

# CRASHING INTO AN ASTEROID

...ON PURPOSE

1  
00:00:35,830 --> 00:00:16,330

[Music]

2  
00:00:37,350 --> 00:00:35,840

hello and welcome to nasa science live

3  
00:00:39,350 --> 00:00:37,360

i'm stephanie smith from the nasa

4  
00:00:41,510 --> 00:00:39,360

headquarters social media team and we

5  
00:00:43,430 --> 00:00:41,520

are coming to you live from sunny

6  
00:00:45,590 --> 00:00:43,440

central california vanderberg space

7  
00:00:48,310 --> 00:00:45,600

force base to be precise where hours

8  
00:00:50,549 --> 00:00:48,320

from now dart that's the double asteroid

9  
00:00:52,310 --> 00:00:50,559

redirection test we'll be lifting off

10  
00:00:54,310 --> 00:00:52,320

there's tons of activity going on inside

11  
00:00:55,750 --> 00:00:54,320

the nasa hangar so come with me we're

12  
00:00:57,350 --> 00:00:55,760

going to take you inside you're going to

13  
00:00:59,189 --> 00:00:57,360

meet scientists you're going to meet

14

00:01:01,990 --> 00:00:59,199

engineers and

15

00:01:03,430 --> 00:01:02,000

by the way we're taking your questions

16

00:01:05,750 --> 00:01:03,440

just go ahead and use the hashtag

17

00:01:07,990 --> 00:01:05,760

asknasa or if the feed you're watching

18

00:01:09,990 --> 00:01:08,000

has a comment box pop your questions in

19

00:01:12,230 --> 00:01:10,000

there moderators are standing by while

20

00:01:14,550 --> 00:01:12,240

we take you behind the scenes heck we've

21

00:01:16,950 --> 00:01:14,560

even got the shipping container the dart

22

00:01:18,550 --> 00:01:16,960

came in from the applied physics lab and

23

00:01:20,950 --> 00:01:18,560

this is the hangar where the launch

24

00:01:23,109 --> 00:01:20,960

commentary will be tonight as we get

25

00:01:26,070 --> 00:01:23,119

ready to blast off for a date with an

26

00:01:29,270 --> 00:01:26,080

asteroid you might be wondering does

27

00:01:31,350 --> 00:01:29,280

that asteroid pose a threat to us now or

28

00:01:34,469 --> 00:01:31,360

after the test and the short answer is

29

00:01:36,789 --> 00:01:34,479

no it doesn't in fact there are no known

30

00:01:39,030 --> 00:01:36,799

asteroid threats to earth for the next

31

00:01:41,109 --> 00:01:39,040

hundred years but it doesn't mean that

32

00:01:42,710 --> 00:01:41,119

we're not keeping our eyes on the skies

33

00:01:44,950 --> 00:01:42,720

we'll get into all of that and more on

34

00:01:47,510 --> 00:01:44,960

nasa science live but first let's do a

35

00:01:49,270 --> 00:01:47,520

deep dive on dart

36

00:01:51,270 --> 00:01:49,280

in case there was an asteroid coming

37

00:01:53,670 --> 00:01:51,280

towards earth and you're there you can

38

00:01:56,469 --> 00:01:53,680

actually stop it i mean that's kind of

39

00:01:58,789 --> 00:01:56,479

fantastic nasa is crashing a spacecraft

40

00:02:01,190 --> 00:01:58,799

into an asteroid what you think science

41

00:02:03,510 --> 00:02:01,200

fiction but this is real never in my

42

00:02:05,270 --> 00:02:03,520

life would i have thought i would take a

43

00:02:08,550 --> 00:02:05,280

couple hundred million dollar spacecraft

44

00:02:10,949 --> 00:02:08,560

and crash it into an asteroid my name is

45

00:02:13,030 --> 00:02:10,959

michelle chen i'm layna adams my name is

46

00:02:15,270 --> 00:02:13,040

kelly fast i'm andy rivkin i'm justina

47

00:02:17,270 --> 00:02:15,280

serogets and i help tell the story of

48

00:02:19,830 --> 00:02:17,280

the dart mission i'm a planetary

49

00:02:21,350 --> 00:02:19,840

defender and i study how the orbits of

50

00:02:23,510 --> 00:02:21,360

asteroids change after we hit the

51  
00:02:25,430 --> 00:02:23,520  
spacecraft my job was primarily to make

52  
00:02:27,990 --> 00:02:25,440  
sure all the systems on the spacecraft

53  
00:02:30,949 --> 00:02:28,000  
work together the dart mission is nasa's

54  
00:02:33,190 --> 00:02:30,959  
first test of a planetary defense

55  
00:02:35,430 --> 00:02:33,200  
technique called kinetic impactor dart

56  
00:02:37,350 --> 00:02:35,440  
is the double asteroid redirection test

57  
00:02:40,150 --> 00:02:37,360  
it's just a spacecraft that is going to

58  
00:02:42,309 --> 00:02:40,160  
go and smack an asteroid the moonlit

59  
00:02:44,630 --> 00:02:42,319  
dimorphose which orbits the asteroid

60  
00:02:46,949 --> 00:02:44,640  
dynamos and see if we can change its

61  
00:02:48,869 --> 00:02:46,959  
trajectory just a little bit in order to

62  
00:02:50,630 --> 00:02:48,879  
show that we can deflect incoming

63  
00:02:52,949 --> 00:02:50,640

asteroids if you need to dart will only

64

00:02:56,390 --> 00:02:52,959

be changing the period of the orbit of

65

00:02:58,550 --> 00:02:56,400

dimorphose by a tiny amount but in space

66

00:03:00,309 --> 00:02:58,560

just a little bit is just enough to make

67

00:03:02,869 --> 00:03:00,319

an asteroid actually miss us in the

68

00:03:05,270 --> 00:03:02,879

event that an asteroid is discovered

69

00:03:07,509 --> 00:03:05,280

well ahead of time before it might

70

00:03:09,589 --> 00:03:07,519

impact earth behind me you see the

71

00:03:11,509 --> 00:03:09,599

spacecraft it's really cool to see it

72

00:03:13,990 --> 00:03:11,519

coming together in real life it is

73

00:03:17,030 --> 00:03:14,000

fantastic to see it in real life to see

74

00:03:20,149 --> 00:03:17,040

it turn from ideas into real pieces that

75

00:03:22,309 --> 00:03:20,159

are gonna go into space the solar arrays

76

00:03:24,390 --> 00:03:22,319

will actually roll out to 28 feet in

77

00:03:25,750 --> 00:03:24,400

length once the solar rays are deployed

78

00:03:28,229 --> 00:03:25,760

it's going to be the size of a school

79

00:03:30,390 --> 00:03:28,239

bus as the solar array opens up it's

80

00:03:31,990 --> 00:03:30,400

going to swing out in this direction the

81

00:03:34,630 --> 00:03:32,000

asteroids only two football fields

82

00:03:37,030 --> 00:03:34,640

inside we're flying at over six

83

00:03:39,030 --> 00:03:37,040

kilometers a second thirty days out we

84

00:03:40,789 --> 00:03:39,040

see one pixel on our field of view you

85

00:03:43,030 --> 00:03:40,799

can see dynamos and demorphos as one

86

00:03:45,110 --> 00:03:43,040

point of light about four hours of our

87

00:03:47,110 --> 00:03:45,120

spacecraft becomes autonomous and that's

88

00:03:49,030 --> 00:03:47,120

where everything gets really exciting

89

00:03:52,229 --> 00:03:49,040

you actually are seeing

90

00:03:53,910 --> 00:03:52,239

impact we're super excited and nervous

91

00:03:56,309 --> 00:03:53,920

as well i feel really honored and

92

00:04:00,149 --> 00:03:56,319

humbled to be working in an area of

93

00:04:02,550 --> 00:04:00,159

science that has such a broader impact

94

00:04:05,190 --> 00:04:02,560

figuratively and literally

95

00:04:07,350 --> 00:04:05,200

so dark the dinosaurs are made

96

00:04:10,309 --> 00:04:07,360

completely extinct by an asteroid impact

97

00:04:12,229 --> 00:04:10,319

so many years ago here we are we can

98

00:04:18,310 --> 00:04:12,239

actually do something about it i think

99

00:04:22,710 --> 00:04:20,229

well now that you've had a chance to see

100

00:04:24,310 --> 00:04:22,720

what dart aims to do we know you've got

101  
00:04:27,110 --> 00:04:24,320  
questions let's go ahead and meet the

102  
00:04:29,270 --> 00:04:27,120  
folks who've got answers joining me now

103  
00:04:32,230 --> 00:04:29,280  
are dr laurie glaze the director of

104  
00:04:34,870 --> 00:04:32,240  
planetary science at nasa headquarters

105  
00:04:36,870 --> 00:04:34,880  
lisa wu mechanical engineer at johns

106  
00:04:39,110 --> 00:04:36,880  
hopkins university applied physics

107  
00:04:42,150 --> 00:04:39,120  
laboratory or apl

108  
00:04:45,110 --> 00:04:42,160  
for short and then also from apl dr

109  
00:04:46,710 --> 00:04:45,120  
nancy chabot the dart coordination lead

110  
00:04:49,909 --> 00:04:46,720  
all right well thanks so much for being

111  
00:04:52,230 --> 00:04:49,919  
here how are you feeling on launch day

112  
00:04:54,310 --> 00:04:52,240  
amazing exhilarated i mean i just can't

113  
00:04:56,469 --> 00:04:54,320

even believe this day's here

114

00:04:58,150 --> 00:04:56,479

so excited so excited got to go out and

115

00:05:01,510 --> 00:04:58,160

look at the rocket this morning and it's

116

00:05:04,710 --> 00:05:01,520

on the pad and we are so ready to go

117

00:05:06,710 --> 00:05:04,720

it is just so amazing we are on the pad

118

00:05:09,270 --> 00:05:06,720

we're going to launch tonight and it's

119

00:05:11,189 --> 00:05:09,280

beautiful here it is in california yeah

120

00:05:14,150 --> 00:05:11,199

vandenberg air force base space force

121

00:05:16,150 --> 00:05:14,160

base man old habits die hard can have

122

00:05:18,790 --> 00:05:16,160

some really really thick marine layer

123

00:05:21,189 --> 00:05:18,800

and clouds but the skies are clear and

124

00:05:23,350 --> 00:05:21,199

let's let's hope let's hope for a good

125

00:05:26,310 --> 00:05:23,360

lift off but also clear skies and good

126

00:05:27,909 --> 00:05:26,320

visibility exactly okay so this show is

127

00:05:30,310 --> 00:05:27,919

all about questions i'm going to start

128

00:05:32,790 --> 00:05:30,320

with a few of mine and then we'll get to

129

00:05:34,150 --> 00:05:32,800

yours okay so lori

130

00:05:36,950 --> 00:05:34,160

the big question

131

00:05:38,629 --> 00:05:36,960

why is the dart mission important why do

132

00:05:41,430 --> 00:05:38,639

we have to do this

133

00:05:43,350 --> 00:05:41,440

great question this is a really really

134

00:05:45,990 --> 00:05:43,360

important mission because it is

135

00:05:50,230 --> 00:05:46,000

humanity's first ever

136

00:05:52,469 --> 00:05:50,240

mission to try and deflect an asteroid

137

00:05:55,029 --> 00:05:52,479

to help us prepare for

138

00:05:55,749 --> 00:05:55,039

a potential danger in the future

139

00:05:57,909 --> 00:05:55,759

so

140

00:06:00,150 --> 00:05:57,919

what we're going to try and do is is

141

00:06:02,469 --> 00:06:00,160

move this asteroid just change its orbit

142

00:06:04,230 --> 00:06:02,479

a little bit and demonstrate that we can

143

00:06:06,390 --> 00:06:04,240

actually do this this is really really

144

00:06:08,870 --> 00:06:06,400

important that we do this now

145

00:06:10,390 --> 00:06:08,880

when we are in a point where we don't

146

00:06:12,550 --> 00:06:10,400

know of any asteroids that are

147

00:06:14,629 --> 00:06:12,560

potentially dangerous right now that are

148

00:06:16,230 --> 00:06:14,639

significant threat i should say those

149

00:06:19,110 --> 00:06:16,240

are a significant threat over the next

150

00:06:21,029 --> 00:06:19,120

hundred years but we want to test this

151

00:06:23,189 --> 00:06:21,039

technique so that if and when we

152

00:06:26,150 --> 00:06:23,199

discover an asteroid that might be a

153

00:06:28,710 --> 00:06:26,160

potential threat we have this tool in

154

00:06:30,629 --> 00:06:28,720

our belt and we're ready to go luck

155

00:06:33,350 --> 00:06:30,639

favors the prepared so we want to test

156

00:06:36,469 --> 00:06:33,360

the technology before we need it

157

00:06:38,710 --> 00:06:36,479

absolutely okay all right now lisa

158

00:06:41,029 --> 00:06:38,720

on on the engineering side of things you

159

00:06:43,749 --> 00:06:41,039

have been with this mission since it was

160

00:06:45,590 --> 00:06:43,759

a new baby cat drawing and now i know

161

00:06:49,110 --> 00:06:45,600

it's a full-fledged spacecraft sitting

162

00:06:50,950 --> 00:06:49,120

on top of its falcon 9 rocket oh man can

163

00:06:51,990 --> 00:06:50,960

you tell us more about this amazing

164

00:06:53,990 --> 00:06:52,000

machine

165

00:06:56,390 --> 00:06:54,000

how it works what are its parts how is

166

00:06:58,950 --> 00:06:56,400

it going to do do the job it's it's made

167

00:07:01,110 --> 00:06:58,960

to do sure of course so part of the dart

168

00:07:03,510 --> 00:07:01,120

spacecraft we have this instrument

169

00:07:06,710 --> 00:07:03,520

called draco and it's basically a camera

170

00:07:08,710 --> 00:07:06,720

the eye of the spacecraft if you will

171

00:07:11,350 --> 00:07:08,720

on board we also have this algorithm

172

00:07:13,350 --> 00:07:11,360

called smart nav built at apl and

173

00:07:16,309 --> 00:07:13,360

together these two things work as the

174

00:07:17,589 --> 00:07:16,319

eye and the brain and that is how we

175

00:07:19,270 --> 00:07:17,599

will go and

176

00:07:20,790 --> 00:07:19,280

get to our target and then on the

177

00:07:24,070 --> 00:07:20,800

spacecraft of course because our number

178

00:07:25,830 --> 00:07:24,080

one mission is to impact this asteroid

179

00:07:28,870 --> 00:07:25,840

that means you know we can do a few more

180

00:07:30,790 --> 00:07:28,880

technology demonstrations so we have

181

00:07:34,070 --> 00:07:30,800

some really cool technologies like the

182

00:07:35,510 --> 00:07:34,080

roses the rollout solar arrays those are

183

00:07:37,990 --> 00:07:35,520

really cool because they literally roll

184

00:07:41,749 --> 00:07:38,000

out like a yoga mat and those are solar

185

00:07:43,830 --> 00:07:41,759

rays we have our nexi ion engine and

186

00:07:46,150 --> 00:07:43,840

that's going to test out the ion engine

187

00:07:49,430 --> 00:07:46,160

um we also have our high gan antenna

188

00:07:51,189 --> 00:07:49,440

that uses a radial line slot array so

189

00:07:53,430 --> 00:07:51,199

like these there's so many cool

190

00:07:55,270 --> 00:07:53,440

technologies on this mission and i'm

191

00:07:57,830 --> 00:07:55,280

just so excited to have been part of it

192

00:08:00,150 --> 00:07:57,840

you you're like a like a glowing proud

193

00:08:02,230 --> 00:08:00,160

parent over there basically

194

00:08:04,150 --> 00:08:02,240

are you sure you're gonna be okay

195

00:08:06,230 --> 00:08:04,160

when you destroy your spacecraft by

196

00:08:08,629 --> 00:08:06,240

slamming it into an asteroid you know i

197

00:08:10,629 --> 00:08:08,639

worked really hard on spacecraft but

198

00:08:13,350 --> 00:08:10,639

this is for the science

199

00:08:15,029 --> 00:08:13,360

so i'm okay with it smash it

200

00:08:16,869 --> 00:08:15,039

okay for the greater good yes for the

201

00:08:19,110 --> 00:08:16,879

greater good but one one follow-up

202

00:08:20,790 --> 00:08:19,120

question on that if you destroy the

203

00:08:23,430 --> 00:08:20,800

spacecraft which is what you intend to

204

00:08:27,430 --> 00:08:23,440

do on a successful day uh

205

00:08:30,230 --> 00:08:27,440

how will you know how will you see it

206

00:08:32,310 --> 00:08:30,240

so when we're approaching this asteroid

207

00:08:33,509 --> 00:08:32,320

draco will be sending all these images

208

00:08:36,389 --> 00:08:33,519

back to earth

209

00:08:37,670 --> 00:08:36,399

until it doesn't

210

00:08:39,589 --> 00:08:37,680

and then

211

00:08:42,310 --> 00:08:39,599

10 days before we actually impact we

212

00:08:44,470 --> 00:08:42,320

will be deploying a cubesat and that

213

00:08:48,150 --> 00:08:44,480

cubesat will be

214

00:08:49,910 --> 00:08:48,160

taking pictures of the entire impact so

215

00:08:53,030 --> 00:08:49,920

we will also be getting all of that

216

00:08:55,829 --> 00:08:53,040

really cool pictures so stay tuned

217

00:08:58,470 --> 00:08:55,839

all right okay from engineering over to

218

00:09:00,310 --> 00:08:58,480

science nancy this is the first time

219

00:09:02,310 --> 00:09:00,320

that we're doing a test of a kinetic

220

00:09:03,990 --> 00:09:02,320

impactor

221

00:09:05,990 --> 00:09:04,000

what are you most looking forward to

222

00:09:08,070 --> 00:09:06,000

about this test

223

00:09:10,150 --> 00:09:08,080

well i'm most looking forward to how

224

00:09:11,670 --> 00:09:10,160

much we actually deflect this asteroid

225

00:09:13,030 --> 00:09:11,680

right i mean this is a test and you know

226

00:09:14,550 --> 00:09:13,040

these asteroids aren't a threat to the

227

00:09:16,470 --> 00:09:14,560

earth like we were talking about but we

228

00:09:18,949 --> 00:09:16,480

want to do this test before we need to

229

00:09:20,710 --> 00:09:18,959

to be ready um and we're not really sure

230

00:09:22,870 --> 00:09:20,720

exactly how much we're going to deflect

231

00:09:24,790 --> 00:09:22,880

it we know it's a double asteroid system

232

00:09:27,350 --> 00:09:24,800

because telescopes all right yeah we've

233

00:09:28,870 --> 00:09:27,360

got we've got a handy dandy handy here

234

00:09:31,990 --> 00:09:28,880

yeah we know it's

235

00:09:34,470 --> 00:09:32,000

right dynamos is not not did a moon but

236

00:09:36,710 --> 00:09:34,480

dimorphous amorphous okay a smaller one

237

00:09:39,509 --> 00:09:36,720

and it goes around like clockwork every

238

00:09:41,990 --> 00:09:39,519

11 hours and 55 minutes like a so we're

239

00:09:44,150 --> 00:09:42,000

just we're coming around sure just like

240

00:09:45,750 --> 00:09:44,160

around every 11 hours and 55 minutes and

241

00:09:47,750 --> 00:09:45,760

telescopes on the earth discovered that

242

00:09:49,350 --> 00:09:47,760

this was a double asteroid system and

243

00:09:51,030 --> 00:09:49,360

know this and that's why they've gotten

244

00:09:52,630 --> 00:09:51,040

this down really precisely and so what's

245

00:09:53,829 --> 00:09:52,640

going to happen it's going around okay

246

00:09:55,190 --> 00:09:53,839

we're coming around and then coming

247

00:09:57,350 --> 00:09:55,200

around spacecraft's going to come and

248

00:09:58,870 --> 00:09:57,360

slam into it head on oh thank you lori

249

00:10:00,949 --> 00:09:58,880

that's perfect

250

00:10:02,470 --> 00:10:00,959

and there we go dart spacecraft totally

251  
00:10:04,310 --> 00:10:02,480  
destroyed how are we going to know how

252  
00:10:06,310 --> 00:10:04,320  
much we deflected it dart spacecraft is

253  
00:10:08,550 --> 00:10:06,320  
not gonna tell us the italian lychee

254  
00:10:10,630 --> 00:10:08,560  
cube cubesat is is long gone after some

255  
00:10:12,949 --> 00:10:10,640  
spectacular images telescopes on the

256  
00:10:14,310 --> 00:10:12,959  
ground again are key to this mission and

257  
00:10:16,710 --> 00:10:14,320  
we think we're gonna change it by maybe

258  
00:10:19,030 --> 00:10:16,720  
about 10 minutes so the clock will be

259  
00:10:20,790 --> 00:10:19,040  
more like 11 hours and 45 minutes going

260  
00:10:22,470 --> 00:10:20,800  
forward but we're not really sure could

261  
00:10:24,710 --> 00:10:22,480  
be less could be more and that's what

262  
00:10:27,430 --> 00:10:24,720  
i'm most excited about learning and

263  
00:10:29,190 --> 00:10:27,440

because this is bigger than dart dart is

264

00:10:31,269 --> 00:10:29,200

just the start we're doing this first

265

00:10:32,630 --> 00:10:31,279

test but we want to understand this to

266

00:10:34,230 --> 00:10:32,640

potentially protect the earth in the

267

00:10:35,990 --> 00:10:34,240

future so i think that also makes this

268

00:10:38,150 --> 00:10:36,000

really exciting that it's not just this

269

00:10:39,509 --> 00:10:38,160

one test but how are we going to apply

270

00:10:42,949 --> 00:10:39,519

it going forward

271

00:10:45,430 --> 00:10:42,959

fantastic okay so those are some of my

272

00:10:48,310 --> 00:10:45,440

questions what are your questions

273

00:10:49,350 --> 00:10:48,320

remember you can use the hashtag asknasa

274

00:10:51,990 --> 00:10:49,360

if you are

275

00:10:54,069 --> 00:10:52,000

on twitter or instagram if you've got a

276

00:10:56,230 --> 00:10:54,079

live chat like on youtube or facebook

277

00:10:58,630 --> 00:10:56,240

just pop your questions right there and

278

00:11:00,550 --> 00:10:58,640

the moderators will get those over to me

279

00:11:03,350 --> 00:11:00,560

and as they do that and we begin to

280

00:11:04,870 --> 00:11:03,360

ponder your questions here's one more

281

00:11:06,870 --> 00:11:04,880

for you to ponder

282

00:11:07,750 --> 00:11:06,880

how will dart deflect an asteroid in

283

00:11:09,750 --> 00:11:07,760

space

284

00:11:11,750 --> 00:11:09,760

we asked astronauts shane kimbrough and

285

00:11:13,430 --> 00:11:11,760

tomah pasquet to demonstrate in

286

00:11:15,590 --> 00:11:13,440

microgravity

287

00:11:18,150 --> 00:11:15,600

hi everyone i'm tomate and i'm with my

288

00:11:19,990 --> 00:11:18,160

favorite astronaut shane kimbrough uh up

289

00:11:21,590 --> 00:11:20,000

here on the space station

290

00:11:24,550 --> 00:11:21,600

today we're going to talk about a very

291

00:11:26,550 --> 00:11:24,560

cool new nasa mission is called dart can

292

00:11:28,949 --> 00:11:26,560

you tell us and tell me a little bit

293

00:11:30,630 --> 00:11:28,959

more about what is nasa's dart mission

294

00:11:33,430 --> 00:11:30,640

and what does nasa

295

00:11:34,949 --> 00:11:33,440

dart mission stand for

296

00:11:37,829 --> 00:11:34,959

okay yeah so

297

00:11:39,190 --> 00:11:37,839

dart is nasa's first planetary defense

298

00:11:41,190 --> 00:11:39,200

test

299

00:11:42,949 --> 00:11:41,200

so we're gonna we're gonna try to do

300

00:11:45,829 --> 00:11:42,959

something we've never done before

301

00:11:49,190 --> 00:11:45,839

with a spacecraft uh dart stands for

302

00:11:52,230 --> 00:11:49,200

double asteroid redirection test so a

303

00:11:54,310 --> 00:11:52,240

nice acronym nasa does like acronyms

304

00:11:55,990 --> 00:11:54,320

dart is another one

305

00:11:57,750 --> 00:11:56,000

and now the purpose of this spacecraft

306

00:12:00,310 --> 00:11:57,760

and this mission it has one purpose

307

00:12:02,310 --> 00:12:00,320

that's to crash itself into an asteroid

308

00:12:03,750 --> 00:12:02,320

and try to redirect it or try to move it

309

00:12:05,269 --> 00:12:03,760

into a different orbit

310

00:12:06,150 --> 00:12:05,279

so today shane

311

00:12:08,230 --> 00:12:06,160

uh

312

00:12:10,629 --> 00:12:08,240

we're gonna demonstrate

313

00:12:11,829 --> 00:12:10,639

some of those principles that you laid

314

00:12:14,550 --> 00:12:11,839

out before

315

00:12:16,949 --> 00:12:14,560

um but can you tell us exactly how we're

316

00:12:18,310 --> 00:12:16,959

gonna do that

317

00:12:20,069 --> 00:12:18,320

well i can try we're gonna it's the

318

00:12:22,069 --> 00:12:20,079

first time for us but uh we're gonna try

319

00:12:24,470 --> 00:12:22,079

to demonstrate this this asteroid

320

00:12:26,550 --> 00:12:24,480

kinetic deflection method which is

321

00:12:28,870 --> 00:12:26,560

really the moment that that that

322

00:12:30,310 --> 00:12:28,880

spacecraft crashes into the asteroid so

323

00:12:31,829 --> 00:12:30,320

we're going to use microgravity up here

324

00:12:34,150 --> 00:12:31,839

because we have that

325

00:12:35,190 --> 00:12:34,160

all the time we're going to try to

326

00:12:37,030 --> 00:12:35,200

show you

327

00:12:40,230 --> 00:12:37,040

kind of how this is going to work when

328

00:12:41,829 --> 00:12:40,240

the asteroid is hit by this spacecraft

329

00:12:43,070 --> 00:12:41,839

called dart

330

00:12:48,230 --> 00:12:43,080

so here we go

331

00:12:52,150 --> 00:12:49,750

so what i'll do

332

00:12:53,670 --> 00:12:52,160

shane's going to be the asteroid

333

00:12:56,150 --> 00:12:53,680

and i'm going to be the nasa dart

334

00:12:57,910 --> 00:12:56,160

mission on this ctb more exactly is

335

00:13:00,150 --> 00:12:57,920

going to be a spacecraft

336

00:13:03,030 --> 00:13:00,160

i'm going to try to throw it and we look

337

00:13:06,230 --> 00:13:03,040

at the effect of that mass coming at him

338

00:13:09,350 --> 00:13:06,240

and the kinetic energy transfer from the

339

00:13:12,230 --> 00:13:09,360

ctb to shane shane will be perfectly

340

00:13:26,150 --> 00:13:14,870

it's not an easy test you ready

341

00:13:30,629 --> 00:13:29,210

i've redirected shane successfully

342

00:13:33,509 --> 00:13:30,639

[Music]

343

00:13:37,430 --> 00:13:35,750

a while ago we we uh got out the door

344

00:13:39,189 --> 00:13:37,440

and we got some new solar arrays here on

345

00:13:41,189 --> 00:13:39,199

space station and so the same technology

346

00:13:42,949 --> 00:13:41,199

we have here now on the space station is

347

00:13:46,069 --> 00:13:42,959

going to be used to power the dart

348

00:13:48,949 --> 00:13:46,079

mission on its way to this asteroid rosa

349

00:13:51,350 --> 00:13:48,959

um in case you didn't know but you knew

350

00:13:52,949 --> 00:13:51,360

it stands for iss rolled out solar rays

351

00:13:56,150 --> 00:13:52,959

so we got a chance to go outside and

352

00:13:58,870 --> 00:13:56,160

install the very first two of these new

353

00:14:00,470 --> 00:13:58,880

irosas or roll out solar rays on the

354

00:14:03,350 --> 00:14:00,480

very end of the space station out on the

355

00:14:05,509 --> 00:14:03,360

port side um these are different because

356

00:14:07,430 --> 00:14:05,519

for one they're much lighter and smaller

357

00:14:09,430 --> 00:14:07,440

they're to me they look very fragile

358

00:14:10,870 --> 00:14:09,440

when we were picking them up and moving

359

00:14:12,629 --> 00:14:10,880

them but they're rolled up so they when

360

00:14:14,790 --> 00:14:12,639

they launch they're kind of rolled up

361

00:14:17,110 --> 00:14:14,800

into a compact cylinder

362

00:14:19,430 --> 00:14:17,120

which is great for launch conditions

363

00:14:21,670 --> 00:14:19,440

and then once they get up on the space

364

00:14:23,030 --> 00:14:21,680

station or in space for a satellite or

365

00:14:25,509 --> 00:14:23,040

something they can then roll these

366

00:14:27,430 --> 00:14:25,519

things out to be useful and so the same

367

00:14:29,509 --> 00:14:27,440

technology we have here now on the space

368

00:14:32,230 --> 00:14:29,519

station is going to be used to power the

369

00:14:32,950 --> 00:14:32,240

dart mission on its way to crashing into

370

00:14:35,910 --> 00:14:32,960

an asteroid

371

00:14:37,350 --> 00:14:35,920

[Music]

372

00:14:39,750 --> 00:14:37,360

and that's the kind of successful

373

00:14:42,949 --> 00:14:39,760

deflection that we're looking for okay

374

00:14:45,590 --> 00:14:42,959

we're back with lori lisa and nancy to

375

00:14:47,990 --> 00:14:45,600

answer your questions remember hashtag

376

00:14:50,949 --> 00:14:48,000

ask nasa or just pop them right in the

377

00:14:53,430 --> 00:14:50,959

stream wherever you are watching okay

378

00:14:54,310 --> 00:14:53,440

first question and this one has lots of

379

00:14:57,030 --> 00:14:54,320

likes

380

00:14:58,550 --> 00:14:57,040

joseph forbes on facebook asks

381

00:15:01,030 --> 00:14:58,560

what if the law of unintended

382

00:15:04,230 --> 00:15:01,040

consequences is it outside the realm of

383

00:15:06,150 --> 00:15:04,240

possibility that a nudge

384

00:15:07,990 --> 00:15:06,160

might change in orbit from an innocuous

385

00:15:09,910 --> 00:15:08,000

one to one that does put it on a

386

00:15:11,430 --> 00:15:09,920

collision course with earth

387

00:15:13,829 --> 00:15:11,440

yeah and that's a really really

388

00:15:16,550 --> 00:15:13,839

important question and it's important to

389

00:15:18,710 --> 00:15:16,560

understand that we chose this system

390

00:15:21,750 --> 00:15:18,720

here didimos and dimorphis specifically

391

00:15:23,590 --> 00:15:21,760

because it really provides the perfect

392

00:15:24,949 --> 00:15:23,600

test case for this

393

00:15:27,590 --> 00:15:24,959

experiment

394

00:15:29,749 --> 00:15:27,600

where we have no chance of that

395

00:15:31,829 --> 00:15:29,759

unintended consequence and the way i

396

00:15:33,990 --> 00:15:31,839

like to think about this is the little

397

00:15:35,269 --> 00:15:34,000

moon here dimorphous if you could

398

00:15:38,150 --> 00:15:35,279

imagine

399

00:15:40,949 --> 00:15:38,160

a high school football stadium that's

400

00:15:42,310 --> 00:15:40,959

full of rocks that's about the size of

401  
00:15:44,310 --> 00:15:42,320  
that little moon

402  
00:15:45,990 --> 00:15:44,320  
so you imagine that big football stadium

403  
00:15:47,749 --> 00:15:46,000  
that's full of rocks and then you take a

404  
00:15:50,389 --> 00:15:47,759  
refrigerator and you ram that

405  
00:15:53,509 --> 00:15:50,399  
refrigerator into that big pile of rocks

406  
00:15:56,069 --> 00:15:53,519  
so it's going to make a little bit of a

407  
00:15:58,710 --> 00:15:56,079  
little tiny change in the speed of that

408  
00:16:01,350 --> 00:15:58,720  
um little moon but not very much just a

409  
00:16:03,269 --> 00:16:01,360  
tiny bit but over time it's going to

410  
00:16:05,350 --> 00:16:03,279  
it's going to go around diddy most and

411  
00:16:06,790 --> 00:16:05,360  
it'll we're hoping to slow it down nancy

412  
00:16:08,949 --> 00:16:06,800  
can talk about that a little more how we

413  
00:16:11,749 --> 00:16:08,959

slow it down and it goes around but

414

00:16:14,470 --> 00:16:11,759

overall this whole system that didimos

415

00:16:16,389 --> 00:16:14,480

is like a half a mile across it's big

416

00:16:18,550 --> 00:16:16,399

compared to dimorphosis so when we make

417

00:16:21,269 --> 00:16:18,560

this little change to dimorphous the

418

00:16:23,110 --> 00:16:21,279

overall momentum of this system is

419

00:16:25,430 --> 00:16:23,120

pretty much going to be the same it will

420

00:16:27,110 --> 00:16:25,440

not even be detectable what we've done

421

00:16:29,670 --> 00:16:27,120

so it really is

422

00:16:31,829 --> 00:16:29,680

exactly why we chose this kind of

423

00:16:33,590 --> 00:16:31,839

a binary asteroid system for this kind

424

00:16:36,949 --> 00:16:33,600

of experiment that's one of the reasons

425

00:16:39,509 --> 00:16:36,959

why it provides such a good example that

426

00:16:41,829 --> 00:16:39,519

we really it is no risk physically and

427

00:16:44,870 --> 00:16:41,839

physically impossible we're not going to

428

00:16:48,629 --> 00:16:44,880

set off a billiard ball reaction exactly

429

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

okay exactly everybody rest easy

430

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

okay moving right along okay well maybe

431

00:16:56,550 --> 00:16:53,759

not keith keith taylor asked i've heard

432

00:16:58,470 --> 00:16:56,560

some scientists say that if

433

00:17:01,350 --> 00:16:58,480

an earth killer asteroid was headed our

434

00:17:03,910 --> 00:17:01,360

way you'd need five years to spot it get

435

00:17:05,990 --> 00:17:03,920

to it bombard it giving deflected shards

436

00:17:07,750 --> 00:17:06,000

enough time to deviate their path and

437

00:17:09,750 --> 00:17:07,760

miss us

438

00:17:11,350 --> 00:17:09,760

is that true

439

00:17:12,949 --> 00:17:11,360

yeah warning time is really what you

440

00:17:14,870 --> 00:17:12,959

want and this is really why it's

441

00:17:16,789 --> 00:17:14,880

important to understand that planetary

442

00:17:18,390 --> 00:17:16,799

defense is much more than just

443

00:17:19,909 --> 00:17:18,400

deflecting asteroids

444

00:17:22,069 --> 00:17:19,919

you need to be finding all of the

445

00:17:24,150 --> 00:17:22,079

asteroids this is key to planetary

446

00:17:26,630 --> 00:17:24,160

defense knowing where the asteroids are

447

00:17:29,430 --> 00:17:26,640

characterizing them tracking them

448

00:17:31,029 --> 00:17:29,440

assessing collaborating internationally

449

00:17:33,270 --> 00:17:31,039

because it's a global concern we're all

450

00:17:35,110 --> 00:17:33,280

on this planet together and then

451  
00:17:36,390 --> 00:17:35,120  
mitigating doing something about it if

452  
00:17:38,710 --> 00:17:36,400  
you need it to and that's where dart

453  
00:17:40,390 --> 00:17:38,720  
comes in into this one larger strategy

454  
00:17:41,909 --> 00:17:40,400  
and so really you want to give yourself

455  
00:17:43,990 --> 00:17:41,919  
this warning time because something like

456  
00:17:46,390 --> 00:17:44,000  
this is just a small nudge which adds up

457  
00:17:47,990 --> 00:17:46,400  
to a big position change over time so

458  
00:17:49,830 --> 00:17:48,000  
the asteroid in the earth theoretically

459  
00:17:51,990 --> 00:17:49,840  
wouldn't be on a path to hit in the

460  
00:17:53,590 --> 00:17:52,000  
future on a collision course and this is

461  
00:17:55,270 --> 00:17:53,600  
why you need this warning time and you

462  
00:17:56,549 --> 00:17:55,280  
have to do so much more to find the

463  
00:17:58,150 --> 00:17:56,559

asteroids and there's actually a lot

464

00:17:59,430 --> 00:17:58,160

that we need to do on that still i guess

465

00:18:01,029 --> 00:17:59,440

maybe you want to pick it up there lori

466

00:18:02,789 --> 00:18:01,039

yeah i do i want to add just a little

467

00:18:04,549 --> 00:18:02,799

bit to that because what nancy said is

468

00:18:07,190 --> 00:18:04,559

so correct that it's critically

469

00:18:09,430 --> 00:18:07,200

important that we uh identify the

470

00:18:12,310 --> 00:18:09,440

asteroids and then characterize them so

471

00:18:14,150 --> 00:18:12,320

we know their orbits and so right now we

472

00:18:16,150 --> 00:18:14,160

have ground-based telescopes that are

473

00:18:17,350 --> 00:18:16,160

observing the night sky every night

474

00:18:20,470 --> 00:18:17,360

looking and searching for these

475

00:18:23,270 --> 00:18:20,480

asteroids we actually also have

476

00:18:26,230 --> 00:18:23,280

a space-based telescope

477

00:18:27,909 --> 00:18:26,240

called neo wise which was a repurposed

478

00:18:30,310 --> 00:18:27,919

astrophysics mission that was originally

479

00:18:32,630 --> 00:18:30,320

called wise and it's out there also

480

00:18:34,870 --> 00:18:32,640

looking for asteroids but we uh we're

481

00:18:36,310 --> 00:18:34,880

still we know there's still many of

482

00:18:38,070 --> 00:18:36,320

these smaller asteroids out there that

483

00:18:39,750 --> 00:18:38,080

we haven't discovered yet so we actually

484

00:18:42,390 --> 00:18:39,760

have a new mission that we've just

485

00:18:44,870 --> 00:18:42,400

started called neo surveyor the near

486

00:18:46,549 --> 00:18:44,880

earth object surveyor mission

487

00:18:48,549 --> 00:18:46,559

and it's just getting underway now and

488

00:18:50,630 --> 00:18:48,559

that's going to be a really powerful

489

00:18:53,270 --> 00:18:50,640

mission uh when it gets launched a few

490

00:18:55,510 --> 00:18:53,280

years from now that its sole purpose is

491

00:18:56,870 --> 00:18:55,520

to really

492

00:18:59,909 --> 00:18:56,880

every day and every night to be

493

00:19:01,669 --> 00:18:59,919

searching the skies looking for um these

494

00:19:04,230 --> 00:19:01,679

uh these asteroids essentially the same

495

00:19:06,070 --> 00:19:04,240

size as dimorphous helping us better

496

00:19:07,830 --> 00:19:06,080

understand what the potential threats

497

00:19:10,870 --> 00:19:07,840

are that are out there always keeping

498

00:19:13,270 --> 00:19:10,880

those eyes on the skies right okay so

499

00:19:15,590 --> 00:19:13,280

back to little dimorphis here for a

500

00:19:19,029 --> 00:19:15,600

second um what's going to happen to the

501

00:19:20,549 --> 00:19:19,039

debris from the asteroid

502

00:19:21,830 --> 00:19:20,559

well the debris is actually we think

503

00:19:23,669 --> 00:19:21,840

going to be an important part of the

504

00:19:25,350 --> 00:19:23,679

experiment so we think dart's going to

505

00:19:27,510 --> 00:19:25,360

come well dart will come speeding in at

506

00:19:30,150 --> 00:19:27,520

15 000 miles per hour and it's going to

507

00:19:31,830 --> 00:19:30,160

crash into demorphos right but we think

508

00:19:33,590 --> 00:19:31,840

that ejecta is going to go off in the

509

00:19:35,669 --> 00:19:33,600

other direction and actually give it

510

00:19:37,590 --> 00:19:35,679

even an extra push like a little jet

511

00:19:39,270 --> 00:19:37,600

engine that shoots out from it right the

512

00:19:41,430 --> 00:19:39,280

rocks shoot out from it in the other way

513

00:19:42,630 --> 00:19:41,440

and uh but how much of that happens is

514

00:19:44,390 --> 00:19:42,640

one of the reasons that we want to do

515

00:19:46,310 --> 00:19:44,400

this test on a real asteroid too because

516

00:19:48,470 --> 00:19:46,320

real asteroids have different shapes and

517

00:19:49,669 --> 00:19:48,480

different sizes and boulders and how are

518

00:19:51,909 --> 00:19:49,679

they put together and what is the

519

00:19:53,750 --> 00:19:51,919

strength um so then these uh this debris

520

00:19:56,150 --> 00:19:53,760

though is very very small it'll stay

521

00:19:57,750 --> 00:19:56,160

with the system and again no threat to

522

00:20:00,870 --> 00:19:57,760

the earth whatsoever

523

00:20:03,830 --> 00:20:00,880

exactly all right so

524

00:20:06,149 --> 00:20:03,840

let's go over back to uh engineering um

525

00:20:08,390 --> 00:20:06,159

yadi on twitter wants to know how do you

526

00:20:11,270 --> 00:20:08,400

know if it worked

527

00:20:13,190 --> 00:20:11,280

well you see we have this camera um

528

00:20:15,510 --> 00:20:13,200

draco as i mentioned before and that's

529

00:20:18,310 --> 00:20:15,520

going to be sending pictures back to

530

00:20:21,110 --> 00:20:18,320

earth and about four hours out that is

531

00:20:23,669 --> 00:20:21,120

when smart nav the brain of dart

532

00:20:26,390 --> 00:20:23,679

actually will start taking over so we'll

533

00:20:28,630 --> 00:20:26,400

not be joysticking the spacecraft from

534

00:20:31,430 --> 00:20:28,640

earth it's fully autonomous four hours

535

00:20:33,430 --> 00:20:31,440

out and then at one hour is when we

536

00:20:36,470 --> 00:20:33,440

actually will start seeing the smaller

537

00:20:38,470 --> 00:20:36,480

asteroid and smart nav will start firing

538

00:20:41,909 --> 00:20:38,480

off thrusters getting it closer and

539

00:20:44,470 --> 00:20:41,919

closer to its target until you know we

540

00:20:45,510 --> 00:20:44,480

will hit it

541

00:20:47,990 --> 00:20:45,520

okay

542

00:20:49,669 --> 00:20:48,000

so question for the entire panel here

543

00:20:51,590 --> 00:20:49,679

logan on youtube wants to know how long

544

00:20:53,270 --> 00:20:51,600

have you been working on dart

545

00:20:55,430 --> 00:20:53,280

oh i'm going to let i think lisa should

546

00:20:57,029 --> 00:20:55,440

start on this one okay because i think

547

00:20:58,789 --> 00:20:57,039

we've got we've got you know you're

548

00:21:00,789 --> 00:20:58,799

coming at this from a lot of different

549

00:21:03,750 --> 00:21:00,799

angles correct from from sort of the

550

00:21:06,230 --> 00:21:03,760

nasa science and business side right

551  
00:21:08,149 --> 00:21:06,240  
engineering building and then the

552  
00:21:10,470 --> 00:21:08,159  
science the science that really starts

553  
00:21:12,470 --> 00:21:10,480  
with uh you know with that impact yeah

554  
00:21:14,230 --> 00:21:12,480  
so i've been on dart for five years

555  
00:21:16,470 --> 00:21:14,240  
about when i started enjoying the dart

556  
00:21:18,870 --> 00:21:16,480  
team so nasa started initial development

557  
00:21:20,549 --> 00:21:18,880  
phase of dart in 2015 and i started

558  
00:21:22,630 --> 00:21:20,559  
shortly after that on the project as

559  
00:21:24,070 --> 00:21:22,640  
well and it's just been a joy to join

560  
00:21:25,669 --> 00:21:24,080  
this team one of the things that i love

561  
00:21:27,990 --> 00:21:25,679  
about being on a team like this is it

562  
00:21:30,070 --> 00:21:28,000  
takes so much different expertise to all

563  
00:21:31,510 --> 00:21:30,080

come together in order to accomplish

564

00:21:33,190 --> 00:21:31,520

something that's so much bigger than any

565

00:21:35,830 --> 00:21:33,200

one person could do on their own and

566

00:21:37,750 --> 00:21:35,840

dart obviously is a key example of that

567

00:21:40,310 --> 00:21:37,760

and you know i'm just overjoyed to be a

568

00:21:43,590 --> 00:21:40,320

part of this mission yeah so i've been

569

00:21:46,149 --> 00:21:43,600

on dart for three years this is my very

570

00:21:48,390 --> 00:21:46,159

first spacecraft so i'm super excited

571

00:21:50,070 --> 00:21:48,400

for launch and the fact i was a part of

572

00:21:51,990 --> 00:21:50,080

building the spacecraft like how many

573

00:21:54,310 --> 00:21:52,000

people get to say that i built this

574

00:21:56,230 --> 00:21:54,320

spacecraft like wow

575

00:21:57,029 --> 00:21:56,240

i'm just a few years out of college so

576  
00:21:58,470 --> 00:21:57,039  
like

577  
00:22:00,149 --> 00:21:58,480  
to everyone out there

578  
00:22:03,669 --> 00:22:00,159  
this is so cool

579  
00:22:06,549 --> 00:22:03,679  
no you got your foot in the door at apl

580  
00:22:07,990 --> 00:22:06,559  
yes and you did a rotation there yeah

581  
00:22:08,870 --> 00:22:08,000  
that landed you

582  
00:22:11,909 --> 00:22:08,880  
yes

583  
00:22:13,669 --> 00:22:11,919  
so right out of undergrad i went to apl

584  
00:22:15,510 --> 00:22:13,679  
and i was in a rotation program where i

585  
00:22:16,710 --> 00:22:15,520  
went to all different types of groups at

586  
00:22:18,789 --> 00:22:16,720  
the lab

587  
00:22:21,270 --> 00:22:18,799  
one of them one of my projects was dart

588  
00:22:23,510 --> 00:22:21,280

and you know i i really liked it so

589

00:22:25,990 --> 00:22:23,520

here i am three years later

590

00:22:27,990 --> 00:22:26,000

that is so cool that's so cool did you

591

00:22:30,310 --> 00:22:28,000

did you greenlight this thing do we have

592

00:22:33,350 --> 00:22:30,320

you to thank for this mission lori well

593

00:22:35,029 --> 00:22:33,360

i've been paying for this mission

594

00:22:37,430 --> 00:22:35,039

thank you very much

595

00:22:39,590 --> 00:22:37,440

but so i i joined nasa headquarters

596

00:22:40,470 --> 00:22:39,600

about three and a half years ago

597

00:22:45,590 --> 00:22:40,480

and

598

00:22:47,590 --> 00:22:45,600

doing my my research at nasa's goddard

599

00:22:50,230 --> 00:22:47,600

space flight center and of course i knew

600

00:22:51,750 --> 00:22:50,240

about dart but i was not specifically

601  
00:22:54,070 --> 00:22:51,760  
involved with dart but when i came to

602  
00:22:56,789 --> 00:22:54,080  
headquarters in my current role dart is

603  
00:22:58,549 --> 00:22:56,799  
a part of my overall portfolio for

604  
00:23:00,470 --> 00:22:58,559  
planetary science

605  
00:23:01,830 --> 00:23:00,480  
and when i look across our entire

606  
00:23:04,549 --> 00:23:01,840  
portfolio

607  
00:23:06,549 --> 00:23:04,559  
i was so excited to to actually have

608  
00:23:08,789 --> 00:23:06,559  
dart be a part of this when i came in

609  
00:23:11,110 --> 00:23:08,799  
because we have a lot of great science

610  
00:23:12,789 --> 00:23:11,120  
missions but we only have one planetary

611  
00:23:14,549 --> 00:23:12,799  
defense mission or we did at the time

612  
00:23:16,549 --> 00:23:14,559  
and now we have two but at that time

613  
00:23:19,430 --> 00:23:16,559

there was only one and dart i thought

614

00:23:22,230 --> 00:23:19,440

you know we have an amazing opportunity

615

00:23:24,950 --> 00:23:22,240

with this mission to uh to tell the

616

00:23:26,950 --> 00:23:24,960

world about how important it is that we

617

00:23:29,750 --> 00:23:26,960

defend our planet and and get more

618

00:23:31,750 --> 00:23:29,760

planetary defenders um out there and so

619

00:23:34,070 --> 00:23:31,760

it's been a really really important part

620

00:23:36,789 --> 00:23:34,080

of what we do in planetary science

621

00:23:40,070 --> 00:23:36,799

okay so all right from the personal

622

00:23:43,029 --> 00:23:40,080

stories back to the science nancy uh

623

00:23:45,830 --> 00:23:43,039

jake smith 9287 wants to know could

624

00:23:48,470 --> 00:23:45,840

asteroids be the reason water came to

625

00:23:50,950 --> 00:23:48,480

earth oh that's a great question yeah i

626

00:23:52,789 --> 00:23:50,960

mean asteroids are fascinating objects

627

00:23:55,110 --> 00:23:52,799

they're the relics of the early solar

628

00:23:57,350 --> 00:23:55,120

system they were the building blocks of

629

00:23:59,190 --> 00:23:57,360

the planets um and so they really did

630

00:24:00,870 --> 00:23:59,200

bring a lot of important stuff to the

631

00:24:03,029 --> 00:24:00,880

planets water might have been one of

632

00:24:05,909 --> 00:24:03,039

them along with other materials that's

633

00:24:07,430 --> 00:24:05,919

really an active area of science um

634

00:24:09,269 --> 00:24:07,440

that's that's fascinating and we have

635

00:24:11,110 --> 00:24:09,279

some other missions that nasa is doing

636

00:24:13,029 --> 00:24:11,120

that are really in a position to address

637

00:24:14,710 --> 00:24:13,039

that specifically like the osiris-rex

638

00:24:16,070 --> 00:24:14,720

mission so maybe laura you want to say a

639

00:24:17,750 --> 00:24:16,080

few words let's say a few words we're

640

00:24:20,149 --> 00:24:17,760

here to talk about dart today but i will

641

00:24:22,870 --> 00:24:20,159

give a quick shout out to the osiris-rex

642

00:24:23,909 --> 00:24:22,880

mission which collected a sample um a

643

00:24:25,269 --> 00:24:23,919

year ago

644

00:24:27,510 --> 00:24:25,279

in october

645

00:24:28,630 --> 00:24:27,520

and is now on its way back to earth to

646

00:24:30,630 --> 00:24:28,640

bring that back and that's a

647

00:24:32,470 --> 00:24:30,640

particularly special asteroid because we

648

00:24:35,430 --> 00:24:32,480

do think not only did it have water

649

00:24:37,669 --> 00:24:35,440

bearing minerals on it but also organic

650

00:24:39,510 --> 00:24:37,679

molecules so not just delivering water

651  
00:24:41,669 --> 00:24:39,520  
to earth and other planets but also the

652  
00:24:44,630 --> 00:24:41,679  
building blocks for life and as nancy

653  
00:24:46,549 --> 00:24:44,640  
says these are are fantastic relics of

654  
00:24:48,710 --> 00:24:46,559  
the early solar system that each tell us

655  
00:24:50,789 --> 00:24:48,720  
different parts of the story of how our

656  
00:24:52,470 --> 00:24:50,799  
solar system formed and evolved i think

657  
00:24:54,310 --> 00:24:52,480  
that's what's neat about asteroids too

658  
00:24:55,669 --> 00:24:54,320  
is that you kind of can look in the past

659  
00:24:57,350 --> 00:24:55,679  
right you know these things that are

660  
00:24:58,870 --> 00:24:57,360  
before the earth right that we can look

661  
00:25:01,110 --> 00:24:58,880  
back to see how they did but we're

662  
00:25:02,470 --> 00:25:01,120  
really talking here about the present

663  
00:25:04,310 --> 00:25:02,480

right you know with what the current

664

00:25:06,549 --> 00:25:04,320

threat to the earth might be from these

665

00:25:08,149 --> 00:25:06,559

and then preparing for the future where

666

00:25:10,230 --> 00:25:08,159

we can be ready to do something about

667

00:25:12,710 --> 00:25:10,240

this if we needed to so it sort of spans

668

00:25:14,870 --> 00:25:12,720

this whole thing with asteroids

669

00:25:17,750 --> 00:25:14,880

well osiris-rex is on the minds of

670

00:25:19,669 --> 00:25:17,760

others too astro balrog on twitter wants

671

00:25:22,149 --> 00:25:19,679

to know does the dart mission have a

672

00:25:25,750 --> 00:25:22,159

volunteer ambassador team like

673

00:25:29,190 --> 00:25:25,760

osiris-rex did and if so he wants in or

674

00:25:30,710 --> 00:25:29,200

she or they but astro ball rock wants in

675

00:25:33,029 --> 00:25:30,720

okay

676

00:25:35,029 --> 00:25:33,039

planetary defenders with that terry

677

00:25:36,950 --> 00:25:35,039

defenders i think that's the the best

678

00:25:38,549 --> 00:25:36,960

way to go there um and you maybe have

679

00:25:41,029 --> 00:25:38,559

the url there for the

680

00:25:42,630 --> 00:25:41,039

military defenders stay tuned you have

681

00:25:44,470 --> 00:25:42,640

to you have to wait a little later in

682

00:25:46,390 --> 00:25:44,480

the show but we'll tell you how to be a

683

00:25:48,149 --> 00:25:46,400

planetary defender and i will say on the

684

00:25:49,909 --> 00:25:48,159

dart website we recently posted some

685

00:25:52,230 --> 00:25:49,919

great outreach materials so you can go

686

00:25:54,310 --> 00:25:52,240

under outreach on the dart website and

687

00:25:56,789 --> 00:25:54,320

there's a kit where you can build the

688

00:25:58,549 --> 00:25:56,799

dart spacecraft out of blocks yeah i saw

689

00:26:00,310 --> 00:25:58,559

that the other night it's awesome

690

00:26:02,310 --> 00:26:00,320

there's a virtual spacecraft that you

691

00:26:03,830 --> 00:26:02,320

can kind of go like pokemon go and like

692

00:26:05,510 --> 00:26:03,840

put it out there and take your you know

693

00:26:06,549 --> 00:26:05,520

see it in your scene and some other fun

694

00:26:07,669 --> 00:26:06,559

things so

695

00:26:10,149 --> 00:26:07,679

definitely there's a lot of stuff

696

00:26:11,669 --> 00:26:10,159

ramping up and check that out

697

00:26:14,390 --> 00:26:11,679

okay so

698

00:26:16,789 --> 00:26:14,400

back to our system seth on youtube asks

699

00:26:19,269 --> 00:26:16,799

how close are dynamos and demorphos to

700

00:26:22,149 --> 00:26:19,279

each other if you were standing on one

701

00:26:25,029 --> 00:26:22,159

would you be able to see the other

702

00:26:26,630 --> 00:26:25,039

yeah that models to scale and so this is

703

00:26:28,950 --> 00:26:26,640

uh this is the right scale for how it

704

00:26:31,190 --> 00:26:28,960

should be so i don't know if people are

705

00:26:33,029 --> 00:26:31,200

familiar with um the washington dc area

706

00:26:35,510 --> 00:26:33,039

but this is the analog that i have in my

707

00:26:38,230 --> 00:26:35,520

mind okay um the whole system didimos

708

00:26:39,909 --> 00:26:38,240

and dimorphos would fit between the u.s

709

00:26:42,470 --> 00:26:39,919

capitol building and the washington

710

00:26:44,149 --> 00:26:42,480

monument so you can absolutely see the

711

00:26:45,830 --> 00:26:44,159

washington monument from the capitol

712

00:26:49,430 --> 00:26:45,840

building right and you would see

713

00:26:52,870 --> 00:26:49,440

dimorphous from diddymos there we go

714

00:26:54,710 --> 00:26:52,880

okay so um nancy

715

00:26:56,950 --> 00:26:54,720

lilly hall on twitter wants to know how

716

00:26:59,669 --> 00:26:56,960

long ago did you identify the target

717

00:27:03,830 --> 00:27:01,510

well there was the uh

718

00:27:06,149 --> 00:27:03,840

1990s that this was discovered to be a

719

00:27:07,909 --> 00:27:06,159

binary asteroid system a double asteroid

720

00:27:10,230 --> 00:27:07,919

system was the first time that that was

721

00:27:12,230 --> 00:27:10,240

seen i mean so uh but you know dart

722

00:27:14,390 --> 00:27:12,240

mission didn't exist then so you know it

723

00:27:16,230 --> 00:27:14,400

was sort of uh talked about in some

724

00:27:17,990 --> 00:27:16,240

science conferences and planetary

725

00:27:19,750 --> 00:27:18,000

defense conferences this whole idea of a

726

00:27:21,990 --> 00:27:19,760

double asteroid system actually one of

727

00:27:23,669 --> 00:27:22,000

my colleagues andy chang at apl was one

728

00:27:25,110 --> 00:27:23,679

of the ones who originated he likes to

729

00:27:27,430 --> 00:27:25,120

tell this story where he was uh

730

00:27:29,510 --> 00:27:27,440

exercising in his basement and it just

731

00:27:31,029 --> 00:27:29,520

sort of came to him and uh anyways then

732

00:27:32,230 --> 00:27:31,039

he sort of shared it with colleagues who

733

00:27:34,149 --> 00:27:32,240

have been thinking about planetary

734

00:27:35,750 --> 00:27:34,159

defense and dynamos is just the ideal

735

00:27:37,590 --> 00:27:35,760

target because of this double asteroid

736

00:27:39,669 --> 00:27:37,600

nature nancy do you want to talk for

737

00:27:41,750 --> 00:27:39,679

just a minute about how we know it's a

738

00:27:43,590 --> 00:27:41,760

binary asteroid and how we know what the

739

00:27:45,110 --> 00:27:43,600

orbit is of dimorphous around data yeah

740

00:27:46,470 --> 00:27:45,120

what's really interesting right i mean

741

00:27:48,149 --> 00:27:46,480

and even if you look at the model like

742

00:27:49,590 --> 00:27:48,159

those two are pretty close to each other

743

00:27:51,430 --> 00:27:49,600

and from earth it just looks like a

744

00:27:53,350 --> 00:27:51,440

single point of light you can't see that

745

00:27:55,350 --> 00:27:53,360

there's two asteroids there especially

746

00:27:57,350 --> 00:27:55,360

especially if it's bad okay so yeah so

747

00:27:59,750 --> 00:27:57,360

when it's behind like that right what

748

00:28:02,789 --> 00:27:59,760

you only see the big one so it's less

749

00:28:04,310 --> 00:28:02,799

bright but when it comes out to the side

750

00:28:05,669 --> 00:28:04,320

there it's brighter because you're

751  
00:28:07,510 --> 00:28:05,679  
getting the light from both of those

752  
00:28:09,110 --> 00:28:07,520  
objects in the same frame and then it's

753  
00:28:11,029 --> 00:28:09,120  
darker and then it goes around and so

754  
00:28:12,789 --> 00:28:11,039  
that you just map out the brightness

755  
00:28:15,029 --> 00:28:12,799  
versus time brightness versus time take

756  
00:28:16,870 --> 00:28:15,039  
lots of measurements and over this 11

757  
00:28:19,350 --> 00:28:16,880  
hours and 55 minutes this brightness

758  
00:28:20,870 --> 00:28:19,360  
versus time changes and that's a really

759  
00:28:22,549 --> 00:28:20,880  
a great way and that's the same

760  
00:28:24,149 --> 00:28:22,559  
technique that's going to be used to

761  
00:28:26,630 --> 00:28:24,159  
figure out how much we deflected the

762  
00:28:28,230 --> 00:28:26,640  
asteroid so it's a great story

763  
00:28:30,789 --> 00:28:28,240

okay we're getting lots and lots of

764

00:28:32,149 --> 00:28:30,799

questions about asteroids what we know

765

00:28:34,870 --> 00:28:32,159

what we don't

766

00:28:39,060 --> 00:28:34,880

so we asked a nasa scientist

767

00:28:48,070 --> 00:28:41,110

[Music]

768

00:28:51,269 --> 00:28:49,750

well no

769

00:28:53,190 --> 00:28:51,279

but the good news is we know where most

770

00:28:55,269 --> 00:28:53,200

of the really big ones are they get

771

00:28:57,350 --> 00:28:55,279

closest to the earth we found more than

772

00:28:59,510 --> 00:28:57,360

90 percent of these that's the great

773

00:29:01,430 --> 00:28:59,520

news but there are a lot more smaller

774

00:29:02,710 --> 00:29:01,440

pieces that are still out there that we

775

00:29:04,149 --> 00:29:02,720

haven't found

776

00:29:06,149 --> 00:29:04,159

it's really challenging to find

777

00:29:07,350 --> 00:29:06,159

asteroids and comets simply because even

778

00:29:10,389 --> 00:29:07,360

though some of them are as big as

779

00:29:12,789 --> 00:29:10,399

mountains space is incredibly huge and

780

00:29:14,630 --> 00:29:12,799

these things can be really far away in

781

00:29:16,389 --> 00:29:14,640

fact we want to find them when they're

782

00:29:19,190 --> 00:29:16,399

very far away from the earth so we have

783

00:29:20,789 --> 00:29:19,200

lots of time to take action if we ever

784

00:29:22,789 --> 00:29:20,799

find one that's really headed in our

785

00:29:25,350 --> 00:29:22,799

direction asteroids are both a source of

786

00:29:26,389 --> 00:29:25,360

fascination but sometimes fear because

787

00:29:28,630 --> 00:29:26,399

we wonder

788

00:29:30,789 --> 00:29:28,640

can they hit the earth it's really

789

00:29:32,710 --> 00:29:30,799

incredibly unlikely that a significant

790

00:29:35,269 --> 00:29:32,720

asteroid impact is going to occur in our

791

00:29:37,190 --> 00:29:35,279

lifetimes however that said if even one

792

00:29:38,870 --> 00:29:37,200

happens it could be really bad and

793

00:29:40,549 --> 00:29:38,880

that's why we want to go out and look

794

00:29:42,470 --> 00:29:40,559

for these objects and make sure that the

795

00:29:44,470 --> 00:29:42,480

earth and an asteroid never get too

796

00:29:47,029 --> 00:29:44,480

close for comfort so does nasa know

797

00:29:48,710 --> 00:29:47,039

about all the asteroids well no

798

00:29:50,789 --> 00:29:48,720

but we know what we have to do and we're

799

00:29:54,280 --> 00:29:50,799

on the job and we're really glad to be

800

00:29:58,149 --> 00:29:54,290

part of team planetary defense

801  
00:30:03,190 --> 00:30:00,789  
so as you can see nasa has an entire

802  
00:30:06,710 --> 00:30:03,200  
team of planetary defenders working to

803  
00:30:08,710 --> 00:30:06,720  
keep our planet safe and we want you

804  
00:30:12,389 --> 00:30:08,720  
that's right you can become a planetary

805  
00:30:14,389 --> 00:30:12,399  
defender today by visiting [bitly.com](https://bitly.com)

806  
00:30:15,350 --> 00:30:14,399  
planetary defender and test your

807  
00:30:17,750 --> 00:30:15,360  
knowledge

808  
00:30:19,990 --> 00:30:17,760  
if you do well enough on the quiz you

809  
00:30:22,710 --> 00:30:20,000  
will be able to get a special badge that

810  
00:30:26,070 --> 00:30:22,720  
you can share on social media planetary

811  
00:30:28,230 --> 00:30:26,080  
defender so we can see it over on the

812  
00:30:30,149 --> 00:30:28,240  
social media team here at nasa

813  
00:30:32,149 --> 00:30:30,159

and with that we're gonna go back to

814

00:30:35,190 --> 00:30:32,159

questions okay

815

00:30:37,350 --> 00:30:35,200

next one up is from matthew cummins

816

00:30:40,070 --> 00:30:37,360

how do you determine what weight the

817

00:30:41,990 --> 00:30:40,080

spacecraft should be and its speed in

818

00:30:44,230 --> 00:30:42,000

relation to the weight and speed of the

819

00:30:46,870 --> 00:30:44,240

asteroid in order to change the

820

00:30:49,590 --> 00:30:46,880

asteroid's trajectory all right physics

821

00:30:50,950 --> 00:30:49,600

question coming at you engineer

822

00:30:52,870 --> 00:30:50,960

momentum

823

00:30:53,909 --> 00:30:52,880

physics

824

00:30:55,590 --> 00:30:53,919

so

825

00:30:58,310 --> 00:30:55,600

as we all know

826

00:31:00,310 --> 00:30:58,320

the asteroid is quite large and dart is

827

00:31:03,269 --> 00:31:00,320

quite small we're about the size of a

828

00:31:06,470 --> 00:31:03,279

smart car and we weigh roughly like

829

00:31:08,789 --> 00:31:06,480

60 pounds so you know compared to how

830

00:31:09,830 --> 00:31:08,799

big the asteroid is which as you said

831

00:31:12,549 --> 00:31:09,840

it's like

832

00:31:15,350 --> 00:31:12,559

a football stadium filled with rocks

833

00:31:17,029 --> 00:31:15,360

we're like really really small but we

834

00:31:19,509 --> 00:31:17,039

are going super super fast we're going

835

00:31:22,549 --> 00:31:19,519

15 000 miles per hour

836

00:31:25,590 --> 00:31:22,559

which per scale is like four miles per

837

00:31:28,070 --> 00:31:25,600

second so try going that fast that's a

838

00:31:30,830 --> 00:31:28,080

really fast um and with that and you

839

00:31:33,590 --> 00:31:30,840

know momentum you hit something transfer

840

00:31:36,870 --> 00:31:33,600

momentum that's how we're doing it

841

00:31:39,430 --> 00:31:36,880

the good old  $f$  equals  $ma$  yes all right

842

00:31:41,029 --> 00:31:39,440

my favorite my favorite equation yeah

843

00:31:43,029 --> 00:31:41,039

do do you have favorite equations or is

844

00:31:47,909 --> 00:31:43,039

that just me

845

00:31:51,590 --> 00:31:49,750

internet if you have a favorite equation

846

00:31:53,110 --> 00:31:51,600

please post it in the chat

847

00:31:53,990 --> 00:31:53,120

and i will go back and i will like it

848

00:31:54,870 --> 00:31:54,000

later

849

00:31:56,389 --> 00:31:54,880

okay

850

00:31:57,909 --> 00:31:56,399

um

851  
00:32:00,070 --> 00:31:57,919  
calachini

852  
00:32:02,230 --> 00:32:00,080  
craig mcguire how long is it going to

853  
00:32:03,830 --> 00:32:02,240  
take dart to get to this asteroid nancy

854  
00:32:06,789 --> 00:32:03,840  
how long do you have to wait to start

855  
00:32:09,110 --> 00:32:06,799  
your science well once we launch tonight

856  
00:32:12,149 --> 00:32:09,120  
and then it'll be 10 months so

857  
00:32:14,789 --> 00:32:12,159  
late september of 2022 is gonna be the

858  
00:32:16,070 --> 00:32:14,799  
smashing event if you will and uh so

859  
00:32:17,590 --> 00:32:16,080  
yeah

860  
00:32:19,190 --> 00:32:17,600  
thank you very much i know it's there's

861  
00:32:21,509 --> 00:32:19,200  
a lot of bad puns out there so i just

862  
00:32:23,750 --> 00:32:21,519  
embraced them um but yeah then we'll use

863  
00:32:25,350 --> 00:32:23,760

uh the telescopes on the earth um we'll

864

00:32:28,389 --> 00:32:25,360

actually continue observing until around

865

00:32:30,549 --> 00:32:28,399

march of 2023 even because we're timing

866

00:32:33,029 --> 00:32:30,559

this in 2022 such that the distance

867

00:32:35,029 --> 00:32:33,039

between dynamos and earth is still large

868

00:32:36,389 --> 00:32:35,039

totally safe but is minimized and so the

869

00:32:38,630 --> 00:32:36,399

telescopes on earth are going to get the

870

00:32:40,310 --> 00:32:38,640

most precise data that they possibly can

871

00:32:42,149 --> 00:32:40,320

they'll be able to observe for months in

872

00:32:44,230 --> 00:32:42,159

order to really get a measure of how

873

00:32:47,029 --> 00:32:44,240

much we deflected this asteroid so and

874

00:32:49,909 --> 00:32:47,039

at this point in the day it's still

875

00:32:52,230 --> 00:32:49,919

fall 2022 late september early october

876

00:32:54,310 --> 00:32:52,240

but how soon are you gonna know when you

877

00:32:55,430 --> 00:32:54,320

have your date with destiny

878

00:32:56,600 --> 00:32:55,440

at uh

879

00:32:58,870 --> 00:32:56,610

10 22.

880

00:33:00,549 --> 00:32:58,880

[Laughter]

881

00:33:03,029 --> 00:33:00,559

when we launch it 10 21 as soon as we

882

00:33:05,509 --> 00:33:03,039

launch um then that'll set the uh date

883

00:33:07,350 --> 00:33:05,519

for darts collision with demorphos so

884

00:33:09,830 --> 00:33:07,360

awesome and then we can we can send out

885

00:33:12,389 --> 00:33:09,840

a save the date so that you can all join

886

00:33:13,830 --> 00:33:12,399

us back um yeah what do you say do you

887

00:33:17,430 --> 00:33:13,840

want to do you want to do do another

888

00:33:22,310 --> 00:33:18,710

you'll be there lori all right

889

00:33:24,870 --> 00:33:22,320

absolutely okay okay um slice fire on

890

00:33:26,470 --> 00:33:24,880

youtube what are your future plans i'm

891

00:33:28,789 --> 00:33:26,480

going to give this one to you lori what

892

00:33:30,630 --> 00:33:28,799

are your future plans for the use of

893

00:33:31,990 --> 00:33:30,640

this new technology that dart's going to

894

00:33:34,950 --> 00:33:32,000

give us

895

00:33:37,190 --> 00:33:34,960

great great question so the first step

896

00:33:40,149 --> 00:33:37,200

of course as nancy has said is that we

897

00:33:43,190 --> 00:33:40,159

need to assess the data we really need

898

00:33:45,990 --> 00:33:43,200

to learn from this experiment we need to

899

00:33:48,230 --> 00:33:46,000

learn and understand number one how well

900

00:33:51,990 --> 00:33:48,240

the smart nav system works how well

901  
00:33:53,509 --> 00:33:52,000  
we're able to target the asteroid um

902  
00:33:55,590 --> 00:33:53,519  
and impact it

903  
00:33:58,789 --> 00:33:55,600  
and then we need to understand how well

904  
00:34:00,389 --> 00:33:58,799  
that momentum transfer actually happens

905  
00:34:02,389 --> 00:34:00,399  
you know we don't know necessarily if

906  
00:34:05,110 --> 00:34:02,399  
the rock is solid rock or whether it's

907  
00:34:06,310 --> 00:34:05,120  
just a collection of rubble

908  
00:34:08,629 --> 00:34:06,320  
and that's going to make a difference on

909  
00:34:10,869 --> 00:34:08,639  
how effective we can transfer the the

910  
00:34:12,790 --> 00:34:10,879  
momentum so we need to really assess

911  
00:34:14,389 --> 00:34:12,800  
that data and understand how well did

912  
00:34:16,550 --> 00:34:14,399  
this technique work

913  
00:34:18,470 --> 00:34:16,560

we also have some other techniques that

914

00:34:20,790 --> 00:34:18,480

we've been studying and thinking about

915

00:34:23,109 --> 00:34:20,800

for asteroid deflection um that we may

916

00:34:25,589 --> 00:34:23,119

want to think about perhaps for a future

917

00:34:28,230 --> 00:34:25,599

test or uh for comparison with how the

918

00:34:29,750 --> 00:34:28,240

connecticut other than connecticut so

919

00:34:31,829 --> 00:34:29,760

there's a couple other ideas that are

920

00:34:33,750 --> 00:34:31,839

out there that have also been explored

921

00:34:36,550 --> 00:34:33,760

and have been investigated one is

922

00:34:38,550 --> 00:34:36,560

something called a gravity tractor

923

00:34:40,869 --> 00:34:38,560

which to me sounds like uh science

924

00:34:43,750 --> 00:34:40,879

fiction but it is actually for real

925

00:34:45,510 --> 00:34:43,760

right that you can by adjusting the mass

926  
00:34:47,030 --> 00:34:45,520  
of an object by maybe taking off some

927  
00:34:49,270 --> 00:34:47,040  
mass or putting some mass onto it you

928  
00:34:51,030 --> 00:34:49,280  
can change its gravity field

929  
00:34:53,030 --> 00:34:51,040  
and so it's possible to actually change

930  
00:34:54,869 --> 00:34:53,040  
that a little bit another thought that's

931  
00:34:57,670 --> 00:34:54,879  
been out there is

932  
00:34:59,589 --> 00:34:57,680  
to potentially take a nuclear device and

933  
00:35:02,390 --> 00:34:59,599  
detonate it not

934  
00:35:04,710 --> 00:35:02,400  
detonate the asteroid i'll make that

935  
00:35:07,510 --> 00:35:04,720  
clear you want to detonate it near the

936  
00:35:09,510 --> 00:35:07,520  
asteroid to give it a bit of a push a

937  
00:35:11,510 --> 00:35:09,520  
bit of a big force

938  
00:35:13,589 --> 00:35:11,520

and just for the record we don't want to

939

00:35:16,470 --> 00:35:13,599

blow up an asteroid nor do we want to

940

00:35:18,630 --> 00:35:16,480

hire a ragtag group of drillers to go

941

00:35:20,230 --> 00:35:18,640

out there and places i think i saw that

942

00:35:21,589 --> 00:35:20,240

one

943

00:35:23,910 --> 00:35:21,599

yeah i just want to explain though why

944

00:35:25,510 --> 00:35:23,920

you don't want to you know explode an

945

00:35:26,870 --> 00:35:25,520

asteroid because a lot of people say

946

00:35:29,270 --> 00:35:26,880

well i've seen it in the movies don't

947

00:35:30,950 --> 00:35:29,280

you want to just explode the asteroid

948

00:35:33,670 --> 00:35:30,960

and the problem with that

949

00:35:36,630 --> 00:35:33,680

idea is that if the asteroid is on a

950

00:35:39,670 --> 00:35:36,640

collision course with earth and you blow

951  
00:35:41,510 --> 00:35:39,680  
it up you then not just have one rock

952  
00:35:44,710 --> 00:35:41,520  
coming towards earth you now have

953  
00:35:46,230 --> 00:35:44,720  
thousands of rocks

954  
00:35:48,150 --> 00:35:46,240  
and then we have new problems so we

955  
00:35:49,589 --> 00:35:48,160  
really don't want to blow it up okay um

956  
00:35:51,670 --> 00:35:49,599  
so so those are things that we're

957  
00:35:53,670 --> 00:35:51,680  
thinking about for the future i already

958  
00:35:55,750 --> 00:35:53,680  
mentioned the neo surveyor mission which

959  
00:35:58,230 --> 00:35:55,760  
is another thing we have in our in our

960  
00:36:00,870 --> 00:35:58,240  
pocket for the future a really important

961  
00:36:03,030 --> 00:36:00,880  
part as i said to make sure we find all

962  
00:36:04,870 --> 00:36:03,040  
of the asteroids and then we know which

963  
00:36:06,870 --> 00:36:04,880

ones are potential threat

964

00:36:08,230 --> 00:36:06,880

right now we know all of the asteroids

965

00:36:09,750 --> 00:36:08,240

we think we know almost all the ones

966

00:36:12,230 --> 00:36:09,760

that are really big

967

00:36:14,230 --> 00:36:12,240

um the ones that could like wipe out the

968

00:36:16,390 --> 00:36:14,240

dinosaurs that kind of size but the

969

00:36:17,910 --> 00:36:16,400

smaller ones like dimorphous and larger

970

00:36:20,069 --> 00:36:17,920

we still know there's a lot out there we

971

00:36:21,589 --> 00:36:20,079

haven't discovered and obviously yeah

972

00:36:23,750 --> 00:36:21,599

we're really excited about the hera

973

00:36:26,390 --> 00:36:23,760

mission too so yeah i mean so the

974

00:36:28,390 --> 00:36:26,400

european space agency a going to

975

00:36:30,950 --> 00:36:28,400

rendezvous with the ditto master morpho

976  
00:36:32,470 --> 00:36:30,960  
system with the hera mission in 2026

977  
00:36:34,069 --> 00:36:32,480  
which is going to be great they'll be

978  
00:36:35,430 --> 00:36:34,079  
able to see the crater made by dart

979  
00:36:37,030 --> 00:36:35,440  
they'll be able to get the mass of

980  
00:36:38,710 --> 00:36:37,040  
demorphos and really characterize the

981  
00:36:40,069 --> 00:36:38,720  
system every more so along with all of

982  
00:36:41,829 --> 00:36:40,079  
everything that laurie said to we have

983  
00:36:43,270 --> 00:36:41,839  
to figure out from dart and we're just

984  
00:36:45,510 --> 00:36:43,280  
really working collaboratively with

985  
00:36:47,510 --> 00:36:45,520  
these two teams as is important for

986  
00:36:50,870 --> 00:36:47,520  
planetary defense international issue

987  
00:36:51,750 --> 00:36:50,880  
absolutely okay um so obviously

988  
00:36:55,829 --> 00:36:51,760

uh

989

00:36:57,510 --> 00:36:55,839

in watching out for asteroids on the

990

00:36:59,510 --> 00:36:57,520

collision course with earth origami

991

00:37:02,230 --> 00:36:59,520

masters on twitter wants to know how

992

00:37:04,069 --> 00:37:02,240

often are their asteroid impacts um

993

00:37:06,150 --> 00:37:04,079

with other planets

994

00:37:08,150 --> 00:37:06,160

in our solar system oh

995

00:37:10,630 --> 00:37:08,160

regularly all the time in fact we've

996

00:37:12,310 --> 00:37:10,640

even seen some of them from earth uh

997

00:37:14,550 --> 00:37:12,320

we've actually saw an asteroid for

998

00:37:16,630 --> 00:37:14,560

example that went into jupiter's

999

00:37:19,510 --> 00:37:16,640

atmosphere several years back that was

1000

00:37:22,790 --> 00:37:19,520

kind of cool um on mars where we've been

1001  
00:37:23,670 --> 00:37:22,800  
having spacecraft that orbited mars

1002  
00:37:25,349 --> 00:37:23,680  
for

1003  
00:37:27,670 --> 00:37:25,359  
decades now

1004  
00:37:30,470 --> 00:37:27,680  
we can see new craters all the time that

1005  
00:37:32,550 --> 00:37:30,480  
are being created by asteroids that

1006  
00:37:34,470 --> 00:37:32,560  
impact on mars so we know this is a

1007  
00:37:37,510 --> 00:37:34,480  
process that's happening all over the

1008  
00:37:39,910 --> 00:37:37,520  
solar system at earth objects are

1009  
00:37:42,230 --> 00:37:39,920  
entering earth's atmosphere all the time

1010  
00:37:44,310 --> 00:37:42,240  
very small ones we actually get

1011  
00:37:45,670 --> 00:37:44,320  
reasonable size meteorites that that

1012  
00:37:48,310 --> 00:37:45,680  
fall all the way to the surface and

1013  
00:37:49,750 --> 00:37:48,320

don't burn up for on a regular basis so

1014

00:37:51,589 --> 00:37:49,760

they're they're pretty common out there

1015

00:37:54,710 --> 00:37:51,599

but hopefully you know the ones that are

1016

00:37:57,589 --> 00:37:54,720

the bigger ones are not quite as common

1017

00:37:59,750 --> 00:37:57,599

okay so we uh we have teacher and and

1018

00:38:02,150 --> 00:37:59,760

her students all the way from hawaii

1019

00:38:05,109 --> 00:38:02,160

hawaiian disney mama on youtube asks

1020

00:38:07,750 --> 00:38:05,119

aloha my students want to know if the

1021

00:38:11,510 --> 00:38:07,760

asteroid didn't hit earth back in the

1022

00:38:13,829 --> 00:38:11,520

day and wipe out all the dinosaurs

1023

00:38:15,670 --> 00:38:13,839

would dinosaurs still be alive today

1024

00:38:18,630 --> 00:38:15,680

we're going to test the breadth of yours

1025

00:38:20,710 --> 00:38:18,640

science that is speculation that is a

1026  
00:38:22,390 --> 00:38:20,720  
really hypothetical questions because

1027  
00:38:25,430 --> 00:38:22,400  
there's so many

1028  
00:38:26,710 --> 00:38:25,440  
uh variables at play there

1029  
00:38:29,190 --> 00:38:26,720  
so many different things that have

1030  
00:38:31,030 --> 00:38:29,200  
happened since that time it was quite a

1031  
00:38:32,710 --> 00:38:31,040  
long time ago of course

1032  
00:38:33,750 --> 00:38:32,720  
um fair but you know the one thing we

1033  
00:38:35,670 --> 00:38:33,760  
like to say is that you know the

1034  
00:38:37,349 --> 00:38:35,680  
dinosaurs didn't have the planetary

1035  
00:38:39,190 --> 00:38:37,359  
defense coordination office they didn't

1036  
00:38:40,950 --> 00:38:39,200  
have a planetary defender to help them

1037  
00:38:42,790 --> 00:38:40,960  
save the day so right they didn't know

1038  
00:38:45,270 --> 00:38:42,800

we're here to build the spacecraft to go

1039

00:38:47,030 --> 00:38:45,280

out there that's right and save them all

1040

00:38:48,310 --> 00:38:47,040

okay but thank you and we hope that

1041

00:38:49,190 --> 00:38:48,320

you'll be watching

1042

00:38:51,670 --> 00:38:49,200

okay

1043

00:38:52,950 --> 00:38:51,680

um on to shannon wayne bowman on

1044

00:38:55,829 --> 00:38:52,960

facebook

1045

00:38:57,349 --> 00:38:55,839

will we get to see it crash live and

1046

00:39:00,310 --> 00:38:57,359

would we be able to see it with the

1047

00:39:01,750 --> 00:39:00,320

naked eye by looking up

1048

00:39:04,230 --> 00:39:01,760

so the images are going to come stream

1049

00:39:06,150 --> 00:39:04,240

back from draco once every second and we

1050

00:39:08,390 --> 00:39:06,160

will be sure to get those images back

1051

00:39:10,069 --> 00:39:08,400

before the dart collision

1052

00:39:12,390 --> 00:39:10,079

happens so they'll be sent and on their

1053

00:39:14,230 --> 00:39:12,400

way streaming back every one per second

1054

00:39:15,670 --> 00:39:14,240

and that's going be uh information that

1055

00:39:18,230 --> 00:39:15,680

we'll have here on the earth the lychee

1056

00:39:19,990 --> 00:39:18,240

cube images will get transmitted back um

1057

00:39:21,349 --> 00:39:20,000

a few weeks later and it'll take them a

1058

00:39:22,710 --> 00:39:21,359

little bit longer so they'll capture

1059

00:39:24,710 --> 00:39:22,720

them and store them on board and then

1060

00:39:25,990 --> 00:39:24,720

send them back after the fact um you're

1061

00:39:27,510 --> 00:39:26,000

not really gonna be able to look up and

1062

00:39:29,829 --> 00:39:27,520

see anything with the naked eye again

1063

00:39:31,270 --> 00:39:29,839

this is like a tiny little nudge we're

1064

00:39:33,190 --> 00:39:31,280

changing it so you're not even being

1065

00:39:35,030 --> 00:39:33,200

able to see it on that scale model over

1066

00:39:36,310 --> 00:39:35,040

there so it's uh it's not going to be

1067

00:39:37,750 --> 00:39:36,320

the sort of thing that you can look up

1068

00:39:39,349 --> 00:39:37,760

and see but the images coming back will

1069

00:39:41,109 --> 00:39:39,359

be spectacular and correct me if i'm

1070

00:39:43,829 --> 00:39:41,119

wrong nancy but i believe what the time

1071

00:39:45,750 --> 00:39:43,839

of the impact um and lisa that the the

1072

00:39:48,230 --> 00:39:45,760

uh dynamos and dimorphos will be about

1073

00:39:50,790 --> 00:39:48,240

six and a half million miles away from

1074

00:39:52,790 --> 00:39:50,800

earth so it's a long way away very far

1075

00:39:54,310 --> 00:39:52,800

it's long but it's not as long as a lot

1076

00:39:56,390 --> 00:39:54,320

of things it's actually pretty close in

1077

00:39:57,430 --> 00:39:56,400

the things but

1078

00:39:59,349 --> 00:39:57,440

you won't be able to see it you need

1079

00:40:00,790 --> 00:39:59,359

some powerful telescopes to even be able

1080

00:40:01,589 --> 00:40:00,800

to see how the brightness changes with

1081

00:40:03,270 --> 00:40:01,599

time

1082

00:40:04,790 --> 00:40:03,280

okay okay so this is not something that

1083

00:40:07,190 --> 00:40:04,800

the home astronomer is going to be able

1084

00:40:09,750 --> 00:40:07,200

to to point their their telescope at and

1085

00:40:10,630 --> 00:40:09,760

find in the night sky no no that's not

1086

00:40:12,390 --> 00:40:10,640

the plan

1087

00:40:15,829 --> 00:40:12,400

we've got plenty of other stuff we'll

1088

00:40:17,430 --> 00:40:15,839

tell you just stay tuned okay um now for

1089

00:40:19,829 --> 00:40:17,440

those of you who are just joining us

1090

00:40:22,550 --> 00:40:19,839

again get your questions in use the

1091

00:40:25,030 --> 00:40:22,560

hashtag ask nasa you can also pop stuff

1092

00:40:27,750 --> 00:40:25,040

right in the stream in the chat wherever

1093

00:40:30,950 --> 00:40:27,760

you are watching and because some folks

1094

00:40:32,790 --> 00:40:30,960

are just tuning in um we are getting a

1095

00:40:35,190 --> 00:40:32,800

lot of some of the questions that you've

1096

00:40:37,670 --> 00:40:35,200

handled uh one that i think we have got

1097

00:40:40,870 --> 00:40:37,680

like a a public responsibility to touch

1098

00:40:45,510 --> 00:40:43,430

donna donna we hear you donna k bradshaw

1099

00:40:46,950 --> 00:40:45,520

on facebook wants to know

1100

00:40:49,270 --> 00:40:46,960

what if

1101

00:40:51,829 --> 00:40:49,280

this puts the asteroid in a chaotic

1102

00:40:54,470 --> 00:40:51,839

rotation that causes a horrible chain

1103

00:40:56,550 --> 00:40:54,480

reaction and it becomes a threat to

1104

00:40:58,710 --> 00:40:56,560

earth lori sure

1105

00:41:00,390 --> 00:40:58,720

yeah and again i'm happy to answer this

1106

00:41:01,589 --> 00:41:00,400

question as many times as you ask it

1107

00:41:02,630 --> 00:41:01,599

because it's really an important

1108

00:41:06,390 --> 00:41:02,640

question

1109

00:41:08,790 --> 00:41:06,400

and we really we chose this particular

1110

00:41:10,230 --> 00:41:08,800

double asteroid system this binary

1111

00:41:12,550 --> 00:41:10,240

asteroid system

1112

00:41:15,829 --> 00:41:12,560

precisely because it does not pose a

1113

00:41:18,309 --> 00:41:15,839

threat there is zero risk of that kind

1114

00:41:19,750 --> 00:41:18,319

of unintended consequence

1115

00:41:27,430 --> 00:41:19,760

the

1116

00:41:29,829 --> 00:41:27,440

very very tiny thank you yes we'll

1117

00:41:32,069 --> 00:41:29,839

impact here but that little impact is

1118

00:41:34,790 --> 00:41:32,079

really not going to change at all it has

1119

00:41:36,790 --> 00:41:34,800

no chance of changing the overall

1120

00:41:40,309 --> 00:41:36,800

system of how fast the overall system is

1121

00:41:42,069 --> 00:41:40,319

going or its path so nothing will change

1122

00:41:44,069 --> 00:41:42,079

in the whole dittimos system it's going

1123

00:41:46,390 --> 00:41:44,079

to stay exactly on the same trajectory

1124

00:41:48,069 --> 00:41:46,400

where it is now which is of no threat to

1125

00:41:49,030 --> 00:41:48,079

earth it's not coming anywhere near

1126

00:41:50,870 --> 00:41:49,040

earth

1127

00:41:52,470 --> 00:41:50,880

any time in

1128

00:41:53,750 --> 00:41:52,480

you know at least 100 years and probably

1129

00:41:56,710 --> 00:41:53,760

longer than that

1130

00:41:59,430 --> 00:41:56,720

so okay so rest easy

1131

00:42:00,950 --> 00:41:59,440

and enjoy the show too right this is

1132

00:42:03,990 --> 00:42:00,960

this is exciting

1133

00:42:06,390 --> 00:42:04,000

um chris bettencourt on facebook wants

1134

00:42:09,190 --> 00:42:06,400

to know what kind of systems do we have

1135

00:42:10,790 --> 00:42:09,200

in place to to monitor potentially

1136

00:42:13,190 --> 00:42:10,800

dangerous asteroids we've talked about

1137

00:42:15,030 --> 00:42:13,200

the ones that we know how are we keeping

1138

00:42:18,069 --> 00:42:15,040

our eyes on the skies

1139

00:42:20,150 --> 00:42:18,079

yeah it's a great question and we have

1140

00:42:22,150 --> 00:42:20,160

many ground-based telescopes that are

1141

00:42:24,950 --> 00:42:22,160

searching the night skies every single

1142

00:42:27,270 --> 00:42:24,960

night looking for potentially hazardous

1143

00:42:31,670 --> 00:42:27,280

asteroids and comets

1144

00:42:33,109 --> 00:42:31,680

and we also have a space-based telescope

1145

00:42:36,309 --> 00:42:33,119

which i think i mentioned earlier called

1146

00:42:38,950 --> 00:42:36,319

neo wise which is an old astrophysics

1147

00:42:41,030 --> 00:42:38,960

telescope that we we took over for

1148

00:42:44,470 --> 00:42:41,040

planetary defense purposes

1149

00:42:46,470 --> 00:42:44,480

it also is out looking uh for uh looking

1150

00:42:47,349 --> 00:42:46,480

for asteroids but also characterizing

1151

00:42:48,630 --> 00:42:47,359

them

1152

00:42:50,630 --> 00:42:48,640

and then we have this new mission the

1153

00:42:52,790 --> 00:42:50,640

neo surveyor near earth object surveyor

1154

00:42:55,109 --> 00:42:52,800

mission which we hope to launch um

1155

00:42:57,510 --> 00:42:55,119

perhaps in the next five years or so

1156

00:42:59,910 --> 00:42:57,520

that will be dedicated to searching for

1157

00:43:02,150 --> 00:42:59,920

those new asteroids and you do work in

1158

00:43:04,230 --> 00:43:02,160

conjunction with the amateur astronomy

1159

00:43:06,069 --> 00:43:04,240

community right good point yes we work

1160

00:43:09,190 --> 00:43:06,079

with the amateur astronomy community and

1161

00:43:10,790 --> 00:43:09,200

it's a global network right this is

1162

00:43:13,349 --> 00:43:10,800

planetary defense is not something

1163

00:43:15,030 --> 00:43:13,359

that's unique to united states

1164

00:43:17,349 --> 00:43:15,040

or any particular country this is a

1165

00:43:19,670 --> 00:43:17,359

global issue and

1166

00:43:22,150 --> 00:43:19,680

there are many space agencies and others

1167

00:43:24,150 --> 00:43:22,160

around the world that all work together

1168

00:43:25,910 --> 00:43:24,160

to coordinate the observations someone

1169

00:43:27,829 --> 00:43:25,920

detects an asteroid and they send the

1170

00:43:29,670 --> 00:43:27,839

signal out to everybody that says hey i

1171

00:43:31,829 --> 00:43:29,680

found this asteroid and everybody points

1172

00:43:34,470 --> 00:43:31,839

their telescope and says let me follow

1173

00:43:37,430 --> 00:43:34,480

up so we can better constrain just where

1174

00:43:39,030 --> 00:43:37,440

that asteroid what its orbit is and and

1175

00:43:41,670 --> 00:43:39,040

where it is and what uh what it looks

1176

00:43:43,910 --> 00:43:41,680

like and characterize it its size um so

1177

00:43:46,550 --> 00:43:43,920

it's it is really an international

1178

00:43:48,390 --> 00:43:46,560

collaboration and as a follow-up to that

1179

00:43:50,470 --> 00:43:48,400

uh mark new on facebook wants to know

1180

00:43:53,030 --> 00:43:50,480

what are the benefits of global

1181

00:43:55,190 --> 00:43:53,040

creativity and global cooperation in

1182

00:43:57,430 --> 00:43:55,200

such an important mission

1183

00:44:00,150 --> 00:43:57,440

well i think the the global cooperation

1184

00:44:03,190 --> 00:44:00,160

is absolutely critical um if if there

1185

00:44:04,550 --> 00:44:03,200

ever were actually a real threat we are

1186

00:44:06,470 --> 00:44:04,560

all going to have to come together as a

1187

00:44:07,190 --> 00:44:06,480

global community

1188

00:44:17,670 --> 00:44:07,200

to

1189

00:44:19,910 --> 00:44:17,680

help protect ourselves from a potential

1190

00:44:22,710 --> 00:44:19,920

threat um so it is ab this is an

1191

00:44:25,990 --> 00:44:22,720

absolutely critical um international

1192

00:44:27,829 --> 00:44:26,000

cooperation and lenin on youtube um

1193

00:44:30,230 --> 00:44:27,839

wants to know is there any other country

1194

00:44:33,109 --> 00:44:30,240

openly working on planetary defense or

1195

00:44:34,870 --> 00:44:33,119

is it just nasa no they're i think nancy

1196

00:44:36,790 --> 00:44:34,880

just mentioned a couple minutes ago the

1197

00:44:38,870 --> 00:44:36,800

hera mission that's being built by the

1198

00:44:40,950 --> 00:44:38,880

european space agency i mean we've got

1199

00:44:43,030 --> 00:44:40,960

lithium cube right so the italian space

1200

00:44:45,589 --> 00:44:43,040

agency already actively contributed

1201  
00:44:48,550 --> 00:44:45,599  
we're already here from the european

1202  
00:44:50,470 --> 00:44:48,560  
space agency and so it really is uh

1203  
00:44:51,910 --> 00:44:50,480  
people around the world and agencies

1204  
00:44:53,589 --> 00:44:51,920  
around the world working together

1205  
00:44:55,030 --> 00:44:53,599  
cooperatively for this i mean the

1206  
00:44:56,470 --> 00:44:55,040  
database that you're referring to is all

1207  
00:44:57,910 --> 00:44:56,480  
publicly available right i mean you put

1208  
00:45:00,550 --> 00:44:57,920  
it all into the same database it's

1209  
00:45:02,309 --> 00:45:00,560  
constantly monitored updated real time

1210  
00:45:04,630 --> 00:45:02,319  
and you know you can go check it out at

1211  
00:45:07,670 --> 00:45:04,640  
the nasa website yeah

1212  
00:45:10,230 --> 00:45:07,680  
so to get a sense of scope

1213  
00:45:12,390 --> 00:45:10,240

how many people have been involved in

1214

00:45:14,150 --> 00:45:12,400

this mission maybe we can kind of tote

1215

00:45:16,309 --> 00:45:14,160

it up from from the different parts of

1216

00:45:19,270 --> 00:45:16,319

nasa even just represented by the three

1217

00:45:21,430 --> 00:45:19,280

of you i'll pass it over to you guys

1218

00:45:24,390 --> 00:45:21,440

let's see what's the size of your uh

1219

00:45:26,790 --> 00:45:24,400

your team there my engineering team so

1220

00:45:28,950 --> 00:45:26,800

mechanical engineering we have about

1221

00:45:31,349 --> 00:45:28,960

let's say like a handful 10

1222

00:45:33,990 --> 00:45:31,359

but like there's so many people we have

1223

00:45:36,069 --> 00:45:34,000

our int folks our electrical folks we

1224

00:45:38,150 --> 00:45:36,079

have people who make our blankets former

1225

00:45:41,030 --> 00:45:38,160

seamstresses we have our truck drivers

1226  
00:45:43,670 --> 00:45:41,040  
who have to drive this spacecraft across

1227  
00:45:46,309 --> 00:45:43,680  
the country like there's a lot of people

1228  
00:45:48,550 --> 00:45:46,319  
and i also want to know that like we're

1229  
00:45:51,109 --> 00:45:48,560  
i've been working with like roughly 50

1230  
00:45:53,829 --> 00:45:51,119  
women and that is so rare in

1231  
00:45:56,470 --> 00:45:53,839  
an engineering field so i'm so thankful

1232  
00:45:58,470 --> 00:45:56,480  
to be working on a project where i have

1233  
00:46:00,790 --> 00:45:58,480  
so many role models

1234  
00:46:02,950 --> 00:46:00,800  
it's super cool great and yeah but

1235  
00:46:04,630 --> 00:46:02,960  
definitely the team if you have to do it

1236  
00:46:05,990 --> 00:46:04,640  
you should guess in the thousands right

1237  
00:46:07,510 --> 00:46:06,000  
i mean hundreds is too loud once you get

1238  
00:46:09,430 --> 00:46:07,520

to the other day i mean you know i mean

1239

00:46:10,950 --> 00:46:09,440

like like creating the dart logo right

1240

00:46:12,870 --> 00:46:10,960

what you were talking about so cool i

1241

00:46:14,870 --> 00:46:12,880

mean it's just uh ghost takes people we

1242

00:46:16,950 --> 00:46:14,880

have a i mean we have apl right and then

1243

00:46:18,870 --> 00:46:16,960

there's nasa we have scientists across

1244

00:46:21,430 --> 00:46:18,880

the country we have scientists actually

1245

00:46:22,950 --> 00:46:21,440

around the world on this team um and you

1246

00:46:24,950 --> 00:46:22,960

know we have a lot of different partners

1247

00:46:26,790 --> 00:46:24,960

and really uh thousands is going to be

1248

00:46:30,630 --> 00:46:26,800

the right order of magnitude

1249

00:46:32,950 --> 00:46:30,640

to get there okay okay so uh earlier

1250

00:46:36,470 --> 00:46:32,960

lisa you talked a little bit about some

1251

00:46:37,430 --> 00:46:36,480

of the technologies that are on dart

1252

00:46:40,150 --> 00:46:37,440

um

1253

00:46:42,550 --> 00:46:40,160

just you know tween us on the internet

1254

00:46:45,670 --> 00:46:42,560

uh natocha on youtube wants to know does

1255

00:46:48,630 --> 00:46:45,680

dart carry any explosive devices

1256

00:46:50,950 --> 00:46:48,640

no i did not put any explosive devices

1257

00:46:52,710 --> 00:46:50,960

on the spacecraft and lisa would know i

1258

00:46:54,870 --> 00:46:52,720

was one of the last people to see this

1259

00:46:56,150 --> 00:46:54,880

facebook i was one of the last people to

1260

00:46:59,109 --> 00:46:56,160

see the spacecraft before we

1261

00:47:01,990 --> 00:46:59,119

encapsulated i know this thing inside

1262

00:47:05,589 --> 00:47:02,000

out so no explosives

1263

00:47:07,990 --> 00:47:05,599

fantastic okay on to facebook marcel on

1264

00:47:10,309 --> 00:47:08,000

facebook asks why crash the spacecraft

1265

00:47:13,030 --> 00:47:10,319

and not try a soft landing and then use

1266

00:47:14,230 --> 00:47:13,040

the engine of the spacecraft to push the

1267

00:47:16,150 --> 00:47:14,240

asteroid

1268

00:47:16,790 --> 00:47:16,160

goes back to momentum transfer doesn't

1269

00:47:18,470 --> 00:47:16,800

it

1270

00:47:21,190 --> 00:47:18,480

yeah do you want to

1271

00:47:24,230 --> 00:47:21,200

you know we are hitting this asteroid

1272

00:47:27,190 --> 00:47:24,240

really really fast the amount of thrust

1273

00:47:30,470 --> 00:47:27,200

you will need if we per say like landed

1274

00:47:33,829 --> 00:47:30,480

on the asteroid and try to like push

1275

00:47:36,069 --> 00:47:33,839

ourselves it's way way like a lot it's

1276

00:47:38,470 --> 00:47:36,079

much easier just to use the momentum or

1277

00:47:39,270 --> 00:47:38,480

we already have fifteen 000 miles per

1278

00:47:41,109 --> 00:47:39,280

hour

1279

00:47:42,390 --> 00:47:41,119

to hit the asteroid

1280

00:47:43,990 --> 00:47:42,400

yeah but i think lori's point is good

1281

00:47:46,309 --> 00:47:44,000

too right i mean that this is just one

1282

00:47:48,390 --> 00:47:46,319

technology it's the most mature it's the

1283

00:47:49,750 --> 00:47:48,400

one that's ready to test now

1284

00:47:51,190 --> 00:47:49,760

maybe in the future we'll want to have

1285

00:47:52,710 --> 00:47:51,200

other tools in our toolkit and people

1286

00:47:54,710 --> 00:47:52,720

have talked about the idea engines

1287

00:47:56,150 --> 00:47:54,720

specifically the ion engines but you

1288

00:47:57,750 --> 00:47:56,160

have to have it burn for a really long

1289

00:47:59,430 --> 00:47:57,760

time yeah right i mean as compared to

1290

00:48:00,790 --> 00:47:59,440

like this instantaneous event it would

1291

00:48:02,230 --> 00:48:00,800

be you would have to operate the

1292

00:48:03,829 --> 00:48:02,240

spacecraft and that's challenging in its

1293

00:48:06,309 --> 00:48:03,839

own right right you know to have that

1294

00:48:07,349 --> 00:48:06,319

sort of fidelity and asteroids are not

1295

00:48:08,390 --> 00:48:07,359

round

1296

00:48:10,069 --> 00:48:08,400

you know they have all sorts of

1297

00:48:12,069 --> 00:48:10,079

complications with them and landing is

1298

00:48:13,990 --> 00:48:12,079

its own complications so but dart really

1299

00:48:16,230 --> 00:48:14,000

is just the start it's just the first

1300

00:48:17,990 --> 00:48:16,240

test of one technique that you might use

1301  
00:48:19,829 --> 00:48:18,000  
and it'll be interesting to see what

1302  
00:48:21,829 --> 00:48:19,839  
else we might develop in the future and

1303  
00:48:23,430 --> 00:48:21,839  
you gotta walk before you run right it

1304  
00:48:25,990 --> 00:48:23,440  
is a technical challenge in and of

1305  
00:48:27,030 --> 00:48:26,000  
itself just to make contact

1306  
00:48:28,309 --> 00:48:27,040  
with this

1307  
00:48:31,030 --> 00:48:28,319  
okay

1308  
00:48:33,510 --> 00:48:31,040  
so uh lori and that is another sort of

1309  
00:48:35,510 --> 00:48:33,520  
between us questions boo

1310  
00:48:36,870 --> 00:48:35,520  
on facebook who's watching from canada's

1311  
00:48:39,510 --> 00:48:36,880  
east coast

1312  
00:48:41,030 --> 00:48:39,520  
wants to know if an asteroid was headed

1313  
00:48:42,790 --> 00:48:41,040

straight for earth

1314

00:48:44,390 --> 00:48:42,800

would you inform the public

1315

00:48:46,069 --> 00:48:44,400

absolutely

1316

00:48:48,790 --> 00:48:46,079

also i don't even have to think about

1317

00:48:50,790 --> 00:48:48,800

that when we have um before you get to

1318

00:48:55,109 --> 00:48:50,800

the rest of the question yeah yeah um we

1319

00:48:57,109 --> 00:48:55,119

actually have um not just a uh

1320

00:48:59,349 --> 00:48:57,119

a group that is collaborating and

1321

00:49:00,790 --> 00:48:59,359

cooperating amongst uh multiple federal

1322

00:49:02,390 --> 00:49:00,800

agencies in the united states but

1323

00:49:04,790 --> 00:49:02,400

working with other agencies around the

1324

00:49:06,710 --> 00:49:04,800

world we meet regularly there are

1325

00:49:09,030 --> 00:49:06,720

conferences every year to bring all of

1326

00:49:11,030 --> 00:49:09,040

these various entities together and talk

1327

00:49:12,870 --> 00:49:11,040

about what are we going to do and how

1328

00:49:15,430 --> 00:49:12,880

are we going to communicate this if we

1329

00:49:16,790 --> 00:49:15,440

ever had a potential threat so

1330

00:49:19,190 --> 00:49:16,800

absolutely

1331

00:49:20,950 --> 00:49:19,200

the the public would be told we would

1332

00:49:22,790 --> 00:49:20,960

provide the best information that we

1333

00:49:25,109 --> 00:49:22,800

have available and we would start

1334

00:49:27,270 --> 00:49:25,119

developing uh what the mitigation plans

1335

00:49:29,270 --> 00:49:27,280

are and um

1336

00:49:31,430 --> 00:49:29,280

also any kind of protection plans that

1337

00:49:33,270 --> 00:49:31,440

we need for people so there's there's no

1338

00:49:35,750 --> 00:49:33,280

doubt

1339

00:49:38,470 --> 00:49:35,760

and also we couldn't hide it

1340

00:49:40,549 --> 00:49:38,480

no no you can't like any you look up

1341

00:49:41,910 --> 00:49:40,559

those amateur astronomers that we depend

1342

00:49:44,710 --> 00:49:41,920

on so much to help give us more

1343

00:49:47,430 --> 00:49:44,720

observations everyone would see it as as

1344

00:49:49,510 --> 00:49:47,440

nancy said when we look at these data

1345

00:49:51,270 --> 00:49:49,520

and we calculate the trajectories and

1346

00:49:55,109 --> 00:49:51,280

their orbits this is in a public

1347

00:49:56,230 --> 00:49:55,119

database anybody has access to that so

1348

00:49:57,910 --> 00:49:56,240

there's as soon as an asteroid's

1349

00:49:59,990 --> 00:49:57,920

discovered you can know about it too

1350

00:50:02,230 --> 00:50:00,000

right i mean it's out there so maybe you

1351  
00:50:04,390 --> 00:50:02,240  
took the planetary defender quiz it wet

1352  
00:50:06,630 --> 00:50:04,400  
your appetite and then you want to join

1353  
00:50:07,510 --> 00:50:06,640  
us we'd be happy to have you you bet

1354  
00:50:11,270 --> 00:50:07,520  
okay

1355  
00:50:13,190 --> 00:50:11,280  
so uh nancy um are you know talking

1356  
00:50:14,390 --> 00:50:13,200  
about our our little asteroid here our

1357  
00:50:17,109 --> 00:50:14,400  
little

1358  
00:50:18,790 --> 00:50:17,119  
football stadium full of rocks uh james

1359  
00:50:21,430 --> 00:50:18,800  
taylor on youtube wants to know do you

1360  
00:50:23,910 --> 00:50:21,440  
know the composition of these two

1361  
00:50:25,990 --> 00:50:23,920  
asteroids especially the one targeted

1362  
00:50:28,230 --> 00:50:26,000  
for impact yeah that's a great question

1363  
00:50:29,990 --> 00:50:28,240

so what we do know from ground-based

1364

00:50:33,109 --> 00:50:30,000

observations again is the larger one

1365

00:50:34,790 --> 00:50:33,119

dynamos is a s-type asteroid it's a

1366

00:50:36,150 --> 00:50:34,800

ordinary chondrite type meteorite

1367

00:50:37,829 --> 00:50:36,160

material this is actually the most

1368

00:50:39,270 --> 00:50:37,839

common type of material that falls to

1369

00:50:40,950 --> 00:50:39,280

the earth

1370

00:50:42,950 --> 00:50:40,960

we haven't actually directly measured

1371

00:50:44,710 --> 00:50:42,960

demorphos but the way that we think that

1372

00:50:46,230 --> 00:50:44,720

binary asteroids form these double

1373

00:50:48,870 --> 00:50:46,240

asteroids form it's going to have a

1374

00:50:50,470 --> 00:50:48,880

similar composition to the main one so a

1375

00:50:52,710 --> 00:50:50,480

good likelihood that it's going to be

1376  
00:50:54,870 --> 00:50:52,720  
made of this ordinary chondrite material

1377  
00:50:57,270 --> 00:50:54,880  
which ordinary chondrites are mixtures

1378  
00:50:59,430 --> 00:50:57,280  
of rock and metal mixed together they're

1379  
00:51:01,349 --> 00:50:59,440  
4.5 billion years old they predate the

1380  
00:51:02,790 --> 00:51:01,359  
planets they're fascinating just from

1381  
00:51:03,990 --> 00:51:02,800  
the science that you get from them as

1382  
00:51:05,349 --> 00:51:04,000  
well but it also makes it really

1383  
00:51:06,950 --> 00:51:05,359  
relevant because it's the most common

1384  
00:51:08,870 --> 00:51:06,960  
type of thing to hit the earth so that

1385  
00:51:12,069 --> 00:51:08,880  
makes this a great test and a very

1386  
00:51:14,790 --> 00:51:12,079  
appropriate test for this for dart

1387  
00:51:15,829 --> 00:51:14,800  
okay so jay has a very practical

1388  
00:51:18,230 --> 00:51:15,839

question

1389

00:51:20,309 --> 00:51:18,240

um on facebook for someone who's

1390

00:51:22,790 --> 00:51:20,319

interested in entering

1391

00:51:25,510 --> 00:51:22,800

a field like the three of yours science

1392

00:51:26,630 --> 00:51:25,520

or engineering what basic courses do you

1393

00:51:29,750 --> 00:51:26,640

suggest

1394

00:51:31,829 --> 00:51:29,760

um you know to set you up for a career

1395

00:51:33,510 --> 00:51:31,839

involved with the nasa mission that's a

1396

00:51:36,390 --> 00:51:33,520

great question i'll give some of mine

1397

00:51:38,790 --> 00:51:36,400

and then we can all jump in here um

1398

00:51:41,349 --> 00:51:38,800

for me i got started doing uh math and

1399

00:51:43,990 --> 00:51:41,359

physics um and i think that's probably

1400

00:51:45,270 --> 00:51:44,000

fundamental for a lot of things but uh

1401

00:51:48,630 --> 00:51:45,280

i would definitely

1402

00:51:50,950 --> 00:51:48,640

encourage math and physics for sure yeah

1403

00:51:52,390 --> 00:51:50,960

same i love math and physics that's

1404

00:51:54,630 --> 00:51:52,400

something i really enjoyed in high

1405

00:51:56,470 --> 00:51:54,640

school so i decided to keep going with

1406

00:51:59,349 --> 00:51:56,480

it engineering sounded cool you're

1407

00:52:01,750 --> 00:51:59,359

solving problems building things so

1408

00:52:03,990 --> 00:52:01,760

that's what i went with

1409

00:52:06,230 --> 00:52:04,000

yeah i have a phd in planetary science i

1410

00:52:08,230 --> 00:52:06,240

was just fascinated by planets i i blame

1411

00:52:10,390 --> 00:52:08,240

star wars which i love from an early

1412

00:52:12,230 --> 00:52:10,400

early age but i guess also one thing i

1413

00:52:13,910 --> 00:52:12,240

want to stress is that you should do

1414

00:52:16,069 --> 00:52:13,920

what you're passionate about and that it

1415

00:52:18,390 --> 00:52:16,079

really does take all types to do this

1416

00:52:19,750 --> 00:52:18,400

nasa missions i mean if you could look

1417

00:52:21,349 --> 00:52:19,760

around where i am right now you would

1418

00:52:23,349 --> 00:52:21,359

see people with lots of different skills

1419

00:52:25,270 --> 00:52:23,359

and i mean communicating is an important

1420

00:52:27,109 --> 00:52:25,280

part of this as well if somebody had

1421

00:52:29,670 --> 00:52:27,119

told me when i was 17 years old that

1422

00:52:31,589 --> 00:52:29,680

science communication was a job i would

1423

00:52:33,750 --> 00:52:31,599

not have taken the sort of circuitous

1424

00:52:36,069 --> 00:52:33,760

path that i did i'm glad that i did

1425

00:52:37,750 --> 00:52:36,079

though because a lot of different skills

1426

00:52:40,630 --> 00:52:37,760

go into this and when i was in school

1427

00:52:42,150 --> 00:52:40,640

social media wasn't even a field right

1428

00:52:43,750 --> 00:52:42,160

well nancy makes a great point it's

1429

00:52:45,510 --> 00:52:43,760

something when i give public talks

1430

00:52:47,510 --> 00:52:45,520

especially to kids

1431

00:52:49,349 --> 00:52:47,520

try to always emphasize that you know

1432

00:52:51,270 --> 00:52:49,359

people say i want to work for nasa but

1433

00:52:52,470 --> 00:52:51,280

i'm not good at math or science or i

1434

00:52:54,309 --> 00:52:52,480

don't want to be a scientist or an

1435

00:52:57,589 --> 00:52:54,319

engineer so well we have

1436

00:52:59,349 --> 00:52:57,599

lawyers we have financial people that do

1437

00:53:02,549 --> 00:52:59,359

our budgets we have communications

1438

00:53:05,190 --> 00:53:02,559

people we have artists we have animators

1439

00:53:07,430 --> 00:53:05,200

um we have policy people that help us

1440

00:53:09,829 --> 00:53:07,440

deal and work with congress you know we

1441

00:53:11,589 --> 00:53:09,839

have so many different skills that are

1442

00:53:13,910 --> 00:53:11,599

really required and we can't do a

1443

00:53:15,589 --> 00:53:13,920

mission like dart or any of our missions

1444

00:53:17,349 --> 00:53:15,599

without all of those skill sets so

1445

00:53:18,470 --> 00:53:17,359

you're absolutely right yeah i mean and

1446

00:53:19,750 --> 00:53:18,480

if you think about planetary defense

1447

00:53:21,030 --> 00:53:19,760

like everything we were talking about

1448

00:53:23,030 --> 00:53:21,040

right i mean this has a lot of

1449

00:53:24,790 --> 00:53:23,040

implications beyond just you know the

1450

00:53:25,990 --> 00:53:24,800

science and the engineering to make it

1451  
00:53:27,270 --> 00:53:26,000  
come together and then what that is

1452  
00:53:28,309 --> 00:53:27,280  
going forward and

1453  
00:53:29,910 --> 00:53:28,319  
i think that's one of the things i

1454  
00:53:31,670 --> 00:53:29,920  
really love about working at apl and on

1455  
00:53:33,109 --> 00:53:31,680  
missions and with nasa missions and this

1456  
00:53:34,870 --> 00:53:33,119  
sort of thing just so many different

1457  
00:53:36,069 --> 00:53:34,880  
people coming together with a common

1458  
00:53:38,309 --> 00:53:36,079  
goal

1459  
00:53:41,109 --> 00:53:38,319  
okay well you are all smiles and i've

1460  
00:53:44,150 --> 00:53:41,119  
got the warm fuzzies about collaboration

1461  
00:53:46,790 --> 00:53:44,160  
and the village coming together um this

1462  
00:53:49,589 --> 00:53:46,800  
could be our final question

1463  
00:53:52,549 --> 00:53:49,599

kivo bologne on youtube wants to know

1464

00:53:54,710 --> 00:53:52,559

what's been everyone's favorite moment

1465

00:53:57,910 --> 00:53:54,720

or part of the work that you have done

1466

00:54:01,349 --> 00:53:59,430

i think my favorite moment is going to

1467

00:54:04,710 --> 00:54:01,359

happen tonight

1468

00:54:09,030 --> 00:54:07,270

so i'm going to go with that i'm uh

1469

00:54:10,790 --> 00:54:09,040

i'm really i'm just so looking forward

1470

00:54:13,510 --> 00:54:10,800

to the launch tonight

1471

00:54:16,390 --> 00:54:13,520

yeah so one of my favorite moments was i

1472

00:54:20,069 --> 00:54:16,400

mean i was with this spacecraft from its

1473

00:54:22,069 --> 00:54:20,079

youth until its adulthood um and part of

1474

00:54:24,790 --> 00:54:22,079

integration and testing was

1475

00:54:26,790 --> 00:54:24,800

testing it so after this was a bare

1476

00:54:29,349 --> 00:54:26,800

structure we put it all together and

1477

00:54:31,750 --> 00:54:29,359

then we put it on a vibration table and

1478

00:54:34,309 --> 00:54:31,760

seeing that spacecraft shaking on a

1479

00:54:35,910 --> 00:54:34,319

vibration table it was crazy i thought

1480

00:54:38,150 --> 00:54:35,920

we were gonna break it but of course

1481

00:54:39,910 --> 00:54:38,160

analysis we did not break it and it

1482

00:54:42,150 --> 00:54:39,920

survived which means it will survive

1483

00:54:43,589 --> 00:54:42,160

launch loads so like that was really

1484

00:54:45,589 --> 00:54:43,599

cool to like go through the whole

1485

00:54:47,750 --> 00:54:45,599

testing process and just see the

1486

00:54:49,750 --> 00:54:47,760

spacecraft grow up

1487

00:54:51,910 --> 00:54:49,760

that's so cool there's been a lot of

1488

00:54:54,150 --> 00:54:51,920

amazing moments so far but i am going to

1489

00:54:56,549 --> 00:54:54,160

say that my favorite moment is still to

1490

00:54:58,950 --> 00:54:56,559

come for sure so i'm looking forward to

1491

00:55:01,829 --> 00:54:58,960

start getting off the planet and going

1492

00:55:04,789 --> 00:55:01,839

over to de bourfos all right well i know

1493

00:55:07,270 --> 00:55:04,799

that you are all very busy and everyone

1494

00:55:09,750 --> 00:55:07,280

here myself included is all a twitter

1495

00:55:13,510 --> 00:55:09,760

about this launch tonight so thank you

1496

00:55:14,710 --> 00:55:13,520

so much lori lisa nancy will it and to

1497

00:55:17,589 --> 00:55:14,720

all of you

1498

00:55:20,470 --> 00:55:17,599

thank you for joining us this show nasa

1499

00:55:21,990 --> 00:55:20,480

science live is nothing without you you

1500

00:55:24,150 --> 00:55:22,000

are part of the conversation and we're

1501  
00:55:27,270 --> 00:55:24,160  
so so happy to have you

1502  
00:55:31,030 --> 00:55:27,280  
so thank you and know that you can learn

1503  
00:55:32,390 --> 00:55:31,040  
more about dart by visiting [nasa.gov](http://nasa.gov)

1504  
00:55:34,069 --> 00:55:32,400  
dart mission

1505  
00:55:35,990 --> 00:55:34,079  
and join the conversation on twitter and

1506  
00:55:37,510 --> 00:55:36,000  
instagram by using

1507  
00:55:40,069 --> 00:55:37,520  
dart mission

1508  
00:55:42,309 --> 00:55:40,079  
launch is literally hours away and we do

1509  
00:55:44,950 --> 00:55:42,319  
not want you to miss it so you can set

1510  
00:55:47,910 --> 00:55:44,960  
your reminders set your alarms and know

1511  
00:55:50,789 --> 00:55:47,920  
we're streaming live on [nasa.gov](http://nasa.gov) live

1512  
00:55:53,030 --> 00:55:50,799  
nasa television the nasa app youtube

1513  
00:55:54,870 --> 00:55:53,040

facebook twitch dailymotion twitter

1514

00:55:56,789 --> 00:55:54,880

wherever you get your socials we're

1515

00:55:57,829 --> 00:55:56,799

going to be there and we want to hear

1516

00:56:00,789 --> 00:55:57,839

from you

1517

00:56:03,670 --> 00:56:00,799

dart is set to lift off at from

1518

00:56:07,910 --> 00:56:03,680

vandenberg space force base at exactly

1519

00:56:10,950 --> 00:56:07,920

10 21 p.m pacific time because if we

1520

00:56:13,270 --> 00:56:10,960

it's an instantaneous launch window so

1521

00:56:17,190 --> 00:56:13,280

we we launch tonight at that second or

1522

00:56:19,430 --> 00:56:17,200

we try again tomorrow or the next day

1523

00:56:22,069 --> 00:56:19,440

we hope that you'll be watching wherever

1524

00:56:30,490 --> 00:56:22,079

you are thanks for making some space for