49:41,840
target asteroid but years from now a new

2799
01:49:47,109 --> 01:49:44,400
spacecraft will follow darth's path to

2800
01:49:49,350 --> 01:49:47,119
the same double asteroid joining us now

2801
01:49:52,470 --> 01:49:49,360
is ian carnelly the european space

2802
01:49:53,910 --> 01:49:52,480
agency's project manager for hira

2803
01:49:55,830 --> 01:49:53,920
thanks for being here thank you for

2804
01:49:58,070 --> 01:49:55,840
inviting me well tell me a little bit

2805
01:50:00,390 --> 01:49:58,080
about what hera does and how it got its

2806
01:50:02,709 --> 01:50:00,400
name all right so here i will be

2807
01:50:04,709 --> 01:50:02,719
launched in october 2024

2808
01:50:05,990 --> 01:50:04,719
so fears out is currently now in

2809
01:50:08,149 --> 01:50:06,000
integration

2810
01:50:09,830 --> 01:50:08,159
and uh we'll launch it from crew and

2811
01:50:13,030 --> 01:50:09,840
arrive at

2812
01:50:15,189 --> 01:50:13,040
in 2026 around christmas day

2813
01:50:17,510 --> 01:50:15,199

and our primary purpose is really to

2814
01:50:19,589 --> 01:50:17,520
complete the investigation to understand

2815
01:50:22,550 --> 01:50:19,599
what has happened during the and after

2816
01:50:26,149 --> 01:50:22,560
the dart impacts understand the dynamics

2817
01:50:28,390 --> 01:50:26,159
uh the geology the what the the asteroid

2818
01:50:30,629 --> 01:50:28,400
is made of and the name is quite funny

2819
01:50:33,030 --> 01:50:30,639
actually we had uh an evening with the

2820
01:50:34,950 --> 01:50:33,040
scientists and we were thinking about

2821
01:50:36,950 --> 01:50:34,960
names and i only had a constraint from

2822
01:50:39,350 --> 01:50:36,960
my boss saying we don't want acronyms

2823
01:50:42,229 --> 01:50:39,360
for once so

2824
01:50:44,390 --> 01:50:42,239
uh the idea yeah it was a perfect choice

2825
01:50:45,830 --> 01:50:44,400
but it's because there are two

2826
01:50:47,830 --> 01:50:45,840
aspects of this right what is this

2827
01:50:49,990 --> 01:50:47,840
exactly so these are the cubesats so

2828
01:50:52,390 --> 01:50:50,000
here we'll bring with it two cubesats

2829
01:50:53,910 --> 01:50:52,400
one called milani after actually the

2830
01:50:57,109 --> 01:50:53,920
scientists who brought up the name of

2831
01:50:59,189 --> 01:50:57,119
the mission and the concept and juventus

2832
01:51:01,109 --> 01:50:59,199
so the two cubesats will perform

2833
01:51:04,390 --> 01:51:01,119
scientific investigations here we're

2834
01:51:06,950 --> 01:51:04,400
seeing the booms deploying from juventus

2835
01:51:08,870 --> 01:51:06,960
that's actually a a low frequency radar

2836
01:51:11,030 --> 01:51:08,880
what it does it's actually going down is

2837
01:51:12,470 --> 01:51:11,040
actually like a x-ray we want to

2838
01:51:14,950 --> 01:51:12,480

understand what is the internal

2839
01:51:17,589 --> 01:51:14,960
structure of the asteroid understand if

2840
01:51:20,070 --> 01:51:17,599
there are voids or if it's a monolithic

2841
01:51:21,589 --> 01:51:20,080
rock how about that yeah so imagine

2842
01:51:23,750 --> 01:51:21,599
literally going into the crater that

2843
01:51:26,229 --> 01:51:23,760
dart created exactly that's the purpose

2844
01:51:28,790 --> 01:51:26,239
and uh so hera it comes after the

2845
01:51:30,470 --> 01:51:28,800
goddess the greek goddess of marriage

2846
01:51:33,189 --> 01:51:30,480
and the idea being that

2847
01:51:35,750 --> 01:51:33,199
despite being hit by guard the two

2848
01:51:38,229 --> 01:51:35,760
asteroids will stay together so that was

2849
01:51:39,109 --> 01:51:38,239
kind of the history behind the name i

2850
01:51:41,350 --> 01:51:39,119
love it

2851
01:51:43,830 --> 01:51:41,360
well yeah we just got uh dart off the

2852
01:51:46,070 --> 01:51:43,840
planet and so why is it important now to

2853
01:51:48,870 --> 01:51:46,080
you know a few years later for hera to

2854
01:51:51,189 --> 01:51:48,880
go and then follow up yeah absolutely so

2855
01:51:52,550 --> 01:51:51,199
we are so excited about art it was an

2856
01:51:55,589 --> 01:51:52,560
awesome launch

2857
01:51:58,149 --> 01:51:55,599
and we're all expecting beautiful uh

2858
01:52:00,229 --> 01:51:58,159
science data to come next year but then

2859
01:52:02,709 --> 01:52:00,239
the the purpose of here is really to

2860
01:52:03,750 --> 01:52:02,719
complete the experiment to get close and

2861
01:52:06,149 --> 01:52:03,760
personal

2862
01:52:07,990 --> 01:52:06,159
and get all of the science data that we

2863
01:52:10,390 --> 01:52:08,000

need to to actually calibrate our

2864
01:52:12,070 --> 01:52:10,400
numerical input codes meaning that we

2865
01:52:14,709 --> 01:52:12,080
can reproduce on our computer

2866
01:52:17,189 --> 01:52:14,719
simulations exactly what happened during

2867
01:52:18,950 --> 01:52:17,199
the dark impact and that will allow us

2868
01:52:21,109 --> 01:52:18,960
in the future to be able to design a

2869
01:52:24,229 --> 01:52:21,119
planetary defense mission if we need to

2870
01:52:26,310 --> 01:52:24,239
on another object so we will have all of

2871
01:52:28,310 --> 01:52:26,320
the models calibrated so that we can use

2872
01:52:30,229 --> 01:52:28,320
it on another asteroid all right ian

2873
01:52:31,669 --> 01:52:30,239
cornelli fascinating stuff and a great

2874
01:52:32,950 --> 01:52:31,679
mission to follow up on this dart

2875
01:52:35,270 --> 01:52:32,960
mission i appreciate you being here

2876
01:52:37,270 --> 01:52:35,280
thank you for inviting me all right

2877
01:52:38,629 --> 01:52:37,280
well now we are getting to the big

2878
01:52:41,030 --> 01:52:38,639
moment where we're going to try to

2879
01:52:43,270 --> 01:52:41,040
acquire a single signal from the dart

2880
01:52:45,030 --> 01:52:43,280
spacecraft and so let's take a look

2881
01:52:46,790 --> 01:52:45,040
inside at the mission operations center

2882
01:52:48,390 --> 01:52:46,800
in the johns hopkins

2883
01:52:50,709 --> 01:52:48,400
uh university's applied physics

2884
01:52:52,229 --> 01:52:50,719
laboratory if we have that that's where

2885
01:52:54,310 --> 01:52:52,239
that's where the real work is going to

2886
01:52:56,629 --> 01:52:54,320
start being done in terms of acquiring

2887
01:52:59,109 --> 01:52:56,639
that signal and in just a few minutes

2888
01:53:01,510 --> 01:52:59,119

we're expecting that dart team to do

2889
01:53:03,669 --> 01:53:01,520
just that acquire the signal but as

2890
01:53:06,070 --> 01:53:03,679
marine denton mentioned it's not an

2891
01:53:08,070 --> 01:53:06,080
exact science you know we got to go

2892
01:53:09,750 --> 01:53:08,080
through some stations to make sure we

2893
01:53:11,589 --> 01:53:09,760
acquire that signal and get it in there

2894
01:53:12,550 --> 01:53:11,599
but you're pretty familiar kelly with

2895
01:53:14,790 --> 01:53:12,560
the people

2896
01:53:16,950 --> 01:53:14,800
who are going to be in that room

2897
01:53:18,629 --> 01:53:16,960
waiting for this signal to come in well

2898
01:53:19,750 --> 01:53:18,639
the planetary defense coordination

2899
01:53:21,109 --> 01:53:19,760
office and the planetary science

2900
01:53:24,229 --> 01:53:21,119
division have been working with the

2901
01:53:25,589 --> 01:53:24,239
applied physics lab and with the uh

2902
01:53:28,070 --> 01:53:25,599
co-investigators at other other

2903
01:53:28,790 --> 01:53:28,080
institutions for for a long time on this

2904
01:53:33,109 --> 01:53:28,800
and

2905
01:53:35,270 --> 01:53:33,119
people have their jobs that they need to

2906
01:53:36,870 --> 01:53:35,280
do but i mean these are these are

2907
01:53:39,669 --> 01:53:36,880
individuals who are really passionate

2908
01:53:41,430 --> 01:53:39,679
about that what they're doing and so uh

2909
01:53:43,270 --> 01:53:41,440
they're really taking this to heart and

2910
01:53:44,550 --> 01:53:43,280
and and i'm sure they're still on pins

2911
01:53:45,910 --> 01:53:44,560
and needles as they work their way

2912
01:53:48,229 --> 01:53:45,920
through this part of the mission

2913
01:53:50,070 --> 01:53:48,239

speaking of pins and needles there we

2914
01:53:53,030 --> 01:53:50,080
see the room there as you can see at the

2915
01:53:55,910 --> 01:53:53,040
lower uh bottom of your screen a waiting

2916
01:53:58,870 --> 01:53:55,920
dart acquisition of signal and that area

2917
01:54:02,950 --> 01:53:58,880
right there is called the command pit

2918
01:54:05,750 --> 01:54:02,960
at apl and and so those folks are

2919
01:54:07,510 --> 01:54:05,760
patiently and intently listening for

2920
01:54:10,229 --> 01:54:07,520
communication

2921
01:54:11,830 --> 01:54:10,239
from dart to the ground so while we

2922
01:54:13,830 --> 01:54:11,840
await that let's send it over to marie

2923
01:54:16,390 --> 01:54:13,840
and denton who are monitoring the launch

2924
01:54:18,950 --> 01:54:16,400
team communications as we await

2925
01:54:20,950 --> 01:54:18,960
acquisition of signal

2926
01:54:23,910 --> 01:54:20,960
uh so right now daryl and kelly it's

2927
01:54:27,189 --> 01:54:23,920
just a lot of waiting and listening

2928
01:54:28,950 --> 01:54:27,199
we're there's almost no chatter going on

2929
01:54:30,709 --> 01:54:28,960
on the loops everyone is just kind of

2930
01:54:33,270 --> 01:54:30,719
waiting with baited breath

2931
01:54:36,310 --> 01:54:33,280
at this point we're at t plus one hour

2932
01:54:39,030 --> 01:54:36,320
four minutes and counting uh and just in

2933
01:54:40,709 --> 01:54:39,040
these these it all kind of comes down to

2934
01:54:43,030 --> 01:54:40,719
these final minutes when are we going to

2935
01:54:45,669 --> 01:54:43,040
get that signal um

2936
01:54:48,390 --> 01:54:45,679
years of work some of the people in this

2937
01:54:49,189 --> 01:54:48,400
room probably if not if not all of them

2938
01:54:51,750 --> 01:54:49,199

have

2939
01:54:55,109 --> 01:54:51,760
poured years of their life this is their

2940
01:54:55,910 --> 01:54:55,119
life's work into this mission and so

2941
01:54:58,229 --> 01:54:55,920
uh

2942
01:54:59,910 --> 01:54:58,239
what's it like waiting for

2943
01:55:01,990 --> 01:54:59,920
this confirmation

2944
01:55:03,589 --> 01:55:02,000
yeah and so you know having

2945
01:55:05,669 --> 01:55:03,599
been on the launch vehicle side and

2946
01:55:07,589 --> 01:55:05,679
sitting on console and working this is

2947
01:55:09,270 --> 01:55:07,599
you know what you've been working

2948
01:55:11,510 --> 01:55:09,280
years to kind of get to this point and

2949
01:55:13,430 --> 01:55:11,520
as you mentioned the spacecraft teams

2950
01:55:15,990 --> 01:55:13,440
dedicate most of their careers or you

2951
01:55:17,669 --> 01:55:16,000
know their life's work to the spacecraft

2952
01:55:19,669 --> 01:55:17,679
so you know getting through the launch

2953
01:55:21,189 --> 01:55:19,679
you know he's like great we had a great

2954
01:55:22,629 --> 01:55:21,199
launch everything went successful but

2955
01:55:24,709 --> 01:55:22,639
you want to make sure you get that

2956
01:55:26,470 --> 01:55:24,719
confirmation from the spacecraft so it's

2957
01:55:27,990 --> 01:55:26,480
a little excitement that we got through

2958
01:55:29,669 --> 01:55:28,000
the launch but it's a little nervousness

2959
01:55:31,510 --> 01:55:29,679
and we can say okay we want to make sure

2960
01:55:34,070 --> 01:55:31,520
the spacecraft is doing okay and that

2961
01:55:35,990 --> 01:55:34,080
that and so it's a mixture of excitement

2962
01:55:37,589 --> 01:55:36,000
and nervousness at the same time

2963
01:55:40,390 --> 01:55:37,599

yeah and you know

2964
01:55:42,149 --> 01:55:40,400
you mentioned nervousness and

2965
01:55:54,709 --> 01:55:42,159
in

2966
01:55:56,709 --> 01:55:54,719
confirmation that we've

2967
01:56:08,229 --> 01:55:56,719
actually have got signal

2968
01:56:08,239 --> 01:56:20,550
so we just waiting to get word

2969
01:56:24,790 --> 01:56:22,310
if you're just joining us this is a live

2970
01:56:27,669 --> 01:56:24,800
view of the mission operations center at

2971
01:56:29,589 --> 01:56:27,679
johns hopkins applied physics laboratory

2972
01:56:31,990 --> 01:56:29,599
in laurel maryland

2973
01:56:33,350 --> 01:56:32,000
this is where the spacecraft team is

2974
01:56:35,189 --> 01:56:33,360
waiting to

2975
01:56:37,270 --> 01:56:35,199
receive confirmation

2976
01:56:39,990 --> 01:56:37,280
of acquisition of signal from the dart

2977
01:56:41,270 --> 01:56:40,000
spacecraft currently on its way to the

2978
01:56:44,229 --> 01:56:41,280
dynamos

2979
01:56:46,550 --> 01:56:44,239
asteroid system

2980
01:56:49,270 --> 01:56:46,560
where we expect it will impact the

2981
01:57:05,750 --> 01:56:49,280
moonlit dimorphous in late september of

2982
01:57:09,990 --> 01:57:07,350
and then while we wait

2983
01:57:12,629 --> 01:57:10,000
to hear whether we have acquisition of

2984
01:57:14,070 --> 01:57:12,639
signal i was going to mention

2985
01:57:15,830 --> 01:57:14,080
you know the teams

2986
01:57:18,070 --> 01:57:15,840
rehearse this

2987
01:57:20,470 --> 01:57:18,080
many many times there is

2988
01:57:22,629 --> 01:57:20,480

um there are pages and pages of

2989
01:57:24,870 --> 01:57:22,639
procedures that have to be followed down

2990
01:57:26,709 --> 01:57:24,880
to the letter and you go through

2991
01:57:28,310 --> 01:57:26,719
everything a final time during the

2992
01:57:31,510 --> 01:57:28,320
mission dress rehearsal this team did

2993
01:57:33,350 --> 01:57:31,520
that uh less than a week ago

2994
01:57:35,830 --> 01:57:33,360
from the control rooms here in

2995
01:57:38,390 --> 01:57:35,840
vandenberg uh

2996
01:57:41,270 --> 01:57:38,400
john johns hopkins

2997
01:57:43,430 --> 01:57:41,280
all around the country

2998
01:57:44,709 --> 01:57:43,440
and this is the one thing that

2999
01:57:46,629 --> 01:57:44,719
you can't really predict you don't

3000
01:57:47,910 --> 01:57:46,639
really know when it's going to happen

3001
01:57:50,070 --> 01:57:47,920
right

3002
01:57:51,990 --> 01:57:50,080
so it all comes down to

3003
01:57:54,070 --> 01:57:52,000
different the environments are different

3004
01:57:55,030 --> 01:57:54,080
variables that play out on launch day

3005
01:57:56,149 --> 01:57:55,040
and

3006
01:57:57,990 --> 01:57:56,159
whether you're going to get that single

3007
01:57:59,990 --> 01:57:58,000
early or whether you get it later you

3008
01:58:02,709 --> 01:58:00,000
won't know until you get up there so you

3009
01:58:03,990 --> 01:58:02,719
know rehearsals and and practice is

3010
01:58:05,910 --> 01:58:04,000
great

3011
01:58:07,830 --> 01:58:05,920
for dealing with anomalies and and

3012
01:58:09,830 --> 01:58:07,840
things along those lines but at the end

3013
01:58:11,589 --> 01:58:09,840

of the day you still you're 100 sure

3014
01:58:14,950 --> 01:58:11,599
when it'll actually happen until you

3015
01:58:17,109 --> 01:58:14,960
know the launch until launch day

3016
01:58:19,430 --> 01:58:17,119
and so at this point we are officially

3017
01:58:20,629 --> 01:58:19,440
inside that window

3018
01:58:22,629 --> 01:58:20,639
when we

3019
01:58:31,910 --> 01:58:22,639
think we could get acquisition of signal

3020
01:58:35,030 --> 01:58:32,830
and you

3021
01:58:36,950 --> 01:58:35,040
can look in the room you can kind of see

3022
01:58:38,470 --> 01:58:36,960
that nervous energy of people just

3023
01:58:39,669 --> 01:58:38,480
waiting to get that confirmation of

3024
01:58:42,390 --> 01:58:39,679
spacecraft

3025
01:58:43,830 --> 01:58:42,400
um that or i would say first signal from

3026
01:58:52,870 --> 01:58:43,840
the spacecraft and make sure that the

3027
01:58:57,750 --> 01:58:55,910
and then after that signal is acquired

3028
01:58:59,669 --> 01:58:57,760
there i mean there's even more to be

3029
01:59:02,629 --> 01:58:59,679
done then i mean that's a that's a huge

3030
01:59:03,910 --> 01:59:02,639
moment of celebration a sigh of relief

3031
01:59:05,030 --> 01:59:03,920
but there's still a lot of work to be

3032
01:59:07,430 --> 01:59:05,040
done on the other side of that

3033
01:59:09,030 --> 01:59:07,440
absolutely so that's when the dart the

3034
01:59:10,390 --> 01:59:09,040
dart team the spacecraft team that's

3035
01:59:12,310 --> 01:59:10,400
when their work really begins the launch

3036
01:59:14,229 --> 01:59:12,320
vehicle team pretty much did

3037
01:59:15,990 --> 01:59:14,239
all their work kind of leading up to

3038
01:59:17,990 --> 01:59:16,000

spacecraft separation now it's time for

3039
01:59:19,109 --> 01:59:18,000
the dart team to kind of really

3040
01:59:20,629 --> 01:59:19,119
uh

3041
01:59:22,550 --> 01:59:20,639
moving forward on the operational side

3042
01:59:23,990 --> 01:59:22,560
of their their mission

3043
01:59:26,070 --> 01:59:24,000
um at this point because you know they

3044
01:59:28,709 --> 01:59:26,080
spent years developing the technology

3045
01:59:31,030 --> 01:59:28,719
building the spacecraft and now

3046
01:59:32,790 --> 01:59:31,040
since we've had a successful launch

3047
01:59:46,390 --> 01:59:32,800
the operational side of their their

3048
01:59:51,270 --> 01:59:48,950
so we just got confirmation that we do

3049
01:59:53,910 --> 01:59:51,280
have acquisition the signal

3050
01:59:55,669 --> 01:59:53,920
which is great news that the spacecraft

3051
01:59:57,510 --> 01:59:55,679
has been able to talk to the team on the

3052
02:00:00,070 --> 01:59:57,520
ground so that's that's a good thing

3053
02:00:01,109 --> 02:00:00,080
yeah huge news um

3054
02:00:04,550 --> 02:00:01,119
it's

3055
02:00:07,030 --> 02:00:04,560
the

3056
02:00:10,390 --> 02:00:07,040
solar arrays on dart uh

3057
02:00:12,790 --> 02:00:10,400
will still have to unfurl uh that that

3058
02:00:13,990 --> 02:00:12,800
process does not begin until

3059
02:00:19,270 --> 02:00:14,000
uh

3060
02:00:21,669 --> 02:00:19,280
so that's still quite a ways away um and

3061
02:00:24,950 --> 02:00:21,679
that process once the first one begins

3062
02:00:27,750 --> 02:00:24,960
to unfurl that happens uh very gradually

3063
02:00:29,990 --> 02:00:27,760

and then uh it's almost an hour before

3064
02:00:32,629 --> 02:00:30,000
the second one is is fully unfurled and

3065
02:00:34,629 --> 02:00:32,639
the span of those um stretches fully out

3066
02:00:37,510 --> 02:00:34,639
into space each one

3067
02:00:43,910 --> 02:00:37,520
reaching almost 30 feet um in either

3068
02:00:47,990 --> 02:00:46,149
okay and uh just to finish that thought

3069
02:00:50,709 --> 02:00:48,000
they are three times more

3070
02:00:53,270 --> 02:00:50,719
powerful than standard solar arrays uh

3071
02:00:55,910 --> 02:00:53,280
we we've just heard that uh nasa launch

3072
02:00:58,390 --> 02:00:55,920
manager tim dunn is is standing by with

3073
02:01:00,629 --> 02:00:58,400
daryl and kelly to speak to them about

3074
02:01:02,629 --> 02:01:00,639
uh the success so far in the dart

3075
02:01:05,350 --> 02:01:02,639
mission now that we have confirmation of

3076
02:01:07,589 --> 02:01:05,360
acquisition of signal so daryl and kelly

3077
02:01:09,270 --> 02:01:07,599
denton and i will sign off from here and

3078
02:01:11,109 --> 02:01:09,280
we will send it back to you all right

3079
02:01:13,750 --> 02:01:11,119
thank you maria denton great job out

3080
02:01:15,910 --> 02:01:13,760
there and congratulations is in order

3081
02:01:18,310 --> 02:01:15,920
for launch services program tim dunn

3082
02:01:20,870 --> 02:01:18,320
joining us here on set just popped in

3083
02:01:23,270 --> 02:01:20,880
fresh from the control room yes how did

3084
02:01:24,149 --> 02:01:23,280
it go from your perspective oh it went

3085
02:01:26,229 --> 02:01:24,159
great

3086
02:01:28,070 --> 02:01:26,239
just terrific uh

3087
02:01:30,390 --> 02:01:28,080
we got it all settled in about three and

3088
02:01:33,669 --> 02:01:30,400

a half hours before t-zero

3089
02:01:36,390 --> 02:01:33,679
and uh we had a couple of minor issues

3090
02:01:39,510 --> 02:01:36,400
uh with a little bit with the pad a few

3091
02:01:42,790 --> 02:01:39,520
items with the rocket but it's amazing

3092
02:01:45,669 --> 02:01:42,800
daryl to watch the integration of the

3093
02:01:48,070 --> 02:01:45,679
nasa team and the spacex team work

3094
02:01:49,750 --> 02:01:48,080
through anomalies and issues to make

3095
02:01:52,310 --> 02:01:49,760
sure that we are tracking to that

3096
02:01:53,589 --> 02:01:52,320
precious one second instantaneous window

3097
02:01:55,430 --> 02:01:53,599
that we had to hit

3098
02:01:57,510 --> 02:01:55,440
obviously we had perfect weather today

3099
02:02:00,390 --> 02:01:57,520
so that was not a player at all

3100
02:02:01,189 --> 02:02:00,400
uh no range instrumentation issues at

3101
02:02:02,390 --> 02:02:01,199
all

3102
02:02:05,270 --> 02:02:02,400
so

3103
02:02:07,669 --> 02:02:05,280
it was just a terrific countdown and any

3104
02:02:10,070 --> 02:02:07,679
countdown that ends in a successful

3105
02:02:12,470 --> 02:02:10,080
launch followed by spacecraft separation

3106
02:02:14,629 --> 02:02:12,480
is a great day absolutely and what a

3107
02:02:17,109 --> 02:02:14,639
show out there outside as well clear

3108
02:02:18,629 --> 02:02:17,119
skies you don't get that all the time in

3109
02:02:19,750 --> 02:02:18,639
vandenberg that's great to see it

3110
02:02:22,229 --> 02:02:19,760
straight up and there were some great

3111
02:02:24,550 --> 02:02:22,239
camera views as well yes yes we uh we

3112
02:02:26,790 --> 02:02:24,560
got a peek out of the window at the uh

3113
02:02:28,310 --> 02:02:26,800

spacex facility and i got to see

3114
02:02:30,149 --> 02:02:28,320
probably about the first 30 seconds of

3115
02:02:32,950 --> 02:02:30,159
flight looked gorgeous from north

3116
02:02:35,270 --> 02:02:32,960
vandenberg nice oh fantastic and one

3117
02:02:37,669 --> 02:02:35,280
second launch window and um no rest for

3118
02:02:39,030 --> 02:02:37,679
the weary it's been quite uh an end of

3119
02:02:41,109 --> 02:02:39,040
the year for you here with lots of

3120
02:02:44,070 --> 02:02:41,119
launches what has that been like

3121
02:02:46,390 --> 02:02:44,080
it's been very busy you guys know we

3122
02:02:48,709 --> 02:02:46,400
started off just two months ago landsat

3123
02:02:50,629 --> 02:02:48,719
here at vandenberg a month after that

3124
02:02:52,629 --> 02:02:50,639
middle of october lucy back on the east

3125
02:02:54,390 --> 02:02:52,639
coast and here we are

3126
02:02:57,030 --> 02:02:54,400
you know right before thanksgiving with

3127
02:02:59,830 --> 02:02:57,040
a successful dart launch and we turn

3128
02:03:02,470 --> 02:02:59,840
right around 16 days from now we'll be

3129
02:03:04,470 --> 02:03:02,480
launching xp on a falcon 9 from kennedy

3130
02:03:06,790 --> 02:03:04,480
space center and then just a few more

3131
02:03:08,149 --> 02:03:06,800
months after that a goes launch early in

3132
02:03:11,510 --> 02:03:08,159
2022

3133
02:03:13,109 --> 02:03:11,520
so just a very busy time but a very

3134
02:03:15,589 --> 02:03:13,119
exciting time for launch services

3135
02:03:17,189 --> 02:03:15,599
program well it certainly has been the

3136
02:03:19,189 --> 02:03:17,199
end of the year lots of launches as you

3137
02:03:21,669 --> 02:03:19,199
mentioned got to get going in the early

3138
02:03:23,669 --> 02:03:21,679

part of next year as well yes but uh you

3139
02:03:25,430 --> 02:03:23,679
get to enjoy this one now a little bit

3140
02:03:27,189 --> 02:03:25,440
and uh congratulations to you and the

3141
02:03:29,350 --> 02:03:27,199
team oh well thank you so much it means

3142
02:03:31,910 --> 02:03:29,360
a lot to be able to launch uh on the

3143
02:03:33,830 --> 02:03:31,920
23rd of november and be able to get a

3144
02:03:35,669 --> 02:03:33,840
lot of folks on airplanes tomorrow so

3145
02:03:37,910 --> 02:03:35,679
they can be home with their families you

3146
02:03:40,229 --> 02:03:37,920
betcha i'm one of those so thank you

3147
02:03:42,470 --> 02:03:40,239
wonderful thank you all right well our

3148
02:03:45,189 --> 02:03:42,480
coverage of the dart mission is coming

3149
02:03:47,750 --> 02:03:45,199
to a close but uh you can keep track of

3150
02:03:48,950 --> 02:03:47,760
dart and get updates on twitter just go

3151
02:03:50,870 --> 02:03:48,960
to at

3152
02:03:53,350 --> 02:03:50,880
asteroid watch

3153
02:03:54,629 --> 02:03:53,360
on all of the platforms twitter facebook

3154
02:03:56,709 --> 02:03:54,639
and instagram

3155
02:03:58,149 --> 02:03:56,719
so thank you for watching our nasa

3156
02:03:59,990 --> 02:03:58,159
coverage of the dart launch from the

3157
02:04:02,470 --> 02:04:00,000
vandenberg space force base in

3158
02:04:03,910 --> 02:04:02,480
california we want to give all of our

3159
02:04:06,390 --> 02:04:03,920
guests a special thanks for

3160
02:04:08,310 --> 02:04:06,400
participating in the show and a special

3161
02:04:09,750 --> 02:04:08,320
shout out to my co-host kelly fast thank

3162
02:04:11,830 --> 02:04:09,760
you so much for being here no thank you

3163
02:04:13,910 --> 02:04:11,840

daryl this is so much fun

3164
02:04:16,390 --> 02:04:13,920
congratulations and we look to hear more

3165
02:04:17,830 --> 02:04:16,400
from you in the fall of next year ready

3166
02:04:19,830 --> 02:04:17,840
to cheer on the team they've been

3167
02:04:21,669 --> 02:04:19,840
fabulous all right

3168
02:04:23,669 --> 02:04:21,679
fantastic so we leave you now with a

3169
02:04:26,229 --> 02:04:23,679
replay of the dart launch from right

3170
02:04:28,629 --> 02:04:26,239
here at the vandenberg space force base

3171
02:04:33,030 --> 02:04:28,639
in california good night everyone and

3172
02:04:33,040 --> 02:04:39,430
2-15

3173
02:04:41,270 --> 02:04:40,390
nine

3174
02:04:42,149 --> 02:04:41,280
eight

3175
02:04:43,109 --> 02:04:42,159
seven

3176
02:04:44,069 --> 02:04:43,119
six

3177
02:04:45,109 --> 02:04:44,079
five

3178
02:04:46,069 --> 02:04:45,119
four

3179
02:04:47,109 --> 02:04:46,079
three

3180
02:04:49,750 --> 02:04:47,119
two

3181
02:04:56,870 --> 02:04:50,790
and

3182
02:05:04,390 --> 02:04:56,880
nasa's first planetary defense test to

3183
02:05:08,069 --> 02:05:06,229
so we're getting a nice view of the

3184
02:05:10,470 --> 02:05:08,079
on-board cameras from the falcon 9 so

3185
02:05:12,149 --> 02:05:10,480
you can see it looking towards the

3186
02:05:13,830 --> 02:05:12,159
first the

3187
02:05:16,950 --> 02:05:13,840
aft end of the first stage and you can

3188
02:05:20,629 --> 02:05:16,960

see those engines coming to life

3189
02:05:23,189 --> 02:05:20,639
stage when chamber pressures level

3190
02:05:24,790 --> 02:05:23,199
and falcon 9 will be reaching max q in

3191
02:05:39,970 --> 02:05:24,800
just seconds the moment of peak