



1
00:00:08,950 --> 00:00:07,030
hi welcome to the international space

2
00:00:11,749 --> 00:00:08,960
station flight control room we are here

3
00:00:14,629 --> 00:00:11,759
for a distance or digital learning

4
00:00:16,390 --> 00:00:14,639
network event and uh with us we're

5
00:00:19,670 --> 00:00:16,400
talking with the middle middle school

6
00:00:21,750 --> 00:00:19,680
kids at lanier middle school in buford

7
00:00:22,870 --> 00:00:21,760
georgia so today we have a special guest

8
00:00:25,509 --> 00:00:22,880
for you guys because i understand you

9
00:00:27,269 --> 00:00:25,519
guys have been studying about earth and

10
00:00:30,070 --> 00:00:27,279
earth science and it's a good time

11
00:00:31,830 --> 00:00:30,080
because this is earth month here at nasa

12
00:00:33,830 --> 00:00:31,840
um so here with us today we have will

13
00:00:35,750 --> 00:00:33,840

stephanov he is the chief earth

14

00:00:37,190 --> 00:00:35,760

scientist here at the nasa johnson space

15

00:00:39,030 --> 00:00:37,200

center welcome well and thank you for

16

00:00:41,190 --> 00:00:39,040

coming

17

00:00:48,389 --> 00:00:41,200

thank you so guys we're ready to take

18

00:00:52,950 --> 00:00:50,389

um how can you see the difference

19

00:00:55,350 --> 00:00:52,960

between the past and the future and the

20

00:00:58,790 --> 00:00:55,360

present and what shows the plate to

21

00:01:00,310 --> 00:00:58,800

tectonics and the satellites

22

00:01:03,590 --> 00:01:00,320

that's an excellent question

23

00:01:05,509 --> 00:01:03,600

sorry to get myself arranged here

24

00:01:07,590 --> 00:01:05,519

that's an excellent question

25

00:01:09,750 --> 00:01:07,600

the the way that you look at changes in

26

00:01:11,990 --> 00:01:09,760

time with satellite data is you collect

27

00:01:13,750 --> 00:01:12,000

lots and lots of images over a long

28

00:01:15,270 --> 00:01:13,760

period of time

29

00:01:17,429 --> 00:01:15,280

the a good example of this is the

30

00:01:19,830 --> 00:01:17,439

landsat satellite series which has been

31

00:01:21,109 --> 00:01:19,840

collecting data since 1972

32

00:01:23,270 --> 00:01:21,119

so when you have all these scenes you

33

00:01:25,510 --> 00:01:23,280

can line them up and just look at them

34

00:01:27,270 --> 00:01:25,520

directly to see what's changed over time

35

00:01:29,910 --> 00:01:27,280

like you can see things like change in

36

00:01:32,710 --> 00:01:29,920

vegetation growth of cities

37

00:01:34,149 --> 00:01:32,720

new lava flows from erupting volcanoes

38

00:01:36,069 --> 00:01:34,159

things like that

39

00:01:38,550 --> 00:01:36,079

for the plate tectonic question

40

00:01:40,789 --> 00:01:38,560

you it's hard to actually measure or see

41

00:01:42,630 --> 00:01:40,799

plate tectonics from satellites but what

42

00:01:44,950 --> 00:01:42,640

you can see is the

43

00:01:47,030 --> 00:01:44,960

effects of plate tectonics so you can

44

00:01:48,550 --> 00:01:47,040

see where volcanoes are erupting because

45

00:01:50,630 --> 00:01:48,560

volcanoes are typically associated with

46

00:01:52,069 --> 00:01:50,640

plate tectonic activities

47

00:01:54,389 --> 00:01:52,079

you can see

48

00:01:55,830 --> 00:01:54,399

damage from earthquakes and for some

49

00:01:58,230 --> 00:01:55,840

different kinds of satellite sensors

50

00:02:00,230 --> 00:01:58,240

like gps satellites we can actually use

51
00:02:01,910 --> 00:02:00,240
that information to measure

52
00:02:03,670 --> 00:02:01,920
the height of mountains and how they're

53
00:02:05,190 --> 00:02:03,680
growing over time so we can see how that

54
00:02:08,630 --> 00:02:05,200
that part of the plate tectonic process

55
00:02:10,389 --> 00:02:08,640
is working as well

56
00:02:12,309 --> 00:02:10,399
that was a good smart question we have

57
00:02:15,510 --> 00:02:12,319
another one

58
00:02:15,520 --> 00:02:19,430
how are satellites kept from damage

59
00:02:23,430 --> 00:02:21,270
also very good question

60
00:02:24,949 --> 00:02:23,440
satellites typically uh unfortunately

61
00:02:26,390 --> 00:02:24,959
they don't have they don't have

62
00:02:28,869 --> 00:02:26,400
shields like you'd see in star trek or

63
00:02:30,710 --> 00:02:28,879

something like that uh most satellites

64

00:02:32,790 --> 00:02:30,720

the best way to protect them is by

65

00:02:34,390 --> 00:02:32,800

putting them into orbits high enough so

66

00:02:36,150 --> 00:02:34,400

that they're out of most of the orbital

67

00:02:37,430 --> 00:02:36,160

debris that blankets

68

00:02:39,830 --> 00:02:37,440

well that doesn't like our planet but

69

00:02:40,949 --> 00:02:39,840

orbits our planet

70

00:02:43,030 --> 00:02:40,959

this

71

00:02:44,630 --> 00:02:43,040

the orbital debris itself

72

00:02:46,790 --> 00:02:44,640

is caused by

73

00:02:49,509 --> 00:02:46,800

old satellites pieces of old satellites

74

00:02:52,630 --> 00:02:49,519

old rocket pieces of old rocket launches

75

00:02:53,910 --> 00:02:52,640

as well as natural debris like meteors

76

00:02:54,869 --> 00:02:53,920

that enter the earth's atmosphere all

77

00:02:57,670 --> 00:02:54,879

the time

78

00:02:58,949 --> 00:02:57,680

so there's groups both here at nasa and

79

00:03:00,949 --> 00:02:58,959

in the department of defense that

80

00:03:04,229 --> 00:03:00,959

actively track

81

00:03:06,790 --> 00:03:04,239

about a half a million a little objects

82

00:03:08,309 --> 00:03:06,800

some smaller than the size of a baseball

83

00:03:10,229 --> 00:03:08,319

and they track these every day as they

84

00:03:13,030 --> 00:03:10,239

orbit around the earth the purpose of

85

00:03:14,550 --> 00:03:13,040

that is so that they can warn manned

86

00:03:15,589 --> 00:03:14,560

spacecraft like the international space

87

00:03:16,630 --> 00:03:15,599

station

88

00:03:18,149 --> 00:03:16,640

when

89

00:03:19,910 --> 00:03:18,159

orbital debris might be approaching them

90

00:03:21,990 --> 00:03:19,920

so they can take a they can maneuver the

91

00:03:23,430 --> 00:03:22,000

station out of the way for satellites

92

00:03:25,270 --> 00:03:23,440

that aren't manned

93

00:03:26,630 --> 00:03:25,280

uh typically like i said they put them

94

00:03:28,710 --> 00:03:26,640

into high orbits so they're out of the

95

00:03:30,630 --> 00:03:28,720

path of most of this orbital debris

96

00:03:32,229 --> 00:03:30,640

but satellites do occasionally get hit

97

00:03:34,229 --> 00:03:32,239

by things and sometimes they get hit by

98

00:03:37,910 --> 00:03:34,239

other satellites which has happened over

99

00:03:37,920 --> 00:03:42,550

good question

100

00:03:46,470 --> 00:03:44,470

how long does it take to process

101
00:03:48,149 --> 00:03:46,480
information from satellites and what

102
00:03:50,229 --> 00:03:48,159
kind of information can you get from

103
00:03:51,830 --> 00:03:50,239
them

104
00:03:54,789 --> 00:03:51,840
ah that's a that's a twenty thousand

105
00:03:56,550 --> 00:03:54,799
dollar question uh the the time

106
00:03:57,670 --> 00:03:56,560
with with satellites that are up there

107
00:03:59,429 --> 00:03:57,680
now the recent the most recent

108
00:04:01,509 --> 00:03:59,439
generations of satellites

109
00:04:03,910 --> 00:04:01,519
and the fact that

110
00:04:05,589 --> 00:04:03,920
you can put ground stations

111
00:04:06,949 --> 00:04:05,599
almost anywhere now to receive data from

112
00:04:08,630 --> 00:04:06,959
the satellites

113
00:04:10,710 --> 00:04:08,640

depending on the sensor you can get data

114

00:04:12,390 --> 00:04:10,720

back in a few hours

115

00:04:15,750 --> 00:04:12,400

and have it available for other

116

00:04:17,349 --> 00:04:15,760

scientists or the public to look at

117

00:04:18,949 --> 00:04:17,359

the

118

00:04:21,670 --> 00:04:18,959

things you can measure from satellites

119

00:04:23,110 --> 00:04:21,680

is i won't say it's endless but

120

00:04:25,830 --> 00:04:23,120

pretty much almost anything about the

121

00:04:27,830 --> 00:04:25,840

surface of the earth and the atmosphere

122

00:04:29,670 --> 00:04:27,840

you can measure from a satellite you can

123

00:04:31,430 --> 00:04:29,680

look at things like surface compositions

124

00:04:33,350 --> 00:04:31,440

of different materials like the elements

125

00:04:34,550 --> 00:04:33,360

or the minerals that make it up you can

126

00:04:36,390 --> 00:04:34,560

look at the composition of the

127

00:04:38,230 --> 00:04:36,400

atmosphere or the presence of pollutants

128

00:04:39,590 --> 00:04:38,240

in the atmosphere you can look at things

129

00:04:41,270 --> 00:04:39,600

like surface temperature like the

130

00:04:42,950 --> 00:04:41,280

surface of the land surf land surface

131

00:04:45,909 --> 00:04:42,960

temperature or the ocean surface

132

00:04:47,990 --> 00:04:45,919

temperature you can look at things like

133

00:04:49,430 --> 00:04:48,000

vegetation extent and health over the

134

00:04:51,590 --> 00:04:49,440

entire globe

135

00:04:54,550 --> 00:04:51,600

it's really the possibilities are

136

00:04:56,469 --> 00:04:54,560

are really defined by

137

00:05:00,150 --> 00:04:56,479

the physics of the electromagnetic

138

00:05:04,710 --> 00:05:02,390

very good question and very good answer

139

00:05:06,469 --> 00:05:04,720

do we have another one

140

00:05:11,029 --> 00:05:06,479

what is one of the satellites that take

141

00:05:12,230 --> 00:05:11,039

the best and most up-to-date photos

142

00:05:14,150 --> 00:05:12,240

that's

143

00:05:15,990 --> 00:05:14,160

that i'd have to say is in the the

144

00:05:17,270 --> 00:05:16,000

commercial satellite realm

145

00:05:19,270 --> 00:05:17,280

there's a number of commercial

146

00:05:22,070 --> 00:05:19,280

satellites that collect data of fine

147

00:05:24,310 --> 00:05:22,080

enough resolution or surface detail that

148

00:05:26,150 --> 00:05:24,320

you can see things that are less than

149

00:05:27,830 --> 00:05:26,160

about a foot and a half apart on the

150

00:05:29,189 --> 00:05:27,840

ground from orbit

151

00:05:30,390 --> 00:05:29,199

and one of those satellites is called

152

00:05:31,990 --> 00:05:30,400

goi

153

00:05:33,670 --> 00:05:32,000

in fact some of the some of the images

154

00:05:34,950 --> 00:05:33,680

if you look at google earth

155

00:05:36,230 --> 00:05:34,960

some of the imagery that you see in

156

00:05:37,830 --> 00:05:36,240

there when you can zoom down to the

157

00:05:42,230 --> 00:05:37,840

street level

158

00:05:43,909 --> 00:05:42,240

satellites like this that kind of

159

00:05:46,310 --> 00:05:43,919

resolution in fact some of them collect

160

00:05:47,749 --> 00:05:46,320

data that's so finely detailed that you

161

00:05:50,150 --> 00:05:47,759

can't release it to the public because

162

00:05:53,830 --> 00:05:50,160

it's a security concern

163

00:05:55,909 --> 00:05:53,840

but other satellites uh other sensors

164

00:05:57,590 --> 00:05:55,919

are designed so that they collect more

165

00:05:59,670 --> 00:05:57,600

information over the same spot on the

166

00:06:01,430 --> 00:05:59,680

earth in shorter time scales so some

167

00:06:03,590 --> 00:06:01,440

sensors can take data several times a

168

00:06:04,790 --> 00:06:03,600

day over the same spot on the earth as

169

00:06:06,950 --> 00:06:04,800

opposed to getting really high

170

00:06:08,629 --> 00:06:06,960

resolution data it's kind of a trade-off

171

00:06:10,790 --> 00:06:08,639

right now our technology is still at the

172

00:06:13,430 --> 00:06:10,800

level where you either get really really

173

00:06:15,510 --> 00:06:13,440

detailed information or you get detail a

174

00:06:17,029 --> 00:06:15,520

lot of information over the same spot

175

00:06:20,309 --> 00:06:17,039

but you don't typically get it at the

176

00:06:23,909 --> 00:06:22,309

very interesting i can tell you guys

177

00:06:26,870 --> 00:06:23,919

have done your homework

178

00:06:28,950 --> 00:06:26,880

we've got another question

179

00:06:32,309 --> 00:06:28,960

how long will it be until the next png

180

00:06:34,070 --> 00:06:32,319

are simple continent forms

181

00:06:36,150 --> 00:06:34,080

ah that's an excellent geological

182

00:06:37,749 --> 00:06:36,160

question right right close to my heart

183

00:06:39,990 --> 00:06:37,759

um the

184

00:06:41,749 --> 00:06:40,000

the supercontinent pangaea

185

00:06:44,390 --> 00:06:41,759

the last one there's actually been we

186

00:06:47,270 --> 00:06:44,400

think there's been six uh in geological

187

00:06:49,029 --> 00:06:47,280

history the last one formed about 300

188

00:06:51,430 --> 00:06:49,039

million years ago and then started to

189

00:06:53,270 --> 00:06:51,440

break up about 200 million years ago

190

00:06:55,110 --> 00:06:53,280

and we can look at the way the plates

191

00:06:56,550 --> 00:06:55,120

are currently moving today and make

192

00:06:58,550 --> 00:06:56,560

predictive models

193

00:07:01,270 --> 00:06:58,560

of if everything continues the same what

194

00:07:02,629 --> 00:07:01,280

will happen so the current predictions

195

00:07:04,950 --> 00:07:02,639

are that we might see another

196

00:07:06,950 --> 00:07:04,960

pangea-like continent which geologists

197

00:07:16,230 --> 00:07:06,960

are calling pangaea ultima

198

00:07:20,950 --> 00:07:17,990

how long do you have to be in college

199

00:07:22,870 --> 00:07:20,960

before you get to work at nasa as a nasa

200

00:07:24,390 --> 00:07:22,880

scientist

201

00:07:25,990 --> 00:07:24,400

uh it's an excellent question

202

00:07:27,670 --> 00:07:26,000

the the answer is it really kind of

203

00:07:29,749 --> 00:07:27,680

depends on what you want to do

204

00:07:31,589 --> 00:07:29,759

and nasa there's a wide range of job

205

00:07:32,870 --> 00:07:31,599

opportunities available

206

00:07:34,390 --> 00:07:32,880

you can be

207

00:07:35,830 --> 00:07:34,400

i would have to say that

208

00:07:37,909 --> 00:07:35,840

probably getting a bachelor's degree is

209

00:07:40,390 --> 00:07:37,919

the basic minimum that you might want to

210

00:07:41,909 --> 00:07:40,400

do so four to five years in college

211

00:07:43,430 --> 00:07:41,919

uh but you could be

212

00:07:44,869 --> 00:07:43,440

you could be a computer programmer you

213

00:07:47,909 --> 00:07:44,879

can be a scientist you can be an

214

00:07:50,790 --> 00:07:47,919

engineer uh you can be a writer you can

215

00:07:52,150 --> 00:07:50,800

be a speaker you can be a tv producer uh

216

00:07:53,830 --> 00:07:52,160

it's all really depends on what you want

217

00:07:55,270 --> 00:07:53,840

to do but i'd say i'd say a bachelor's

218

00:07:56,390 --> 00:07:55,280

degree is probably the minimum for some

219

00:07:58,469 --> 00:07:56,400

things you might need a more advanced

220

00:07:59,909 --> 00:07:58,479

degree like a master's degree or phd and

221

00:08:02,869 --> 00:07:59,919

that adds more years to your time in

222

00:08:05,350 --> 00:08:02,879

school but it starts where you are now

223

00:08:07,029 --> 00:08:05,360

every every course you take every you

224

00:08:10,550 --> 00:08:07,039

know every year that

225

00:08:12,550 --> 00:08:10,560

you add more education to yourself

226

00:08:14,469 --> 00:08:12,560

is something that only enhances what you

227

00:08:16,869 --> 00:08:14,479

your knowledge and will

228

00:08:19,670 --> 00:08:16,879

pave the way to where you want to go so

229

00:08:23,270 --> 00:08:19,680

keep studying exactly right yes

230

00:08:27,110 --> 00:08:25,430

yes

231

00:08:29,270 --> 00:08:27,120

is there a chance that one of our

232

00:08:31,830 --> 00:08:29,280

current continents will split again if

233

00:08:34,149 --> 00:08:31,840

so which one would be most likely to

234

00:08:35,829 --> 00:08:34,159

split

235

00:08:38,949 --> 00:08:35,839

well okay i think yeah i think you're

236

00:08:41,029 --> 00:08:38,959

asking uh if we're gonna see any any uh

237

00:08:43,430 --> 00:08:41,039

large large new separations of

238

00:08:45,829 --> 00:08:43,440

continents probably not

239

00:08:47,750 --> 00:08:45,839

uh as i as i said earlier

240

00:08:49,190 --> 00:08:47,760

the the current thinking is that we're

241

00:08:50,389 --> 00:08:49,200

actually entering a phase where the

242

00:08:52,870 --> 00:08:50,399

continents are starting to come back

243

00:08:55,829 --> 00:08:52,880

together again over the next 250 million

244

00:08:57,670 --> 00:08:55,839

years or so that being said there is an

245

00:08:59,110 --> 00:08:57,680

active rift an active area where there

246

00:09:00,870 --> 00:08:59,120

is a little bit of continental splitting

247

00:09:03,190 --> 00:09:00,880

going on right now

248

00:09:04,550 --> 00:09:03,200

in east africa the east african rift and

249

00:09:06,389 --> 00:09:04,560

that's where

250

00:09:08,630 --> 00:09:06,399

basaltic magma is coming up through the

251

00:09:10,310 --> 00:09:08,640

earth's crust and actually splitting off

252

00:09:11,750 --> 00:09:10,320

the horn of africa the easternmost part

253

00:09:13,670 --> 00:09:11,760

of africa away from the rest of the

254

00:09:15,190 --> 00:09:13,680

mainland so that's going on right now

255

00:09:17,110 --> 00:09:15,200

but but apart from that that's really

256

00:09:18,949 --> 00:09:17,120

about the only place where we're seeing

257

00:09:25,110 --> 00:09:18,959

a large-scale continental rifting going

258

00:09:25,120 --> 00:09:28,310

good questions

259

00:09:32,150 --> 00:09:30,310

if the ocean floor was a different rock

260

00:09:33,269 --> 00:09:32,160

than basalt what would change about

261

00:09:34,389 --> 00:09:33,279

earth

262

00:09:37,030 --> 00:09:34,399

great questions for you being a

263

00:09:39,350 --> 00:09:37,040

geologist that is that is a that is a

264

00:09:41,269 --> 00:09:39,360

that is a deep question uh

265

00:09:42,949 --> 00:09:41,279

what would happen uh

266

00:09:44,230 --> 00:09:42,959

the first the big answer is plate

267

00:09:45,829 --> 00:09:44,240

tectonics

268

00:09:47,030 --> 00:09:45,839

probably wouldn't work

269

00:09:49,509 --> 00:09:47,040

at least it certainly wouldn't work the

270

00:09:51,509 --> 00:09:49,519

way we see it now uh because the big

271

00:09:53,110 --> 00:09:51,519

difference between the oceanic crust and

272

00:09:55,269 --> 00:09:53,120

the continental crust

273

00:09:57,990 --> 00:09:55,279

is their densities continental crust is

274

00:10:00,710 --> 00:09:58,000

much less dense and light

275

00:10:02,630 --> 00:10:00,720

so it has a tendency to float

276

00:10:04,790 --> 00:10:02,640

or raise higher above the on the earth's

277

00:10:05,910 --> 00:10:04,800

surface oceanic basalt is very dense so

278

00:10:07,910 --> 00:10:05,920

very heavy

279

00:10:09,750 --> 00:10:07,920

and it's produced by

280

00:10:11,990 --> 00:10:09,760

magma from the earth's mantle coming out

281

00:10:13,350 --> 00:10:12,000

and erupting along mid-ocean ridges

282

00:10:16,069 --> 00:10:13,360

what that does is it creates new

283

00:10:17,269 --> 00:10:16,079

seafloor and pushes the continents apart

284

00:10:19,350 --> 00:10:17,279

and that's one of the big driving

285

00:10:21,350 --> 00:10:19,360

factors behind plate tectonics if it was

286

00:10:23,430 --> 00:10:21,360

all the same kind of material

287

00:10:25,509 --> 00:10:23,440

then it would be very difficult to move

288

00:10:28,710 --> 00:10:25,519

them apart that way also

289

00:10:30,470 --> 00:10:28,720

the heavy oceanic crust is recycled

290

00:10:32,150 --> 00:10:30,480

easier back into the mantle along

291

00:10:33,670 --> 00:10:32,160

subduction zones and again if the

292

00:10:35,509 --> 00:10:33,680

material was the same as have the same

293

00:10:36,389 --> 00:10:35,519

density that would be very difficult to

294

00:10:37,269 --> 00:10:36,399

do

295

00:10:39,590 --> 00:10:37,279

so you wouldn't have this whole

296

00:10:41,910 --> 00:10:39,600

recycling going on so that that would be

297

00:10:44,230 --> 00:10:41,920

the major change what that would mean to

298

00:10:46,470 --> 00:10:44,240

the way the earth's surface would look

299

00:10:48,550 --> 00:10:46,480

well over time you you wouldn't have new

300

00:10:50,069 --> 00:10:48,560

mountains being formed for one thing and

301
00:10:51,350 --> 00:10:50,079
so you could expect that over millions

302
00:10:52,949 --> 00:10:51,360
of years you might see the mountains

303
00:10:53,910 --> 00:10:52,959
starting to be eroded down to flat

304
00:10:55,750 --> 00:10:53,920
plains

305
00:10:58,069 --> 00:10:55,760
that doesn't happen on earth because we

306
00:10:59,670 --> 00:10:58,079
have active plate tectonics

307
00:11:01,030 --> 00:10:59,680
that would be one major

308
00:11:03,430 --> 00:11:01,040
change and of course that would cause a

309
00:11:05,350 --> 00:11:03,440
whole series of climatic differences

310
00:11:07,910 --> 00:11:05,360
and uh a lot of stuff would be very

311
00:11:09,590 --> 00:11:07,920
different so very excellent question

312
00:11:12,389 --> 00:11:09,600
there's a lot contained in that question

313
00:11:16,230 --> 00:11:12,399

deep literally and figuratively

314

00:11:21,110 --> 00:11:19,990

how do you predict natural disasters

315

00:11:22,389 --> 00:11:21,120

oh you guys are just coming up with

316

00:11:23,350 --> 00:11:22,399

awesome questions

317

00:11:24,230 --> 00:11:23,360

uh

318

00:11:27,269 --> 00:11:24,240

we

319

00:11:29,590 --> 00:11:27,279

disasters

320

00:11:31,190 --> 00:11:29,600

with any degree of certainty today but

321

00:11:33,509 --> 00:11:31,200

there are there are a lot of types of

322

00:11:34,550 --> 00:11:33,519

disasters that frequently give us

323

00:11:35,910 --> 00:11:34,560

warnings

324

00:11:37,190 --> 00:11:35,920

that something might be might be

325

00:11:39,269 --> 00:11:37,200

happening

326

00:11:40,470 --> 00:11:39,279

for instance large storm systems like

327

00:11:42,710 --> 00:11:40,480

hurricanes

328

00:11:44,949 --> 00:11:42,720

were now pretty good at being able to

329

00:11:46,389 --> 00:11:44,959

detect when those storms are forming and

330

00:11:47,269 --> 00:11:46,399

be able to detect where they're going to

331

00:11:52,470 --> 00:11:47,279

go

332

00:11:54,069 --> 00:11:52,480

plot their tracks enough to let people

333

00:11:56,069 --> 00:11:54,079

know that a storm is coming so they can

334

00:11:57,750 --> 00:11:56,079

evacuate and get out of the way for

335

00:11:59,030 --> 00:11:57,760

other things like volcanoes volcanic

336

00:12:01,030 --> 00:11:59,040

eruptions

337

00:12:03,590 --> 00:12:01,040

sometimes we we can detect some of them

338

00:12:05,190 --> 00:12:03,600

sometimes occasionally volcanoes will

339

00:12:07,110 --> 00:12:05,200

have hot spots that you can detect from

340

00:12:08,710 --> 00:12:07,120

satellites in orbit that indicate that

341

00:12:10,230 --> 00:12:08,720

there might be magnetic magma coming to

342

00:12:12,310 --> 00:12:10,240

the surface and that eruption might be

343

00:12:14,790 --> 00:12:12,320

imminent also sometimes the volcano

344

00:12:16,389 --> 00:12:14,800

shape itself changes as magma comes into

345

00:12:18,710 --> 00:12:16,399

the volcano and it causes the ground to

346

00:12:21,030 --> 00:12:18,720

raise we can measure that

347

00:12:23,350 --> 00:12:21,040

with gps sensors

348

00:12:25,430 --> 00:12:23,360

things like earthquakes those are really

349

00:12:27,350 --> 00:12:25,440

difficult because earthquakes quite

350

00:12:28,949 --> 00:12:27,360

frequently occur with no advanced

351

00:12:30,629 --> 00:12:28,959

warning whatsoever

352

00:12:32,069 --> 00:12:30,639

sometimes we know

353

00:12:34,150 --> 00:12:32,079

where earthquakes have occurred so we

354

00:12:35,590 --> 00:12:34,160

can assume based on the last time a big

355

00:12:37,430 --> 00:12:35,600

earthquake occurred we can make some

356

00:12:39,990 --> 00:12:37,440

some idea of when the next one might

357

00:12:41,990 --> 00:12:40,000

happen but it's really just a prediction

358

00:12:44,310 --> 00:12:42,000

it's really hard to predict with to make

359

00:12:52,710 --> 00:12:44,320

a real certain uh deduction of when a

360

00:12:57,269 --> 00:12:54,870

how will the technology of the goes-r

361

00:13:00,389 --> 00:12:57,279

series satellites improve compared to

362

00:13:01,190 --> 00:13:00,399

the current goes satellites

363

00:13:03,269 --> 00:13:01,200

ah

364

00:13:05,350 --> 00:13:03,279

excellent technical question uh the big

365

00:13:07,110 --> 00:13:05,360

difference there between goes-r and the

366

00:13:09,750 --> 00:13:07,120

current goes satellites

367

00:13:11,910 --> 00:13:09,760

is in the the sensitivity of the sensors

368

00:13:12,949 --> 00:13:11,920

and their capabilities the goes-r

369

00:13:15,670 --> 00:13:12,959

satellite

370

00:13:17,030 --> 00:13:15,680

will still view the western hemisphere

371

00:13:19,190 --> 00:13:17,040

and we'll collect the same measurements

372

00:13:20,790 --> 00:13:19,200

that the current goes satellites collect

373

00:13:23,590 --> 00:13:20,800

but it'll have better imaging

374

00:13:25,269 --> 00:13:23,600

capabilities it'll be sensitive to some

375

00:13:27,350 --> 00:13:25,279

new pieces of information that the

376

00:13:29,509 --> 00:13:27,360

current satellites aren't and on the

377

00:13:32,310 --> 00:13:29,519

solar end it's kind of the same story

378

00:13:34,389 --> 00:13:32,320

better imagers better detectors for some

379

00:13:36,470 --> 00:13:34,399

of the solar particles that come back

380

00:13:37,670 --> 00:13:36,480

and all of this is designed to give us

381

00:13:38,949 --> 00:13:37,680

better

382

00:13:45,990 --> 00:13:38,959

weather forecasting predictive

383

00:13:50,069 --> 00:13:47,990

is it possible for a super storm or

384

00:13:51,750 --> 00:13:50,079

multiple natural disasters at once to

385

00:13:54,069 --> 00:13:51,760

occur and cause mass extinction on the

386

00:13:56,389 --> 00:13:54,079

planet earth

387

00:13:58,389 --> 00:13:56,399

this this is another great question

388

00:14:00,949 --> 00:13:58,399

i'd have to say the answer

389

00:14:03,269 --> 00:14:00,959

is probably no and the reason i say that

390

00:14:05,430 --> 00:14:03,279

is because there's enough spots on the

391

00:14:06,790 --> 00:14:05,440

earth that are geologically quiet

392

00:14:07,910 --> 00:14:06,800

they're not prone to big earthquakes

393

00:14:09,430 --> 00:14:07,920

they're not they don't have active

394

00:14:10,629 --> 00:14:09,440

volcanoes going on

395

00:14:12,470 --> 00:14:10,639

to where

396

00:14:13,990 --> 00:14:12,480

even if all the other ones went off it

397

00:14:15,670 --> 00:14:14,000

wouldn't cause mass extinction the human

398

00:14:17,189 --> 00:14:15,680

race there would still be people left in

399

00:14:19,350 --> 00:14:17,199

those areas

400

00:14:20,470 --> 00:14:19,360

what would be more likely to cause mass

401
00:14:21,990 --> 00:14:20,480
extinction

402
00:14:23,590 --> 00:14:22,000
would probably be something similar to

403
00:14:25,670 --> 00:14:23,600
what caused the dinosaurs extinction

404
00:14:26,629 --> 00:14:25,680
like a large asteroid impact on the

405
00:14:28,310 --> 00:14:26,639
surface

406
00:14:30,550 --> 00:14:28,320
you need a you need an event of that

407
00:14:32,389 --> 00:14:30,560
kind of magnitude to create enough

408
00:14:35,350 --> 00:14:32,399
environmental disturbance

409
00:14:37,269 --> 00:14:35,360
to really make the environment uh

410
00:14:39,110 --> 00:14:37,279
so inhospitable that we'd be looking at

411
00:14:40,230 --> 00:14:39,120
mass extinction but that's a great

412
00:14:44,870 --> 00:14:40,240
question

413
00:14:48,710 --> 00:14:47,030

um at any point in time will any land

414

00:14:50,629 --> 00:14:48,720

forms arrow to a point that there isn't

415

00:14:53,430 --> 00:14:50,639

enough room for the organisms inhabiting

416

00:14:54,470 --> 00:14:53,440

it to remain stationary if so will they

417

00:14:56,550 --> 00:14:54,480

um

418

00:15:00,310 --> 00:14:56,560

evolve into some

419

00:15:01,509 --> 00:15:00,320

other sort of life or migrate

420

00:15:03,509 --> 00:15:01,519

that's that's another great plate

421

00:15:05,829 --> 00:15:03,519

tectonic question uh it kind of gets

422

00:15:07,030 --> 00:15:05,839

back to an answer to a previous question

423

00:15:08,790 --> 00:15:07,040

about what would happen if plate

424

00:15:10,150 --> 00:15:08,800

tectonics stopped working

425

00:15:12,629 --> 00:15:10,160

that's really what you'd need to have

426
00:15:14,949 --> 00:15:12,639
happen to to cause what you're talking

427
00:15:17,590 --> 00:15:14,959
about um there's actually a term that

428
00:15:19,509 --> 00:15:17,600
geologists use for that uh geologists

429
00:15:21,350 --> 00:15:19,519
about 100 years ago thought this same

430
00:15:23,269 --> 00:15:21,360
question they said why how come how come

431
00:15:24,629 --> 00:15:23,279
we have mountains before plate tectonics

432
00:15:26,069 --> 00:15:24,639
was understood

433
00:15:27,829 --> 00:15:26,079
and they were asking why don't the

434
00:15:29,670 --> 00:15:27,839
mountains just wear down

435
00:15:31,269 --> 00:15:29,680
to flat plains we know now it's because

436
00:15:32,949 --> 00:15:31,279
mountains or new mountains are formed

437
00:15:34,310 --> 00:15:32,959
due to plate tectonics but if that

438
00:15:36,310 --> 00:15:34,320

didn't exist

439

00:15:37,990 --> 00:15:36,320

and you just had erosion yeah eventually

440

00:15:39,590 --> 00:15:38,000

you'd wear everything down to a flat

441

00:15:40,710 --> 00:15:39,600

plane

442

00:15:42,150 --> 00:15:40,720

now this this wouldn't happen

443

00:15:44,310 --> 00:15:42,160

instantaneously of course this will take

444

00:15:47,749 --> 00:15:44,320

hundreds of millions of years so that's

445

00:15:50,949 --> 00:15:47,759

plenty of time for existing creatures to

446

00:15:53,670 --> 00:15:50,959

migrate to adapt to new conditions

447

00:15:55,590 --> 00:15:53,680

and so forth so i think you would see

448

00:15:57,990 --> 00:15:55,600

adaption occurring if this if plate

449

00:16:04,310 --> 00:15:58,000

tectonics stopped functioning um but

450

00:16:09,990 --> 00:16:08,310

getting some zingers these are good

451

00:16:12,870 --> 00:16:10,000

they are i'm shifting

452

00:16:15,269 --> 00:16:12,880

so in the near in um anywhere like in

453

00:16:17,189 --> 00:16:15,279

the next million years would there be

454

00:16:20,389 --> 00:16:17,199

anything falling off coming off of north

455

00:16:26,230 --> 00:16:23,350

whoops sorry the the answer that um

456

00:16:27,670 --> 00:16:26,240

probably the short answer is no um

457

00:16:29,910 --> 00:16:27,680

except for

458

00:16:32,389 --> 00:16:29,920

probably southern california

459

00:16:34,230 --> 00:16:32,399

most of the plate tectonic models show

460

00:16:36,870 --> 00:16:34,240

that southern california over the next

461

00:16:38,949 --> 00:16:36,880

50 million years or so is likely to

462

00:16:41,269 --> 00:16:38,959

break kind of along san andreas fault

463

00:16:43,350 --> 00:16:41,279

and start moving towards alaska

464

00:16:50,230 --> 00:16:43,360

so california may get smaller but that's

465

00:16:54,870 --> 00:16:52,870

are the teachers who train astronauts

466

00:16:57,110 --> 00:16:54,880

actual astronauts themselves or are they

467

00:17:01,189 --> 00:16:57,120

just people who use information

468

00:17:04,470 --> 00:17:03,430

that that's a that's a good question

469

00:17:07,029 --> 00:17:04,480

i'm actually one of the people who

470

00:17:08,789 --> 00:17:07,039

trains astronauts uh through the crew of

471

00:17:10,069 --> 00:17:08,799

thobs project here

472

00:17:12,710 --> 00:17:10,079

astronauts

473

00:17:14,949 --> 00:17:12,720

they do train each other in some aspects

474

00:17:16,789 --> 00:17:14,959

but for science training

475

00:17:18,069 --> 00:17:16,799

they're trained by people like me and

476

00:17:20,309 --> 00:17:18,079

others of my colleagues other earth

477

00:17:22,150 --> 00:17:20,319

scientists atmospheric scientists

478

00:17:24,309 --> 00:17:22,160

and for other technical issues like for

479

00:17:26,150 --> 00:17:24,319

taking photographs from the iss they're

480

00:17:28,230 --> 00:17:26,160

trained by another group that is

481

00:17:29,110 --> 00:17:28,240

composed of expert photographers

482

00:17:30,230 --> 00:17:29,120

so

483

00:17:31,830 --> 00:17:30,240

i guess the answer to your question is

484

00:17:33,270 --> 00:17:31,840

yes or no for some things the astronauts

485

00:17:35,909 --> 00:17:33,280

do train themselves but for other things

486

00:17:37,590 --> 00:17:35,919

they rely on outside experts

487

00:17:39,750 --> 00:17:37,600

very good question i think we actually

488

00:17:41,909 --> 00:17:39,760

have a a website maybe we can get that

489

00:17:43,669 --> 00:17:41,919

for you for you guys going up here um

490

00:17:45,350 --> 00:17:43,679

just where you can actually go and look

491

00:17:47,190 --> 00:17:45,360

at a lot of those photographs that are

492

00:17:49,029 --> 00:17:47,200

taking photos yeah absolutely uh yeah

493

00:17:50,870 --> 00:17:49,039

it's if you if you do a google search on

494

00:17:51,909 --> 00:17:50,880

astronaut photography of earth it'll

495

00:17:54,150 --> 00:17:51,919

take you to the website yeah and there

496

00:17:58,150 --> 00:17:54,160

it is yeah

497

00:18:00,549 --> 00:17:58,160

does the upper s uh aspheric uh research

498

00:18:01,430 --> 00:18:00,559

satellite really have pieces falling on

499

00:18:06,230 --> 00:18:01,440

earth

500

00:18:09,270 --> 00:18:07,669

that uh

501
00:18:11,510 --> 00:18:09,280
your that's actually a question to ask

502
00:18:13,590 --> 00:18:11,520
because as kind of i said earlier

503
00:18:14,870 --> 00:18:13,600
there's orbital debris and meteors

504
00:18:17,590 --> 00:18:14,880
falling

505
00:18:19,430 --> 00:18:17,600
on the earth all the time every day most

506
00:18:20,710 --> 00:18:19,440
of that stuff is so small that it does

507
00:18:22,150 --> 00:18:20,720
burn up in the atmosphere and it never

508
00:18:24,390 --> 00:18:22,160
hits the surface

509
00:18:25,750 --> 00:18:24,400
for the you are satellite

510
00:18:28,789 --> 00:18:25,760
that was a little different case that

511
00:18:30,870 --> 00:18:28,799
thing was the size of a bus and when it

512
00:18:32,789 --> 00:18:30,880
entered the atmosphere most of it did

513
00:18:34,789 --> 00:18:32,799

indeed burn up but it was so big that

514

00:18:36,549 --> 00:18:34,799

some pieces did survive

515

00:18:38,630 --> 00:18:36,559

to go through the atmosphere

516

00:18:40,390 --> 00:18:38,640

now most of those pieces

517

00:18:42,390 --> 00:18:40,400

fell into the ocean because the ocean

518

00:18:43,750 --> 00:18:42,400

covers 70 percent of the earth's surface

519

00:18:45,590 --> 00:18:43,760

and this happens to most stuff that

520

00:18:47,350 --> 00:18:45,600

actually makes it through the atmosphere

521

00:18:48,230 --> 00:18:47,360

to hit the to hit the surface of the

522

00:18:50,150 --> 00:18:48,240

earth

523

00:18:52,230 --> 00:18:50,160

there's been no reports that i know of

524

00:18:53,669 --> 00:18:52,240

at least of anyone being hit by any kind

525

00:18:55,909 --> 00:18:53,679

of debris

526

00:19:02,390 --> 00:18:55,919

from space and certainly nothing from

527

00:19:05,990 --> 00:19:04,150

how long does it take for information to

528

00:19:09,669 --> 00:19:06,000

be received from the satellite is there

529

00:19:12,150 --> 00:19:09,679

any delay or does it happen in real time

530

00:19:14,470 --> 00:19:12,160

that's an excellent question

531

00:19:16,789 --> 00:19:14,480

for most satellites there is a slight

532

00:19:18,710 --> 00:19:16,799

delay time uh like i said earlier some

533

00:19:20,710 --> 00:19:18,720

if you have a receiving station

534

00:19:22,870 --> 00:19:20,720

you can collect data from the satellite

535

00:19:25,350 --> 00:19:22,880

as soon as it passes overhead but

536

00:19:27,190 --> 00:19:25,360

typically that data is what we call raw

537

00:19:28,710 --> 00:19:27,200

it's raw form it needs to be processed

538

00:19:31,430 --> 00:19:28,720

before it can be usable

539

00:19:33,669 --> 00:19:31,440

by a scientist or a member of the public

540

00:19:35,669 --> 00:19:33,679

so there typically is a delay time of a

541

00:19:37,029 --> 00:19:35,679

few hours before you get data from the

542

00:19:39,830 --> 00:19:37,039

satellite to the point where it can be

543

00:19:42,630 --> 00:19:39,840

distributed for use by other people

544

00:19:44,630 --> 00:19:42,640

there are some other kinds of sensors

545

00:19:45,909 --> 00:19:44,640

like on the iss there are there are

546

00:19:48,470 --> 00:19:45,919

video cameras

547

00:19:49,510 --> 00:19:48,480

that if there's line of sight to the

548

00:19:51,990 --> 00:19:49,520

ground

549

00:19:54,150 --> 00:19:52,000

you can transmit that information down

550

00:19:56,070 --> 00:19:54,160

in more or less real time

551
00:19:59,350 --> 00:19:56,080
and there's new sensors going up on the

552
00:20:01,430 --> 00:19:59,360
iss high definition external cameras

553
00:20:02,710 --> 00:20:01,440
that will that's the the intent the

554
00:20:04,470 --> 00:20:02,720
intent is to actually have it in real

555
00:20:06,310 --> 00:20:04,480
time so you can view exactly what is

556
00:20:08,310 --> 00:20:06,320
being seen from the space station from

557
00:20:09,430 --> 00:20:08,320
the ground that's excellent

558
00:20:10,950 --> 00:20:09,440
do you have any

559
00:20:15,190 --> 00:20:10,960
more questions i think we have just a

560
00:20:21,430 --> 00:20:18,310
let's say a ship passes over a sea floor

561
00:20:23,430 --> 00:20:21,440
that has a reverse magnetic polarization

562
00:20:25,830 --> 00:20:23,440
how would this affect the magnetic field

563
00:20:30,149 --> 00:20:28,310

for that question uh and the great

564

00:20:32,070 --> 00:20:30,159

question

565

00:20:33,590 --> 00:20:32,080

the ship's compass

566

00:20:34,789 --> 00:20:33,600

wouldn't see any effect it would just

567

00:20:36,470 --> 00:20:34,799

see the uh

568

00:20:38,310 --> 00:20:36,480

the regular you know the current earth's

569

00:20:40,470 --> 00:20:38,320

magnetic field and that's mainly because

570

00:20:42,390 --> 00:20:40,480

the ship is so far away it's far enough

571

00:20:43,750 --> 00:20:42,400

above the sea floor so that you won't

572

00:20:45,110 --> 00:20:43,760

get any effect from remnant

573

00:20:46,789 --> 00:20:45,120

magnetization

574

00:20:49,590 --> 00:20:46,799

uh the way that was originally

575

00:20:51,750 --> 00:20:49,600

discovered was by towing sensitive

576
00:20:53,830 --> 00:20:51,760
sensors behind ships so they were pretty

577
00:20:55,750 --> 00:20:53,840
much right over the sea floor and when

578
00:20:57,350 --> 00:20:55,760
you do that you can see the difference

579
00:20:59,190 --> 00:20:57,360
in the magnetic field orientation from

580
00:21:01,029 --> 00:20:59,200
the minerals that were frozen into the

581
00:21:02,870 --> 00:21:01,039
sea floor when it crystallized

582
00:21:04,390 --> 00:21:02,880
but from a ship on the surface

583
00:21:11,430 --> 00:21:04,400
no you you wouldn't see any effect from

584
00:21:18,310 --> 00:21:13,270
if you see dangerous weather coming to a

585
00:21:22,549 --> 00:21:20,149
okay i think i think you mean are you

586
00:21:26,230 --> 00:21:22,559
asking if you see dangerous weather from

587
00:21:28,310 --> 00:21:26,240
orbit or on the ground yeah

588
00:21:29,750 --> 00:21:28,320

um on the ground

589

00:21:30,950 --> 00:21:29,760

okay well if you see if you see if you

590

00:21:32,549 --> 00:21:30,960

see dangerous weather coming on the

591

00:21:33,350 --> 00:21:32,559

ground like a tornado or something like

592

00:21:35,190 --> 00:21:33,360

that

593

00:21:37,190 --> 00:21:35,200

uh well the first thing i would do is

594

00:21:39,029 --> 00:21:37,200

attend to your own safety first you'll

595

00:21:40,789 --> 00:21:39,039

find somewhere that's out of the path

596

00:21:43,830 --> 00:21:40,799

but then you might you would consider

597

00:21:46,070 --> 00:21:43,840

calling your parents or the local police

598

00:21:47,029 --> 00:21:46,080

department fire department uh typically

599

00:21:49,029 --> 00:21:47,039

though

600

00:21:50,950 --> 00:21:49,039

for most of these this is an exam an

601
00:21:52,630 --> 00:21:50,960
advantage of the weather satellites for

602
00:21:54,870 --> 00:21:52,640
a lot of the big storm systems even for

603
00:21:56,310 --> 00:21:54,880
tornadoes we're improving our ability to

604
00:21:59,510 --> 00:21:56,320
be able to detect where those might

605
00:22:01,110 --> 00:21:59,520
occur from orbit so we're trying to

606
00:22:03,190 --> 00:22:01,120
improve the ability to warn people in

607
00:22:11,350 --> 00:22:03,200
the path of say tornadoes that keep on

608
00:22:17,510 --> 00:22:13,510
how accurate can you measure the speed

609
00:22:21,430 --> 00:22:18,789
well we have a lot of fans of plate

610
00:22:24,549 --> 00:22:21,440
tectonics in the audience today

611
00:22:26,070 --> 00:22:24,559
the with gps satellite measurements you

612
00:22:28,310 --> 00:22:26,080
can actually measure the speed of the

613
00:22:30,470 --> 00:22:28,320

continents down to

614

00:22:32,310 --> 00:22:30,480

millimeters per year

615

00:22:34,630 --> 00:22:32,320

but typically geologists we tend to

616

00:22:36,549 --> 00:22:34,640

measure the rate in centimeters per year

617

00:22:38,230 --> 00:22:36,559

and on average the continents are moving

618

00:22:40,470 --> 00:22:38,240

between about two and ten centimeters

619

00:22:53,029 --> 00:22:40,480

per year and that's about the same rate

620

00:22:53,039 --> 00:22:56,310

do we have any others

621

00:23:03,029 --> 00:22:58,549

this is really exciting i'm enjoying

622

00:23:07,990 --> 00:23:04,470

can you tell us a little bit about your

623

00:23:11,510 --> 00:23:09,270

oh i didn't know i was going to talk

624

00:23:12,870 --> 00:23:11,520

about myself here

625

00:23:15,590 --> 00:23:12,880

i'm a geologist

626
00:23:17,510 --> 00:23:15,600
and most of my research is done using

627
00:23:19,990 --> 00:23:17,520
data from satellites to look at the

628
00:23:22,950 --> 00:23:20,000
earth's surface and in particular i do a

629
00:23:24,230 --> 00:23:22,960
lot of work in mapping where

630
00:23:26,470 --> 00:23:24,240
different minerals are different rocks

631
00:23:28,070 --> 00:23:26,480
and minerals so geological mapping also

632
00:23:28,950 --> 00:23:28,080
i do a lot of work

633
00:23:32,950 --> 00:23:28,960
in

634
00:23:34,390 --> 00:23:32,960
urban heat islands where

635
00:23:36,549 --> 00:23:34,400
where cities get hotter than their

636
00:23:38,870 --> 00:23:36,559
surrounding environments and in

637
00:23:42,310 --> 00:23:38,880
particular where people in those cities

638
00:23:44,390 --> 00:23:42,320

are most at risk from high heat events

639

00:23:46,310 --> 00:23:44,400

so uh my thing is basically like

640

00:23:49,029 --> 00:23:46,320

geologic hazards in general but

641

00:23:50,950 --> 00:23:49,039

particularly looking at geologic hazards

642

00:23:52,390 --> 00:23:50,960

around cities so that's what i spend

643

00:23:54,070 --> 00:23:52,400

most of my time doing that's why those

644

00:23:57,430 --> 00:23:54,080

good geology questions were really great

645

00:23:57,440 --> 00:24:09,669

do we have any others

646

00:24:25,990 --> 00:24:21,190

okay

647

00:24:27,430 --> 00:24:26,000

guys we really really appreciate those

648

00:24:29,750 --> 00:24:27,440

questions they're really great questions

649

00:24:32,070 --> 00:24:29,760

thank you again will for coming out and

650

00:24:33,669 --> 00:24:32,080

talking with the students i hope you all

651

00:24:35,909 --> 00:24:33,679

you're very welcome

652

00:24:38,470 --> 00:24:35,919

learn something new i know i did go back

653

00:24:41,029 --> 00:24:38,480

to to working there and uh

654

00:24:42,630 --> 00:24:41,039

studying hard and making your way to