

SCIENTIST TO

MEASURE

MOVING AN

ASTEROID

LIVE Q&A



1
00:00:06,309 --> 00:00:04,070
the dart mission is nasa's first test of

2
00:00:07,909 --> 00:00:06,319
a planetary defense technique called

3
00:00:10,310 --> 00:00:07,919
kinetic impactor and it's going to smash

4
00:00:12,470 --> 00:00:10,320
itself into the moonlit dimorphos which

5
00:00:14,789 --> 00:00:12,480
orbits the asteroid dynamos in order to

6
00:00:16,950 --> 00:00:14,799
change demorphos orbit and show that we

7
00:00:19,590 --> 00:00:16,960
can deflect incoming asteroids if we

8
00:00:21,670 --> 00:00:19,600
need to i lead a group of astronomers

9
00:00:23,429 --> 00:00:21,680
that are going to measure how much dark

10
00:00:25,189 --> 00:00:23,439
changed demorphos's orbit using

11
00:00:27,910 --> 00:00:25,199
ground-based telescopes all over the

12
00:00:29,589 --> 00:00:27,920
world this is an animation you can see

13
00:00:31,910 --> 00:00:29,599

dynamos and demorphos is one point of

14

00:00:34,150 --> 00:00:31,920

light these curves show the brightness

15

00:00:36,950 --> 00:00:34,160

change due to demorphos moving in front

16

00:00:38,790 --> 00:00:36,960

of and behind dynamos we can tell how

17

00:00:40,630 --> 00:00:38,800

quickly demorphos is moving around

18

00:00:42,630 --> 00:00:40,640

dynamos we make these measurements

19

00:00:44,229 --> 00:00:42,640

before dart arrives and then this is the

20

00:00:45,830 --> 00:00:44,239

same technique that we'll use after the

21

00:00:48,950 --> 00:00:45,840

impact to determine how much we've

22

00:00:53,189 --> 00:00:51,110

i make music a lot of it as you might

23

00:00:55,430 --> 00:00:53,199

imagine has nothing to do with science

24

00:00:57,750 --> 00:00:55,440

but a lot of it does you know i'm not

25

00:00:59,590 --> 00:00:57,760

not immune to the charms of writing uh

26

00:01:00,709 --> 00:00:59,600

writing a gimmicky science song every

27

00:01:03,910 --> 00:01:00,719

once in a while

28

00:01:05,429 --> 00:01:03,920

so um i did write a song about dart the

29

00:01:11,429 --> 00:01:05,439

mission goes

30

00:01:15,270 --> 00:01:13,429

should name the trick a lot of

31

00:01:17,670 --> 00:01:15,280

scientists definitely have a creative

32

00:01:19,910 --> 00:01:17,680

side a lot of us right a lot of us are

33

00:01:21,670 --> 00:01:19,920

in bands or there's a lot who paint and

34

00:01:23,510 --> 00:01:21,680

i think having that creative part of

35

00:01:25,550 --> 00:01:23,520

your brain definitely helps in science

36

00:01:36,710 --> 00:01:25,560

just as much as it does in art practice

37

00:01:41,270 --> 00:01:38,710

hi everyone i'm josh handel and i'm a

38

00:01:43,270 --> 00:01:41,280

public affairs officer here at nasa and

39

00:01:44,950 --> 00:01:43,280

i'm so excited to be joined today by

40

00:01:46,789 --> 00:01:44,960

andy rivkin who you just had the

41

00:01:49,270 --> 00:01:46,799

opportunity to meet andy thank you so

42

00:01:50,710 --> 00:01:49,280

much for joining us today

43

00:01:51,910 --> 00:01:50,720

it's a pleasure josh thanks for having

44

00:01:54,310 --> 00:01:51,920

me

45

00:01:55,990 --> 00:01:54,320

of course andy's here to answer your

46

00:01:58,469 --> 00:01:56,000

questions about planetary defense at

47

00:01:59,990 --> 00:01:58,479

nasa and the dart mission if you have a

48

00:02:02,389 --> 00:02:00,000

question you'd like to ask andy about

49

00:02:05,270 --> 00:02:02,399

planetary defense or dart send it in

50

00:02:06,709 --> 00:02:05,280

using the hashtag ask nasa or by writing

51
00:02:08,710 --> 00:02:06,719
in the comment box of wherever you're

52
00:02:10,229 --> 00:02:08,720
watching today's broadcast

53
00:02:11,910 --> 00:02:10,239
so andy we just learned a little bit

54
00:02:13,750 --> 00:02:11,920
more about you from your video and your

55
00:02:15,510 --> 00:02:13,760
work with dart but can you please tell

56
00:02:17,670 --> 00:02:15,520
us a bit more about why this mission is

57
00:02:20,070 --> 00:02:17,680
so important

58
00:02:22,070 --> 00:02:20,080
sure it's my pleasure um

59
00:02:24,229 --> 00:02:22,080
asteroid impacts into earth are one of

60
00:02:26,150 --> 00:02:24,239
the only maybe the only

61
00:02:28,390 --> 00:02:26,160
natural disaster that we can predict

62
00:02:30,949 --> 00:02:28,400
very far ahead of time and that we can

63
00:02:32,470 --> 00:02:30,959

also do something about so there are a

64

00:02:34,470 --> 00:02:32,480

few different ways that people have come

65

00:02:36,710 --> 00:02:34,480

up with to address

66

00:02:39,670 --> 00:02:36,720

asteroid impacts and prevent them from

67

00:02:41,589 --> 00:02:39,680

happening uh dart is a test of a

68

00:02:43,670 --> 00:02:41,599

technique called the kinetic impactor

69

00:02:46,229 --> 00:02:43,680

where we basically take an a a

70

00:02:48,790 --> 00:02:46,239

spacecraft and we ram it into

71

00:02:52,550 --> 00:02:48,800

an asteroid and by doing that we change

72

00:02:54,229 --> 00:02:52,560

the orbit of uh the asteroid so that in

73

00:02:55,830 --> 00:02:54,239

principle if something were coming our

74

00:02:59,990 --> 00:02:55,840

way we could move the orbit so that it

75

00:03:03,750 --> 00:03:02,309

wow that's a great answer thanks andy

76

00:03:05,190 --> 00:03:03,760

and i actually see that we're already

77

00:03:07,110 --> 00:03:05,200

starting to get some questions in from

78

00:03:09,430 --> 00:03:07,120

our viewers so we're going to go ahead

79

00:03:11,190 --> 00:03:09,440

and get started and as a reminder if you

80

00:03:14,229 --> 00:03:11,200

have a question for andy you can send it

81

00:03:15,750 --> 00:03:14,239

in using the hashtag asknasa or by

82

00:03:17,509 --> 00:03:15,760

writing in the comment box of rover

83

00:03:20,390 --> 00:03:17,519

you're watching today's broadcast all

84

00:03:22,309 --> 00:03:20,400

right andy are you ready

85

00:03:24,149 --> 00:03:22,319

i am let's go first

86

00:03:27,190 --> 00:03:24,159

our first question comes from robert

87

00:03:28,789 --> 00:03:27,200

clauderson on facebook who asks

88

00:03:31,350 --> 00:03:28,799

will we be able to know what the

89

00:03:35,190 --> 00:03:31,360

composition of dimorphous is by looking

90

00:03:38,390 --> 00:03:35,200

at the light from the impact of dart

91

00:03:40,789 --> 00:03:38,400

that's a great question um we have a

92

00:03:43,270 --> 00:03:40,799

pretty good idea of what the composition

93

00:03:45,990 --> 00:03:43,280

of dynamos is the main body

94

00:03:47,990 --> 00:03:46,000

our theories of how asteroid moons form

95

00:03:49,589 --> 00:03:48,000

suggests that demorphos should be made

96

00:03:50,710 --> 00:03:49,599

of the same material

97

00:03:52,309 --> 00:03:50,720

um

98

00:03:54,070 --> 00:03:52,319

when uh

99

00:03:56,309 --> 00:03:54,080

when the the dart impact engine

100

00:03:58,710 --> 00:03:56,319

demorphos occurs we expect there to be a

101

00:04:02,550 --> 00:03:58,720

lot of debris that's that's thrown out

102

00:04:04,710 --> 00:04:02,560

uh into into uh space by that impact

103

00:04:07,350 --> 00:04:04,720

i don't think we're going to be able to

104

00:04:09,509 --> 00:04:07,360

directly measure the composition of that

105

00:04:11,509 --> 00:04:09,519

dust but certainly we're going to try

106

00:04:13,030 --> 00:04:11,519

and then the european hera mission will

107

00:04:15,509 --> 00:04:13,040

be showing up

108

00:04:17,030 --> 00:04:15,519

a few years after the dart impact

109

00:04:19,430 --> 00:04:17,040

and they will be able to directly

110

00:04:21,110 --> 00:04:19,440

measure the composition of demorphos so

111

00:04:22,390 --> 00:04:21,120

they'll be able to confirm

112

00:04:24,390 --> 00:04:22,400

a lot of what

113

00:04:25,909 --> 00:04:24,400

we've been thinking

114

00:04:27,270 --> 00:04:25,919

so it sounds like we have an idea of

115

00:04:30,710 --> 00:04:27,280

what it's made of but we won't really

116

00:04:33,030 --> 00:04:30,720

know until we get there is that correct

117

00:04:35,189 --> 00:04:33,040

yeah that's that's correct we we think

118

00:04:36,870 --> 00:04:35,199

that uh dynamos is made of the same kind

119

00:04:38,390 --> 00:04:36,880

of material as

120

00:04:41,189 --> 00:04:38,400

what we call ordinary chondrite

121

00:04:42,790 --> 00:04:41,199

meteorites so they're very common uh

122

00:04:44,710 --> 00:04:42,800

material that falls to earth we think

123

00:04:47,189 --> 00:04:44,720

it's the same kind of composition that

124

00:04:49,749 --> 00:04:47,199

the asteroid utica has that the asteroid

125

00:04:51,990 --> 00:04:49,759

arrows has and that the asteroid apophis

126

00:04:52,950 --> 00:04:52,000

has so it's it's a common material that

127

00:04:55,670 --> 00:04:52,960

is

128

00:04:57,990 --> 00:04:55,680

pretty commonly uh what uh what falls to

129

00:05:02,150 --> 00:05:00,070

our next question comes from indy magoo

130

00:05:03,990 --> 00:05:02,160

on youtube who asks

131

00:05:05,990 --> 00:05:04,000

would you try to find an object with a

132

00:05:09,430 --> 00:05:06,000

higher albedo so it would be easier to

133

00:05:13,749 --> 00:05:11,350

um

134

00:05:15,350 --> 00:05:13,759

we uh so for for those out there that

135

00:05:18,310 --> 00:05:15,360

are not familiar with what albino is

136

00:05:20,790 --> 00:05:18,320

albedo is how reflective a surface is so

137

00:05:23,189 --> 00:05:20,800

uh something like snow uh is is very

138

00:05:25,909 --> 00:05:23,199

reflective has a high albedo as we say

139

00:05:27,189 --> 00:05:25,919

uh something like tar or or a charcoal

140

00:05:30,790 --> 00:05:27,199

briquette has a very low albedo it's

141

00:05:33,590 --> 00:05:30,800

very dark um as suggested uh high albedo

142

00:05:35,670 --> 00:05:33,600

objects are more visible from far away

143

00:05:38,150 --> 00:05:35,680

uh one of the things in in asteroid

144

00:05:40,070 --> 00:05:38,160

science is we don't always get to pick

145

00:05:42,710 --> 00:05:40,080

what uh what our targets are like the

146

00:05:44,870 --> 00:05:42,720

targets pick that for themselves so uh

147

00:05:47,830 --> 00:05:44,880

dynamos has an albedo we think of about

148

00:05:48,870 --> 00:05:47,840

15 to 20 percent uh so typical for rock

149

00:05:51,670 --> 00:05:48,880

um

150

00:05:55,029 --> 00:05:51,680

and dynamos has so many other great

151

00:05:57,590 --> 00:05:55,039

properties for carrying out uh dart

152

00:05:59,270 --> 00:05:57,600

uh that it's kind of even regardless of

153

00:06:02,550 --> 00:05:59,280

albedo it was clearly going to be the

154

00:06:07,670 --> 00:06:05,749

our next question comes from viswa deep

155

00:06:09,830 --> 00:06:07,680

on youtube who asks

156

00:06:13,909 --> 00:06:09,840

what are possible options to deflect a

157

00:06:17,189 --> 00:06:16,230

that's a great question

158

00:06:20,870 --> 00:06:17,199

the

159

00:06:23,590 --> 00:06:20,880

answer depends a lot on how much warning

160

00:06:27,029 --> 00:06:23,600

time we have before we have to deflect

161

00:06:31,029 --> 00:06:27,039

the asteroid um and the size of the

162

00:06:32,950 --> 00:06:31,039

object so um dart is part of kind of an

163

00:06:37,189 --> 00:06:32,960

overall national strategy

164

00:06:39,270 --> 00:06:37,199

for uh dealing with uh asteroid impacts

165

00:06:41,590 --> 00:06:39,280

one of the other pieces is doing a

166

00:06:43,189 --> 00:06:41,600

search to find objects that are out

167

00:06:44,629 --> 00:06:43,199

there that might be hazardous and find

168

00:06:46,950 --> 00:06:44,639

them as soon as we can

169

00:06:49,110 --> 00:06:46,960

the longer the warning time we have the

170

00:06:50,230 --> 00:06:49,120

more different options we have

171

00:06:51,749 --> 00:06:50,240

um

172

00:06:53,670 --> 00:06:51,759

and some of the options might be if an

173

00:06:54,870 --> 00:06:53,680

object is small enough uh that we just

174

00:06:55,830 --> 00:06:54,880

say okay it's going to burn up in the

175

00:06:57,350 --> 00:06:55,840

atmosphere we're not going to worry

176
00:06:59,589 --> 00:06:57,360
about it

177
00:07:00,870 --> 00:06:59,599
we'll just enjoy the enjoy the meteor

178
00:07:02,790 --> 00:07:00,880
that it makes and

179
00:07:05,029 --> 00:07:02,800
maybe pick up some some little pieces if

180
00:07:07,350 --> 00:07:05,039
they make it to the ground

181
00:07:09,110 --> 00:07:07,360
so dart is obviously testing one form of

182
00:07:10,469 --> 00:07:09,120
asteroid deflection technology but it

183
00:07:11,909 --> 00:07:10,479
sounds like a key

184
00:07:13,510 --> 00:07:11,919
point for it to work is that we would

185
00:07:16,070 --> 00:07:13,520
need to find a potential threat early is

186
00:07:18,150 --> 00:07:16,080
that correct

187
00:07:20,950 --> 00:07:18,160
yes that's that's kind of true for

188
00:07:23,189 --> 00:07:20,960

almost any any of the techniques that uh

189

00:07:25,589 --> 00:07:23,199

people have considered there are other

190

00:07:27,670 --> 00:07:25,599

techniques uh including

191

00:07:30,710 --> 00:07:27,680

civil defense which would in fact be go

192

00:07:34,309 --> 00:07:30,720

and and uh waited out in the basement

193

00:07:36,790 --> 00:07:34,319

the most powerful um

194

00:07:39,749 --> 00:07:36,800

tool we have in our toolbox is to use a

195

00:07:41,510 --> 00:07:39,759

nuclear device to

196

00:07:43,749 --> 00:07:41,520

detonate nearby

197

00:07:47,189 --> 00:07:43,759

a threatening asteroid vaporize part of

198

00:07:48,950 --> 00:07:47,199

it and and deflect it that way uh but

199

00:07:51,189 --> 00:07:48,960

we obviously want to have as many

200

00:07:52,550 --> 00:07:51,199

different tools in our toolbox as we can

201
00:07:54,390 --> 00:07:52,560
because we're going to be faced with

202
00:07:55,830 --> 00:07:54,400
different uh different scenarios so we

203
00:07:58,710 --> 00:07:55,840
want to make sure we have the right tool

204
00:08:00,790 --> 00:07:58,720
for the right job

205
00:08:02,070 --> 00:08:00,800
so kind of following up on how we're

206
00:08:04,790 --> 00:08:02,080
going to know dart will work

207
00:08:07,189 --> 00:08:04,800
videographer on youtube asks

208
00:08:09,350 --> 00:08:07,199
will we measure before and after impact

209
00:08:11,110 --> 00:08:09,360
or will we only look at accelerations at

210
00:08:13,510 --> 00:08:11,120
the moment of impact and how will we

211
00:08:16,469 --> 00:08:13,520
know these measurements will how will

212
00:08:17,749 --> 00:08:16,479
these measurements be taken

213
00:08:20,070 --> 00:08:17,759

it's another great question a lot of

214

00:08:21,830 --> 00:08:20,080

great questions out there um

215

00:08:23,670 --> 00:08:21,840

from the earth

216

00:08:25,430 --> 00:08:23,680

dynamos and demorphos are going to

217

00:08:27,350 --> 00:08:25,440

appear as a single point of light we're

218

00:08:30,309 --> 00:08:27,360

not going to see them separate

219

00:08:33,670 --> 00:08:30,319

so what we can do and what we will do is

220

00:08:35,110 --> 00:08:33,680

measure the brightness of the system uh

221

00:08:36,949 --> 00:08:35,120

as it as it

222

00:08:38,230 --> 00:08:36,959

as demorphos goes around

223

00:08:40,230 --> 00:08:38,240

and from the point of view of the earth

224

00:08:42,230 --> 00:08:40,240

the morphos will move in front of and

225

00:08:43,829 --> 00:08:42,240

behind dytamos

226

00:08:45,509 --> 00:08:43,839

and that will make the brightness go up

227

00:08:48,470 --> 00:08:45,519

and down as it does that we've been

228

00:08:49,670 --> 00:08:48,480

measuring that brightness for years uh

229

00:08:51,910 --> 00:08:49,680

people have been measuring it in some

230

00:08:53,350 --> 00:08:51,920

form or another probably since 2003 but

231

00:08:54,870 --> 00:08:53,360

we've been measuring it for this project

232

00:08:57,190 --> 00:08:54,880

since 2015

233

00:08:58,630 --> 00:08:57,200

so we know the period of that orbit very

234

00:09:00,230 --> 00:08:58,640

well

235

00:09:01,190 --> 00:09:00,240

after the impact we're going to keep

236

00:09:02,389 --> 00:09:01,200

measuring it we're going to keep

237

00:09:03,910 --> 00:09:02,399

measuring the brightness of this point

238

00:09:06,630 --> 00:09:03,920

of light going up and down we're going

239

00:09:09,269 --> 00:09:06,640

to measure the new frequency with which

240

00:09:11,990 --> 00:09:09,279

uh the brightness changes compare that

241

00:09:15,030 --> 00:09:12,000

to the pre-impact measurements and be

242

00:09:18,070 --> 00:09:15,040

able to say okay the orbit period was 11

243

00:09:20,949 --> 00:09:18,080

hours and 55 minutes before the impact

244

00:09:22,550 --> 00:09:20,959

now it's 11 hours and 45 minutes or 38

245

00:09:24,389 --> 00:09:22,560

minutes or whatever it is

246

00:09:28,630 --> 00:09:24,399

that gives us the information we need to

247

00:09:33,190 --> 00:09:30,470

our next question comes from

248

00:09:34,550 --> 00:09:33,200

alan reinke on facebook who asks what

249

00:09:37,750 --> 00:09:34,560

are the characteristics of the

250

00:09:40,630 --> 00:09:37,760

spacecraft itself

251
00:09:41,829 --> 00:09:40,640
the spacecraft is um about the size of a

252
00:09:44,710 --> 00:09:41,839
vending machine

253
00:09:47,030 --> 00:09:44,720
uh not counting the solar panels uh so

254
00:09:47,990 --> 00:09:47,040
it's uh two meters by two meters by two

255
00:09:50,230 --> 00:09:48,000
and a half meters something like that

256
00:09:52,790 --> 00:09:50,240
but a vending machine

257
00:09:54,550 --> 00:09:52,800
the solar panels which you can see in

258
00:09:55,829 --> 00:09:54,560
the video here are rollout solar panels

259
00:09:57,030 --> 00:09:55,839
that's one of the new technologies that

260
00:09:58,150 --> 00:09:57,040
are that's being

261
00:10:00,550 --> 00:09:58,160
tested out

262
00:10:02,150 --> 00:10:00,560
on dart when those are fully deployed

263
00:10:05,350 --> 00:10:02,160

then those are

264

00:10:07,670 --> 00:10:05,360

18 meters from tip to tip which is a

265

00:10:09,590 --> 00:10:07,680

little a little bigger than kind of the

266

00:10:10,710 --> 00:10:09,600

length of a typical bus

267

00:10:12,870 --> 00:10:10,720

um

268

00:10:14,790 --> 00:10:12,880

so we're going to uh take this

269

00:10:16,470 --> 00:10:14,800

spacecraft it's uh several hundred

270

00:10:18,630 --> 00:10:16,480

kilograms in mass i think five or six

271

00:10:21,350 --> 00:10:18,640

hundred kilograms of mass and it is

272

00:10:23,509 --> 00:10:21,360

going to impact demorphos

273

00:10:25,190 --> 00:10:23,519

um demorphos is about the size of one of

274

00:10:27,990 --> 00:10:25,200

the pyramids of egypt and it's going to

275

00:10:30,949 --> 00:10:28,000

impact it at something like uh

276

00:10:32,790 --> 00:10:30,959

six or a half kilometers a second

277

00:10:35,110 --> 00:10:32,800

in imperial units if you prefer that's

278

00:10:36,949 --> 00:10:35,120

something like four miles a second so

279

00:10:38,389 --> 00:10:36,959

uh basically we're firing this vending

280

00:10:39,509 --> 00:10:38,399

machine at one of the pyramids in each

281

00:10:42,389 --> 00:10:39,519

of egypt

282

00:10:46,069 --> 00:10:44,389

so kind of following up on that

283

00:10:47,509 --> 00:10:46,079

how is it possible that something so

284

00:10:49,670 --> 00:10:47,519

small you're saying the size of a

285

00:10:51,990 --> 00:10:49,680

vending machine you know impacting a

286

00:10:53,990 --> 00:10:52,000

pyramid essentially and size how can

287

00:10:56,310 --> 00:10:54,000

something so small change something so

288

00:11:00,150 --> 00:10:56,320

big how can that motion and change how

289

00:11:02,630 --> 00:11:00,160

can that change in space be altered

290

00:11:03,590 --> 00:11:02,640

that's part of the reason

291

00:11:06,150 --> 00:11:03,600

you know

292

00:11:07,750 --> 00:11:06,160

the these objects move through space

293

00:11:09,670 --> 00:11:07,760

um

294

00:11:11,190 --> 00:11:09,680

something like 30 kilometers a second so

295

00:11:12,630 --> 00:11:11,200

20 miles a second

296

00:11:14,069 --> 00:11:12,640

um

297

00:11:15,829 --> 00:11:14,079

if you have enough warning time if you

298

00:11:18,069 --> 00:11:15,839

have 20 years of warning 30 years of

299

00:11:19,829 --> 00:11:18,079

warning 15 years of warning all you need

300

00:11:21,829 --> 00:11:19,839

to do is change that speed by a little

301
00:11:23,430 --> 00:11:21,839
bit just a fraction of an inch

302
00:11:24,550 --> 00:11:23,440
uh per second

303
00:11:26,630 --> 00:11:24,560
and

304
00:11:28,790 --> 00:11:26,640
that gives it enough time to miss the

305
00:11:30,630 --> 00:11:28,800
earth entirely it's sort of like if you

306
00:11:33,350 --> 00:11:30,640
can imagine if you had two trains that

307
00:11:34,949 --> 00:11:33,360
you knew were going to collide

308
00:11:36,949 --> 00:11:34,959
if you knew it

309
00:11:38,389 --> 00:11:36,959
a day before then one of the trains

310
00:11:40,150 --> 00:11:38,399
would only have to change its speed by a

311
00:11:41,509 --> 00:11:40,160
little bit and you'd be fine if you

312
00:11:43,350 --> 00:11:41,519
found out

313
00:11:44,870 --> 00:11:43,360

five minutes before then it's a very

314

00:11:47,269 --> 00:11:44,880

different story if you found out 10

315

00:11:49,750 --> 00:11:47,279

seconds before then you really have have

316

00:11:51,910 --> 00:11:49,760

to take some drastic action so part of

317

00:11:53,670 --> 00:11:51,920

it is the key is finding them early so

318

00:11:57,750 --> 00:11:53,680

that you can just make a little change

319

00:12:03,990 --> 00:12:00,310

logan on youtube asks how long have you

320

00:12:09,350 --> 00:12:06,550

oh um i've been working on dart since

321

00:12:11,590 --> 00:12:09,360

very close to the beginning i think it's

322

00:12:13,350 --> 00:12:11,600

a little over 10 years

323

00:12:14,870 --> 00:12:13,360

since um

324

00:12:16,230 --> 00:12:14,880

you know it basically was a was a

325

00:12:22,470 --> 00:12:16,240

two-page

326

00:12:23,910 --> 00:12:22,480

andy ching over uh also at apl

327

00:12:26,470 --> 00:12:23,920

had come up with the idea of testing

328

00:12:28,870 --> 00:12:26,480

this technique on a binary system the d

329

00:12:29,750 --> 00:12:28,880

a double asteroid part of dart

330

00:12:31,829 --> 00:12:29,760

um

331

00:12:34,710 --> 00:12:31,839

and uh from there it's been kind of

332

00:12:38,389 --> 00:12:34,720

taking that that two-page document and

333

00:12:39,990 --> 00:12:38,399

making it uh more and more you know sure

334

00:12:42,389 --> 00:12:40,000

more and more mature so we could bring

335

00:12:44,069 --> 00:12:42,399

it to nasa convince them that uh that

336

00:12:46,389 --> 00:12:44,079

this was a good thing to do and then of

337

00:12:48,310 --> 00:12:46,399

course the engineers uh doing all of

338

00:12:49,829 --> 00:12:48,320

their work with the hardware

339

00:12:52,310 --> 00:12:49,839

putting it together building it that's

340

00:12:53,990 --> 00:12:52,320

been the last few years

341

00:12:55,350 --> 00:12:54,000

so it's really really amazing that now

342

00:12:56,629 --> 00:12:55,360

we're seeing this thing that that

343

00:12:58,870 --> 00:12:56,639

started out as again this kind of

344

00:13:01,030 --> 00:12:58,880

two-page two-page document

345

00:13:02,629 --> 00:13:01,040

turned into a piece of piece of hardware

346

00:13:06,230 --> 00:13:02,639

that's gonna sit on top of a rocket and

347

00:13:07,910 --> 00:13:06,240

then make its way out to the asteroids

348

00:13:10,230 --> 00:13:07,920

so andy i noticed that you said you know

349

00:13:12,550 --> 00:13:10,240

the double asteroid part of dart double

350

00:13:14,470 --> 00:13:12,560

estrogen reaction redirection test that

351
00:13:16,629 --> 00:13:14,480
we're going to this binary asteroid

352
00:13:20,150 --> 00:13:16,639
system can you tell me a bit about why

353
00:13:25,910 --> 00:13:23,590
absolutely um the uh the

354
00:13:28,949 --> 00:13:25,920
idea of testing a kinetic impactor like

355
00:13:30,550 --> 00:13:28,959
dark uh predates uh predate start by

356
00:13:32,150 --> 00:13:30,560
quite a bit the european space agency

357
00:13:34,470 --> 00:13:32,160
was first looking into it

358
00:13:36,069 --> 00:13:34,480
uh in the early years of this century

359
00:13:38,230 --> 00:13:36,079
but when they conceived that they

360
00:13:40,550 --> 00:13:38,240
imagined visiting a single asteroid in

361
00:13:43,350 --> 00:13:40,560
and changing its orbit around the sun

362
00:13:44,870 --> 00:13:43,360
so uh doing that as you might imagine is

363
00:13:47,670 --> 00:13:44,880

is a very precise measurement that needs

364

00:13:49,590 --> 00:13:47,680

to be made and they

365

00:13:51,670 --> 00:13:49,600

their concept had a second spacecraft

366

00:13:54,069 --> 00:13:51,680

sitting there to make that that

367

00:13:56,790 --> 00:13:54,079

measurement um

368

00:13:59,590 --> 00:13:56,800

that was more more spacecraft than the

369

00:14:03,269 --> 00:13:59,600

europeans wanted to to uh devote to the

370

00:14:05,750 --> 00:14:03,279

problem at the time so um the idea of

371

00:14:07,910 --> 00:14:05,760

going to a double asteroid and watching

372

00:14:09,030 --> 00:14:07,920

this the brightness go up and down from

373

00:14:10,949 --> 00:14:09,040

the earth

374

00:14:13,189 --> 00:14:10,959

um means that you can do it with just

375

00:14:16,310 --> 00:14:13,199

one spacecraft you you don't have to

376

00:14:17,829 --> 00:14:16,320

build two spacecraft send two spacecraft

377

00:14:19,910 --> 00:14:17,839

you can

378

00:14:21,430 --> 00:14:19,920

change the orbit of the of the moon and

379

00:14:22,710 --> 00:14:21,440

then measure what you did from

380

00:14:26,150 --> 00:14:22,720

telescopes

381

00:14:28,949 --> 00:14:27,269

so

382

00:14:31,990 --> 00:14:28,959

keeping in line with dart and the launch

383

00:14:34,470 --> 00:14:32,000

so melanie on youtube asks i'm excited

384

00:14:38,150 --> 00:14:34,480

and i'm scared what should i expect on

385

00:14:40,790 --> 00:14:38,160

the 23rd 24th of november

386

00:14:42,949 --> 00:14:40,800

well melanie i i i feel you i you know

387

00:14:46,230 --> 00:14:42,959

excited and scared is uh i think that's

388

00:14:48,150 --> 00:14:46,240

going around so um

389

00:14:50,949 --> 00:14:48,160

the uh the we're gonna be launching out

390

00:14:52,069 --> 00:14:50,959

of vanderberg uh space force base

391

00:14:54,870 --> 00:14:52,079

um

392

00:14:55,829 --> 00:14:54,880

and uh we're gonna be on a falcon 9

393

00:14:58,790 --> 00:14:55,839

rocket

394

00:15:01,670 --> 00:14:58,800

uh we are gonna

395

00:15:02,629 --> 00:15:01,680

launch um it's gonna be uh kind of late

396

00:15:04,949 --> 00:15:02,639

at night

397

00:15:07,350 --> 00:15:04,959

uh something like 10 20 p.m

398

00:15:09,750 --> 00:15:07,360

on the west coast and in the early early

399

00:15:10,870 --> 00:15:09,760

morning uh wednesday on the east coast

400

00:15:12,949 --> 00:15:10,880

is the plan

401
00:15:16,389 --> 00:15:12,959
uh and then you you can see that the

402
00:15:19,030 --> 00:15:16,399
video here dart will uh separate uh from

403
00:15:21,430 --> 00:15:19,040
from the main uh booster uh it's gonna

404
00:15:23,750 --> 00:15:21,440
spend a little time um

405
00:15:26,150 --> 00:15:23,760
getting its solar wing solar panels

406
00:15:28,230 --> 00:15:26,160
extended uh and then we think about a

407
00:15:29,910 --> 00:15:28,240
half hour 20 minutes to a half hour

408
00:15:32,310 --> 00:15:29,920
after the launch it will

409
00:15:34,550 --> 00:15:32,320
fire the rockets to to kind of get uh

410
00:15:36,230 --> 00:15:34,560
get on its way toward dynamos

411
00:15:37,990 --> 00:15:36,240
uh so um

412
00:15:41,910 --> 00:15:38,000
we're looking forward to it and uh you

413
00:15:43,590 --> 00:15:41,920

know we're excited uh i think i think

414

00:15:44,470 --> 00:15:43,600

you know it's a crazy thing we're doing

415

00:15:46,629 --> 00:15:44,480

so

416

00:15:48,870 --> 00:15:46,639

uh i think scared is not uh

417

00:15:52,230 --> 00:15:48,880

not a foreign uh feeling but also uh

418

00:15:55,670 --> 00:15:53,829

as a reminder we're chatting with andy

419

00:15:57,749 --> 00:15:55,680

rivkin from nasa's double asteroid

420

00:15:59,269 --> 00:15:57,759

redirection test mission and if you'd

421

00:16:01,110 --> 00:15:59,279

like to ask him a question about

422

00:16:02,870 --> 00:16:01,120

planetary defense at nasa or the dart

423

00:16:05,670 --> 00:16:02,880

mission you can send it in using the

424

00:16:07,030 --> 00:16:05,680

hashtag ask nasa or by writing in the

425

00:16:08,629 --> 00:16:07,040

comment box wherever you're watching

426
00:16:10,790 --> 00:16:08,639
today's broadcast

427
00:16:13,110 --> 00:16:10,800
so andy our next question comes from

428
00:16:14,230 --> 00:16:13,120
patricia benner smith on facebook who

429
00:16:16,710 --> 00:16:14,240
asks

430
00:16:18,150 --> 00:16:16,720
so will pieces of the asteroid break off

431
00:16:19,829 --> 00:16:18,160
and will they become

432
00:16:24,310 --> 00:16:19,839
millions of little meteorites that might

433
00:16:27,430 --> 00:16:26,470
great great question and something that

434
00:16:29,269 --> 00:16:27,440
um

435
00:16:31,590 --> 00:16:29,279
is is something that we've looked into

436
00:16:33,749 --> 00:16:31,600
and others have looked into um the

437
00:16:36,790 --> 00:16:33,759
expectation certainly is that when dart

438
00:16:38,949 --> 00:16:36,800

hits demorphos that it will make debris

439

00:16:39,910 --> 00:16:38,959

that debris will will come off of the

440

00:16:42,470 --> 00:16:39,920

surface

441

00:16:45,509 --> 00:16:42,480

of demorphos um

442

00:16:47,749 --> 00:16:45,519

and um in fact leech a cube which is a

443

00:16:48,629 --> 00:16:47,759

cubesat that the italian space agency is

444

00:16:51,189 --> 00:16:48,639

building

445

00:16:53,749 --> 00:16:51,199

um has built it's already built it's

446

00:16:56,150 --> 00:16:53,759

done it's it's attached uh legit cube

447

00:16:58,870 --> 00:16:56,160

has uh for its um

448

00:16:59,990 --> 00:16:58,880

objectives to actually take images

449

00:17:02,470 --> 00:17:00,000

of

450

00:17:03,910 --> 00:17:02,480

uh the the debris cloud that uh that

451
00:17:04,949 --> 00:17:03,920
dark makes when it impacts because

452
00:17:07,029 --> 00:17:04,959
that's going to give us information

453
00:17:08,390 --> 00:17:07,039
about demorphos itself

454
00:17:11,110 --> 00:17:08,400
um

455
00:17:15,429 --> 00:17:11,120
the amount of material that is made by

456
00:17:16,549 --> 00:17:15,439
the dart impact um is not very large

457
00:17:18,390 --> 00:17:16,559
um

458
00:17:20,390 --> 00:17:18,400
you know you might

459
00:17:22,150 --> 00:17:20,400
remember that objects are naturally

460
00:17:23,750 --> 00:17:22,160
hitting objects in space all the time

461
00:17:27,029 --> 00:17:23,760
and making meteorites

462
00:17:29,110 --> 00:17:27,039
um people have studied how much material

463
00:17:31,190 --> 00:17:29,120

from the dart impact might make its way

464

00:17:34,150 --> 00:17:31,200

to earth and the amount is

465

00:17:36,230 --> 00:17:34,160

minuscule i think uh the the report i

466

00:17:37,590 --> 00:17:36,240

remember seeing was maybe one extra

467

00:17:39,590 --> 00:17:37,600

shooting star

468

00:17:42,070 --> 00:17:39,600

um you know over the course of a decade

469

00:17:43,270 --> 00:17:42,080

so we are not gonna do anything that's

470

00:17:44,950 --> 00:17:43,280

that's gonna

471

00:17:46,470 --> 00:17:44,960

uh come to earth we're not gonna do

472

00:17:48,950 --> 00:17:46,480

anything that's that's going to going to

473

00:17:52,230 --> 00:17:48,960

be a problem for satellites

474

00:17:54,710 --> 00:17:52,240

uh or anything like that

475

00:17:56,310 --> 00:17:54,720

so speaking of leachate cube dan shields

476

00:17:58,470 --> 00:17:56,320

on twitter asks

477

00:18:01,110 --> 00:17:58,480

once hashtag dart mission and lychee

478

00:18:03,270 --> 00:18:01,120

over cube results are analyzed what's

479

00:18:05,669 --> 00:18:03,280

next are there subsequent missions or

480

00:18:08,390 --> 00:18:05,679

targets identified or will that come

481

00:18:12,870 --> 00:18:10,470

um sure i'm always happy to answer you

482

00:18:17,350 --> 00:18:12,880

know a twitter question with my tweets

483

00:18:20,950 --> 00:18:17,360

um the the uh the most direct immediate

484

00:18:22,710 --> 00:18:20,960

uh follow-up to dart is the hera mission

485

00:18:24,789 --> 00:18:22,720

which the european space agency is going

486

00:18:27,669 --> 00:18:24,799

to be launching a few years after dart

487

00:18:30,310 --> 00:18:27,679

it will arrive at the dynamo system i

488

00:18:31,270 --> 00:18:30,320

should know this i think it's 2026

489

00:18:33,510 --> 00:18:31,280

um

490

00:18:35,110 --> 00:18:33,520

and they will do direct measurements

491

00:18:37,029 --> 00:18:35,120

that will uh

492

00:18:38,310 --> 00:18:37,039

be useful on their own

493

00:18:39,669 --> 00:18:38,320

they'll do some great science and

494

00:18:42,549 --> 00:18:39,679

they'll also be doing some follow-up

495

00:18:45,430 --> 00:18:42,559

measurements uh that will help uh help

496

00:18:47,830 --> 00:18:45,440

us continue to analyze dart

497

00:18:50,710 --> 00:18:47,840

in terms of the planetary defense office

498

00:18:51,909 --> 00:18:50,720

uh the next mission that i think most

499

00:18:55,190 --> 00:18:51,919

people are

500

00:18:57,750 --> 00:18:55,200

expecting uh is a telescope mission uh

501

00:19:01,029 --> 00:18:57,760

called neo surveyor which will

502

00:19:03,430 --> 00:19:01,039

go back to the job of trying to find

503

00:19:06,230 --> 00:19:03,440

asteroids out there trying to catalog

504

00:19:07,590 --> 00:19:06,240

the the asteroid population and uh

505

00:19:09,110 --> 00:19:07,600

understand the potentially hazard

506

00:19:13,270 --> 00:19:09,120

asteroids that are out there make sure

507

00:19:18,549 --> 00:19:16,390

so jamie jeans on facebook asks

508

00:19:21,990 --> 00:19:18,559

is there an asteroid coming our way is

509

00:19:22,830 --> 00:19:22,000

there an asteroid headed toward earth

510

00:19:30,710 --> 00:19:22,840

um

511

00:19:32,549 --> 00:19:30,720

we are hit by material all of the time

512

00:19:34,950 --> 00:19:32,559

anytime you go out into your backyard

513

00:19:37,110 --> 00:19:34,960

and you see a shooting star that is

514

00:19:38,549 --> 00:19:37,120

asteroidal or cometary material material

515

00:19:41,110 --> 00:19:38,559

hitting the earth it's it's maybe the

516

00:19:42,390 --> 00:19:41,120

size of a sand grain um the earth gets

517

00:19:44,150 --> 00:19:42,400

hit by

518

00:19:45,430 --> 00:19:44,160

objects the size of the chair i'm

519

00:19:46,710 --> 00:19:45,440

sitting in i don't know the chair you're

520

00:19:48,950 --> 00:19:46,720

sitting in i assume it's probably about

521

00:19:50,070 --> 00:19:48,960

the same size um maybe three or four

522

00:19:52,150 --> 00:19:50,080

times a year

523

00:19:54,710 --> 00:19:52,160

um depending on the size of your couch

524

00:19:56,390 --> 00:19:54,720

we get hit by couch sized material again

525

00:19:58,789 --> 00:19:56,400

maybe once a year

526

00:20:00,630 --> 00:19:58,799

um as you get larger and larger

527

00:20:02,710 --> 00:20:00,640

objects they hit less and less

528

00:20:04,549 --> 00:20:02,720

frequently um

529

00:20:05,590 --> 00:20:04,559

so um

530

00:20:07,669 --> 00:20:05,600

that's again part of the reason that

531

00:20:09,270 --> 00:20:07,679

that we are want to send missions like

532

00:20:11,909 --> 00:20:09,280

the neo survey are out to look for

533

00:20:14,310 --> 00:20:11,919

material uh objects that might be large

534

00:20:16,710 --> 00:20:14,320

enough to worry about coming our way um

535

00:20:19,270 --> 00:20:16,720

we know of no objects that are large

536

00:20:20,630 --> 00:20:19,280

enough to cause any damage

537

00:20:22,310 --> 00:20:20,640

uh

538

00:20:25,430 --> 00:20:22,320

that are that are coming our way so i

539

00:20:27,270 --> 00:20:25,440

can absolutely reassure you of that

540

00:20:29,190 --> 00:20:27,280

well that's good to hear

541

00:20:31,669 --> 00:20:29,200

our next question comes from sarah on

542

00:20:35,510 --> 00:20:31,679

twitter who asks how long will it take

543

00:20:36,470 --> 00:20:35,520

dart to get to the dynamo system

544

00:20:38,630 --> 00:20:36,480

um

545

00:20:40,950 --> 00:20:38,640

great question uh

546

00:20:43,029 --> 00:20:40,960

dart will arrive

547

00:20:44,950 --> 00:20:43,039

in um

548

00:20:48,870 --> 00:20:44,960

the end of september

549

00:20:51,750 --> 00:20:48,880

to the the start of october in 2022

550

00:20:54,310 --> 00:20:51,760

the exact date of arrival depends on the

551
00:20:55,669 --> 00:20:54,320
exact date of launch

552
00:20:57,510 --> 00:20:55,679
but it's going to be somewhere in that

553
00:20:59,669 --> 00:20:57,520
last week of september to the first

554
00:21:03,430 --> 00:20:59,679
couple days of october

555
00:21:05,750 --> 00:21:03,440
our launch period is a long one so um

556
00:21:07,029 --> 00:21:05,760
a week from two week from tomorrow is

557
00:21:08,390 --> 00:21:07,039
the the first

558
00:21:11,510 --> 00:21:08,400
opportunity we have to launch yeah

559
00:21:13,350 --> 00:21:11,520
that's crazy um but the last opportunity

560
00:21:14,870 --> 00:21:13,360
we have to launch is is a few months

561
00:21:17,110 --> 00:21:14,880
from now certainly the expectations will

562
00:21:18,950 --> 00:21:17,120
launch as soon as we can

563
00:21:21,510 --> 00:21:18,960

but if for some reason we didn't launch

564

00:21:23,270 --> 00:21:21,520

until january we still would arrive

565

00:21:27,510 --> 00:21:23,280

kind of in that that late september

566

00:21:33,190 --> 00:21:30,789

kct monday on facebook asks

567

00:21:37,350 --> 00:21:33,200

can you predict the new trajectory upon

568

00:21:47,430 --> 00:21:38,710

um

569

00:21:49,110 --> 00:21:47,440

the new trajectory of tomorrowpost the

570

00:21:51,510 --> 00:21:49,120

the dymorphos the new orbit of demorphus

571

00:21:52,390 --> 00:21:51,520

is is what we're hoping to measure

572

00:21:56,070 --> 00:21:52,400

um

573

00:21:58,230 --> 00:21:56,080

we're bringing in or we're sure we're

574

00:22:00,630 --> 00:21:58,240

bringing in and given the way we think

575

00:22:02,549 --> 00:22:00,640

the morphos will

576

00:22:04,470 --> 00:22:02,559

act when we hit it and the amount of

577

00:22:06,549 --> 00:22:04,480

material we think it throws off we're

578

00:22:08,310 --> 00:22:06,559

expecting to change the orbit period by

579

00:22:11,430 --> 00:22:08,320

something like 10 minutes but it could

580

00:22:12,870 --> 00:22:11,440

be 20 or it could be 30.

581

00:22:14,230 --> 00:22:12,880

we we don't think it could be much less

582

00:22:16,870 --> 00:22:14,240

than 10 minutes

583

00:22:18,870 --> 00:22:16,880

we uh are not and we're going to make it

584

00:22:20,230 --> 00:22:18,880

into smaller orbit as as shown in this

585

00:22:21,669 --> 00:22:20,240

uh this uh

586

00:22:22,789 --> 00:22:21,679

animation here so we know we're going to

587

00:22:23,909 --> 00:22:22,799

make the orbit of demorphism a little

588

00:22:25,830 --> 00:22:23,919

bit smaller

589

00:22:28,630 --> 00:22:25,840

um we don't think we're going to

590

00:22:30,710 --> 00:22:28,640

appreciatively change the orbit of

591

00:22:32,230 --> 00:22:30,720

dynamos around the sun in fact i say we

592

00:22:33,990 --> 00:22:32,240

don't think we are confident we're not

593

00:22:36,710 --> 00:22:34,000

going to change that in fact we're not

594

00:22:38,789 --> 00:22:36,720

going to make a change that is

595

00:22:40,549 --> 00:22:38,799

measurable compared to our current

596

00:22:41,430 --> 00:22:40,559

knowledge of the orbit of dynamos around

597

00:22:46,549 --> 00:22:41,440

the sun

598

00:22:51,990 --> 00:22:49,350

and speaking of this uh asteroid system

599

00:22:54,549 --> 00:22:52,000

and darts kinetic impact

600

00:22:56,230 --> 00:22:54,559

robert cyrentini on facebook asks why

601
00:22:58,149 --> 00:22:56,240
not test our theory on an asteroid that

602
00:23:00,149 --> 00:22:58,159
does not pose a threat so that we can

603
00:23:01,270 --> 00:23:00,159
measure that reaction and i think andy

604
00:23:03,510 --> 00:23:01,280
you might have some clarifying

605
00:23:06,310 --> 00:23:03,520
information here

606
00:23:08,789 --> 00:23:06,320
yeah absolutely dynamos is not a threat

607
00:23:10,149 --> 00:23:08,799
dynamos is not the orbit of dynamos does

608
00:23:11,909 --> 00:23:10,159
not intersect that of earth we're not

609
00:23:15,110 --> 00:23:11,919
going to change it to do that

610
00:23:17,669 --> 00:23:15,120
um part of the the

611
00:23:20,149 --> 00:23:17,679
uh confusion or or there there's the

612
00:23:22,390 --> 00:23:20,159
potential force confusion in that there

613
00:23:24,630 --> 00:23:22,400

is a group

614

00:23:26,950 --> 00:23:24,640

a grouping of asteroids that are called

615

00:23:30,630 --> 00:23:26,960

potentially hazardous asteroids um and

616

00:23:32,070 --> 00:23:30,640

they are defined by their orbits but

617

00:23:34,390 --> 00:23:32,080

even though they are all called

618

00:23:36,710 --> 00:23:34,400

potentially hazardous asteroids

619

00:23:38,149 --> 00:23:36,720

they're not actually potentially

620

00:23:40,870 --> 00:23:38,159

hazardous in the way that most people

621

00:23:43,190 --> 00:23:40,880

use the term so dynamos is orbit it

622

00:23:45,510 --> 00:23:43,200

comes close to earth but not close

623

00:23:50,470 --> 00:23:45,520

enough that it is actually going to be a

624

00:23:55,830 --> 00:23:53,510

interesting on youtube asks will nasa be

625

00:23:59,590 --> 00:23:55,840

able to control dart's trajectory or is

626

00:24:00,470 --> 00:23:59,600

it entirely reliant on smart nav

627

00:24:01,750 --> 00:24:00,480

oh

628

00:24:07,190 --> 00:24:01,760

um

629

00:24:09,269 --> 00:24:07,200

navigation system that will bring us in

630

00:24:10,310 --> 00:24:09,279

for the kind of final approach

631

00:24:12,789 --> 00:24:10,320

um

632

00:24:15,430 --> 00:24:12,799

it is not going to be operating until

633

00:24:18,390 --> 00:24:15,440

the last few hours of the mission up

634

00:24:20,390 --> 00:24:18,400

until then um there will be uh

635

00:24:22,630 --> 00:24:20,400

trajectory changes and and

636

00:24:24,710 --> 00:24:22,640

burns that are that are like typical for

637

00:24:26,789 --> 00:24:24,720

a mission um

638

00:24:28,230 --> 00:24:26,799

uh my understanding and i'm not an

639

00:24:30,470 --> 00:24:28,240

engineer so hopefully i'm not gonna

640

00:24:33,430 --> 00:24:30,480

screw this up uh my understanding is

641

00:24:34,950 --> 00:24:33,440

that there is the potential to possibly

642

00:24:37,350 --> 00:24:34,960

intervene

643

00:24:39,350 --> 00:24:37,360

but that there is no no plan to

644

00:24:40,710 --> 00:24:39,360

intervene so we think smart nav is going

645

00:24:41,830 --> 00:24:40,720

to be able to do the job in those last

646

00:24:42,710 --> 00:24:41,840

few hours

647

00:24:47,230 --> 00:24:42,720

um

648

00:24:52,310 --> 00:24:49,990

ivoo0404 on youtube asks

649

00:24:53,990 --> 00:24:52,320

will the loss of the crashing asteroid

650

00:24:56,549 --> 00:24:54,000

affect the trajectory of the other

651
00:24:58,630 --> 00:24:56,559
asteroid

652
00:25:02,470 --> 00:24:58,640
oh yeah we are we are not going to

653
00:25:05,510 --> 00:25:02,480
destroy the demorphos um

654
00:25:07,430 --> 00:25:05,520
it's it's going to we're going to make a

655
00:25:09,110 --> 00:25:07,440
crater we think the crater will be

656
00:25:10,549 --> 00:25:09,120
something like 15 meters across but the

657
00:25:14,549 --> 00:25:10,559
whole object is

658
00:25:16,310 --> 00:25:14,559
160 or more meters across um and it's

659
00:25:19,590 --> 00:25:16,320
that that

660
00:25:22,149 --> 00:25:19,600
distance deep too so um you know

661
00:25:23,909 --> 00:25:22,159
again we're we're hitting a uh the pyram

662
00:25:26,630 --> 00:25:23,919
one of the pyramids with with a vending

663
00:25:28,470 --> 00:25:26,640

machine and uh kind of

664

00:25:30,630 --> 00:25:28,480

you know no matter how how hard we throw

665

00:25:32,230 --> 00:25:30,640

the vending machine at the pyramids

666

00:25:33,269 --> 00:25:32,240

we're not going to do more than maybe

667

00:25:36,470 --> 00:25:33,279

make a

668

00:25:38,390 --> 00:25:36,480

surface

669

00:25:40,310 --> 00:25:38,400

so uh demorphos we'll we'll be fine

670

00:25:41,990 --> 00:25:40,320

demorphos is had worse

671

00:25:45,269 --> 00:25:42,000

um and uh

672

00:25:47,110 --> 00:25:45,279

may again have worse after us so uh

673

00:25:48,630 --> 00:25:47,120

it'll be okay

674

00:25:50,870 --> 00:25:48,640

so andrew we have time for one more

675

00:25:52,710 --> 00:25:50,880

question and i hope you could tell us a

676

00:25:55,909 --> 00:25:52,720

bit more about your career your job at

677

00:25:57,190 --> 00:25:55,919

apl sounds fascinating um i'm curious if

678

00:25:58,789 --> 00:25:57,200

you could just tell us a bit more about

679

00:26:00,870 --> 00:25:58,799

how you got to where you are now and

680

00:26:03,990 --> 00:26:00,880

perhaps if you have any advice for those

681

00:26:09,909 --> 00:26:05,909

uh sure free advice worth every penny as

682

00:26:11,909 --> 00:26:09,919

they say um i uh started out uh i've

683

00:26:13,750 --> 00:26:11,919

always loved space ever since i was a

684

00:26:15,590 --> 00:26:13,760

kid one of my first uh memories was the

685

00:26:17,029 --> 00:26:15,600

viking landing on mars i was six or

686

00:26:18,310 --> 00:26:17,039

seven years old and i remember seeing

687

00:26:21,430 --> 00:26:18,320

the newspapers and getting into space

688

00:26:22,789 --> 00:26:21,440

then and i've been uh following it uh

689

00:26:26,710 --> 00:26:22,799

avidly since

690

00:26:28,230 --> 00:26:26,720

um i went to undergraduate at uh mit

691

00:26:29,830 --> 00:26:28,240

uh where i majored in earth atmospheric

692

00:26:32,310 --> 00:26:29,840

and planetary sciences i knew even then

693

00:26:34,470 --> 00:26:32,320

that i was i was a planet guy and an

694

00:26:36,070 --> 00:26:34,480

asteroid guy not a galaxy and uh

695

00:26:37,669 --> 00:26:36,080

cosmology kind of guy

696

00:26:39,029 --> 00:26:37,679

uh went to

697

00:26:40,549 --> 00:26:39,039

uh

698

00:26:42,070 --> 00:26:40,559

graduate school in tucson at the

699

00:26:43,590 --> 00:26:42,080

university of arizona where i met a

700

00:26:46,230 --> 00:26:43,600

bunch of great great folks i met some

701

00:26:48,870 --> 00:26:46,240

great folks at mit too um

702

00:26:51,510 --> 00:26:48,880

and then i eventually made my way back

703

00:26:53,669 --> 00:26:51,520

uh to mit as a research scientist and

704

00:26:57,110 --> 00:26:53,679

from there i've i've been at uh apl

705

00:26:59,990 --> 00:26:57,120

since 2005. so um advice i would give

706

00:27:01,750 --> 00:27:00,000

anyone who's in science uh is to keep

707

00:27:02,630 --> 00:27:01,760

your non-science hobbies they keep you

708

00:27:05,350 --> 00:27:02,640

fresh

709

00:27:07,190 --> 00:27:05,360

uh they they allow you to kind of

710

00:27:08,870 --> 00:27:07,200

stretch your mind in ways that that

711

00:27:09,909 --> 00:27:08,880

maybe you don't necessarily always get

712

00:27:11,990 --> 00:27:09,919

kind of

713

00:27:15,029 --> 00:27:12,000

hunched over your python code or or your

714

00:27:17,990 --> 00:27:15,039

telescope so uh just uh you know hold on

715

00:27:20,230 --> 00:27:18,000

to hold on if you can to your dancing or

716

00:27:21,590 --> 00:27:20,240

your your violin playing or your

717

00:27:24,149 --> 00:27:21,600

sketching

718

00:27:25,909 --> 00:27:24,159

or your your craft you know your candle

719

00:27:27,750 --> 00:27:25,919

making so uh that's that would be my

720

00:27:29,350 --> 00:27:27,760

advice

721

00:27:30,630 --> 00:27:29,360

andy thank you so much again for your

722

00:27:33,110 --> 00:27:30,640

time and for joining us today it's

723

00:27:34,549 --> 00:27:33,120

really been a pleasure

724

00:27:36,070 --> 00:27:34,559

thanks uh thanks again for having me

725

00:27:38,870 --> 00:27:36,080

thanks for all the great questions and

726

00:27:41,110 --> 00:27:38,880

uh go dart

727

00:27:43,269 --> 00:27:41,120

go dart and thank you all for watching

728

00:27:45,110 --> 00:27:43,279

from home you can keep up with nasa's

729

00:27:47,430 --> 00:27:45,120

dart mission on social media by using

730

00:27:49,909 --> 00:27:47,440

the hashtag dartmission

731

00:27:52,950 --> 00:27:49,919

and you can follow nasa's solar system

732

00:27:54,549 --> 00:27:52,960

on twitter facebook and instagram

733

00:27:56,710 --> 00:27:54,559

you can keep up with all of nasa's

734

00:27:59,029 --> 00:27:56,720

asteroid related and planetary defense

735

00:28:00,230 --> 00:27:59,039

related news by following asteroid watch

736

00:28:02,470 --> 00:28:00,240

on twitter

737

00:28:04,710 --> 00:28:02,480

and for all the latest news on dart

738

00:28:05,750 --> 00:28:04,720

visit nasa.gov

739

00:28:10,789 --> 00:28:05,760

dart

740

00:28:13,990 --> 00:28:10,799

currently scheduled for november 24th at

741

00:28:15,510 --> 00:28:14,000

1 20 a.m eastern time thank you all