
PAO

1
00:00:02,016 --> 00:00:03,006
>> Hi, welcome

2
00:00:03,006 --> 00:00:05,166
to the International Space
Station Flight Control Room.

3
00:00:05,166 --> 00:00:09,786
We are here for a Digital
Learning Network Event

4
00:00:09,996 --> 00:00:13,686
and we are talking
with middle school kids

5
00:00:13,686 --> 00:00:16,456
at Lanier Middle
School in Buford,

6
00:00:16,636 --> 00:00:19,146
Georgia so today we have a
special guest for you guys.

7
00:00:19,146 --> 00:00:21,606
I understand that you guys
have been studying about Earth

8
00:00:22,066 --> 00:00:24,246
and Earth Science
and it's a good time

9
00:00:24,246 --> 00:00:27,306
because this is earth
month here at NASA.

10
00:00:27,306 --> 00:00:29,396
So here with us today
we have Will Stefanov.

11

00:00:29,396 --> 00:00:31,566
He is the Chief Earth
Scientist here

12
00:00:31,566 --> 00:00:33,006
at the NASA Johnson
Space Center.

13
00:00:33,006 --> 00:00:34,486
Welcome, Will, and
thank you for coming.

14
00:00:35,076 --> 00:00:35,256
>> Will Stefanov: Hi.

15
00:00:35,426 --> 00:00:35,996
Thanks for having me.

16
00:00:35,996 --> 00:00:36,536
>> Thank you.

17
00:00:36,536 --> 00:00:38,886
So guys we're ready to
take your questions.

18
00:00:39,526 --> 00:00:47,836
>> How can you see the
difference between the past

19
00:00:47,836 --> 00:00:50,386
and the future, and the present,

20
00:00:50,836 --> 00:00:53,656
and what shows the plate
tectonics in the satellites?

21
00:00:55,506 --> 00:00:56,836
>> Will Stefanov: That's
an excellent question.

22
00:00:57,026 --> 00:00:58,926
Sorry, I need to get
myself arranged here.

23
00:00:59,386 --> 00:01:01,526
That's an excellent question.

24
00:01:02,086 --> 00:01:05,016
The way that you look
at changes in time

25
00:01:05,156 --> 00:01:08,266
with satellite data is you
collect lots and lots of images

26
00:01:08,596 --> 00:01:10,436
over a long period of time.

27
00:01:10,826 --> 00:01:14,066
A good example of this is
the land satellite series

28
00:01:14,066 --> 00:01:16,326
which has been collecting
data since 1972.

29
00:01:16,756 --> 00:01:18,856
So when you have all these
scenes you can line them up

30
00:01:19,356 --> 00:01:22,216
and just look at them directly
to see what's changed over time.

31
00:01:22,616 --> 00:01:25,036
Like you can see things
like change in vegetation,

32
00:01:25,036 --> 00:01:27,936

growth of cities, new lava flows

33
00:01:27,936 --> 00:01:30,406
from erupting volcanoes,
things like that.

34
00:01:30,766 --> 00:01:35,046
For the plate tectonic question,
it's hard to actually measure

35
00:01:35,046 --> 00:01:37,496
or see plate tectonics
from satellites

36
00:01:37,496 --> 00:01:41,166
but what you can see is the
effects of plate tectonics.

37
00:01:41,316 --> 00:01:43,866
So you can see where
volcanoes are erupting

38
00:01:43,866 --> 00:01:45,426
because volcanoes are
typically associated

39
00:01:45,426 --> 00:01:46,726
with plate tectonic activities.

40
00:01:47,466 --> 00:01:50,366
You can see damage
from earthquakes

41
00:01:50,646 --> 00:01:52,886
and for some different
kinds of satellite sensors

42
00:01:52,886 --> 00:01:55,936
like GPS satellites, we can
actually use that information

43
00:01:55,936 --> 00:01:58,536
to measure the height
of mountains

44
00:01:58,536 --> 00:02:00,996
and how they're growing over
time so we can see how that part

45
00:02:00,996 --> 00:02:03,026
of the plate tectonic
processes is working as well.

46
00:02:03,596 --> 00:02:07,016
>> That's a good smart question.

47
00:02:07,196 --> 00:02:09,086
Do we have another one?

48
00:02:09,086 --> 00:02:14,346
>> How are satellites
kept from damage?

49
00:02:16,466 --> 00:02:17,346
>> Will Stefanov: Also
very good question.

50
00:02:18,246 --> 00:02:19,476
Satellites typically,

51
00:02:19,956 --> 00:02:22,726
unfortunately they don't
have shields like you'd see

52
00:02:22,726 --> 00:02:24,796
in Star Trek or something
like that.

53
00:02:24,846 --> 00:02:28,086

Most satellites, the best way to
protect them is by putting them

54
00:02:28,086 --> 00:02:30,906
into orbits high enough so
that they're out of most

55
00:02:30,906 --> 00:02:32,486
of the orbital debris
that blankets,

56
00:02:32,486 --> 00:02:35,146
well that doesn't
blanket our planet

57
00:02:35,706 --> 00:02:37,576
but that orbits our planet.

58
00:02:37,756 --> 00:02:41,476
The orbital debris
itself is caused by pieces

59
00:02:41,476 --> 00:02:45,836
of old satellites, pieces
of old rocket launches,

60
00:02:46,346 --> 00:02:49,666
as well as natural
debris like meteors

61
00:02:49,736 --> 00:02:51,236
that enter the earth's
atmospheres all the time.

62
00:02:51,856 --> 00:02:55,366
So there's groups both here
at NASA and in the Department

63
00:02:55,366 --> 00:02:56,986
of Defense that actively track

64
00:02:57,466 --> 00:03:02,136
about 1/2 a million little
objects, some smaller

65
00:03:02,136 --> 00:03:05,076
than the size of a baseball,
and they track these every day

66
00:03:05,076 --> 00:03:06,636
as they orbit around the earth.

67
00:03:06,636 --> 00:03:10,686
The purpose of that is so that
they can warn manned spacecraft,

68
00:03:10,686 --> 00:03:11,896
like the International
Space Station,

69
00:03:12,556 --> 00:03:15,086
when orbital debris
might be approaching them

70
00:03:15,166 --> 00:03:17,866
so they can maneuver the
station out of the way.

71
00:03:18,316 --> 00:03:21,516
For satellites that
aren't manned, typically,

72
00:03:21,586 --> 00:03:23,456
like I said they put them into
high orbits so that they're

73
00:03:23,456 --> 00:03:25,096
out of the path of most
of this orbital debris

74
00:03:25,486 --> 00:03:28,146
but satellites do
occasionally get hit by things

75
00:03:28,146 --> 00:03:29,936
and sometimes they get
hit by other satellites,

76
00:03:30,236 --> 00:03:34,636
which has happened over the
past 10 years a couple of times.

77
00:03:34,956 --> 00:03:35,526
>> Good question.

78
00:03:35,756 --> 00:03:41,016
>> How long does it take
to process information

79
00:03:41,016 --> 00:03:43,326
from satellites and what kind

80
00:03:43,326 --> 00:03:46,596
of information can
you get from them?

81
00:03:47,296 --> 00:03:49,416
>> Will Stefanov: That's
a $20,000 question.

82
00:03:50,336 --> 00:03:53,846
The time, with satellites
that are up there now,

83
00:03:53,846 --> 00:03:57,396
the most recent generations
of satellites and the fact

84
00:03:57,456 --> 00:04:01,796

that you can put ground
stations almost anywhere now

85
00:04:01,796 --> 00:04:03,146
to receive data from
those satellites,

86
00:04:04,006 --> 00:04:07,376
depending on the censor, you
can get data back in a few hours

87
00:04:07,706 --> 00:04:09,956
and have it available
for other scientists

88
00:04:09,956 --> 00:04:10,846
or the public to look at.

89
00:04:11,676 --> 00:04:16,216
The things you can
measure from satellites is,

90
00:04:16,646 --> 00:04:19,746
I won't say it's endless but
pretty much almost anything

91
00:04:19,746 --> 00:04:21,086
about the surface of the earth

92
00:04:21,086 --> 00:04:24,186
and the atmosphere you can
measure from a satellite.

93
00:04:24,586 --> 00:04:26,726
You can look at things
like surface compositions

94
00:04:26,726 --> 00:04:28,486
of different materials
like the elements

95
00:04:28,486 --> 00:04:29,516
or the minerals that make it up.

96
00:04:30,076 --> 00:04:32,196
You can look at the
composition of the atmosphere

97
00:04:32,196 --> 00:04:34,086
or the presence of
pollutants in the atmosphere.

98
00:04:34,526 --> 00:04:36,266
You can look at things
like surface temperature,

99
00:04:36,356 --> 00:04:40,406
the land surface temperature or
the ocean surface temperature.

100
00:04:41,016 --> 00:04:44,486
You can look at things like
vegetation extent and health

101
00:04:44,636 --> 00:04:45,676
over the entire globe.

102
00:04:46,496 --> 00:04:49,986
It's really, the
possibilities are really defined

103
00:04:49,986 --> 00:04:53,806
by the physics of
electromagnetic spectrum.

104
00:04:57,206 --> 00:04:59,396
>> Very good question
and very good answer.

105

00:04:59,536 --> 00:05:01,726
Do you have another one?

106
00:05:01,726 --> 00:05:03,946
>> What is one of the satellites

107
00:05:03,946 --> 00:05:09,086
that take the most
up to date photos?

108
00:05:09,316 --> 00:05:10,426
>> Will Stefanov: That
I'd have to say is

109
00:05:10,426 --> 00:05:12,406
in the commercial
satellite realm.

110
00:05:12,926 --> 00:05:15,586
There's a number of commercial
satellites that collect data

111
00:05:15,796 --> 00:05:18,546
of fine enough resolution
or surface detail

112
00:05:18,886 --> 00:05:22,576
that you can see things that
are less than about a foot apart

113
00:05:22,936 --> 00:05:25,136
on the ground from orbit and one

114
00:05:25,136 --> 00:05:26,646
of those satellites
is called GOI.

115
00:05:26,646 --> 00:05:30,136
In fact some of the imagery,
if you look at Google Earth,

116
00:05:30,676 --> 00:05:32,896
some of the imagery that you see
in there and when you can zoom

117
00:05:32,896 --> 00:05:36,146
down to the street level, not
the street level itself but just

118
00:05:36,146 --> 00:05:38,686
above the street level, that's
from satellites like this,

119
00:05:38,796 --> 00:05:39,726
that kind of resolution.

120
00:05:40,076 --> 00:05:42,716
In fact some of them collect
data that's so finely detailed

121
00:05:42,966 --> 00:05:44,346
that you can't release
it to the public

122
00:05:44,436 --> 00:05:45,776
because it's a security concern.

123
00:05:47,026 --> 00:05:51,606
But other satellites,
other censors are designed

124
00:05:51,606 --> 00:05:54,326
so that they collect more
information over the same spot

125
00:05:54,326 --> 00:05:56,346
on the earth in shorter
time scales.

126

00:05:56,346 --> 00:05:58,846
So some sensors can take
data several times a day

127
00:05:59,216 --> 00:06:01,056
over the same spot on
the earth as opposed

128
00:06:01,056 --> 00:06:02,536
to getting real high
resolution data.

129
00:06:03,016 --> 00:06:04,226
It's kind of a tradeoff
right now.

130
00:06:04,226 --> 00:06:05,916
Our technology is
still at the level

131
00:06:05,916 --> 00:06:08,776
where you either get really,
really detailed information

132
00:06:09,226 --> 00:06:12,266
or you get a lot of
information over the same spot

133
00:06:12,636 --> 00:06:15,496
but you don't typically
get it at the same time.

134
00:06:17,006 --> 00:06:18,116
>> Very interesting.

135
00:06:18,526 --> 00:06:20,996
I can tell you guys
have done your homework.

136
00:06:21,046 --> 00:06:21,946

Got another question?

137
00:06:23,426 --> 00:06:25,936
>> How long will it be
until the next Pangaea

138
00:06:25,936 --> 00:06:27,516
or super continent forms?

139
00:06:29,306 --> 00:06:31,376
>> Will Stefanov: That's an
excellent geological question,

140
00:06:31,716 --> 00:06:34,496
right close to my heart.

141
00:06:34,706 --> 00:06:38,656
The super continent Pangaea, the
last one, there's actually been,

142
00:06:38,656 --> 00:06:41,706
we think there's been six
in geological history,

143
00:06:42,146 --> 00:06:45,136
the last one formed about
300 million years ago

144
00:06:45,136 --> 00:06:47,906
and then started to break up
about 200 million years ago.

145
00:06:48,436 --> 00:06:51,016
And we can look at the way the
plates are currently moving

146
00:06:51,016 --> 00:06:53,896
today and make predictive
models of,

147
00:06:54,006 --> 00:06:55,936
if everything continues the
same, of what will happen.

148
00:06:56,286 --> 00:06:58,456
So the current predictions are

149
00:06:58,456 --> 00:07:00,916
that we might see another
Pangaea like continent,

150
00:07:01,296 --> 00:07:03,136
which geologists are
calling Pangaea ultimate,

151
00:07:03,536 --> 00:07:06,816
in about another 250
million years or so.

152
00:07:07,516 --> 00:07:12,436
[Silence]

153
00:07:12,936 --> 00:07:16,436
>> How long do you have to be in
college before you get to work

154
00:07:16,436 --> 00:07:18,596
at NASA as a NASA scientist?

155
00:07:19,086 --> 00:07:20,846
>> Will Stefanov: [laughter]
That's actually a good question.

156
00:07:21,146 --> 00:07:23,356
The answer is it
really kind of depends

157
00:07:23,356 --> 00:07:25,426
on what you want to do at NASA.

158
00:07:25,426 --> 00:07:27,776
There's a wide range of job
opportunities available.

159
00:07:28,506 --> 00:07:30,686
You can be, I would have to say

160
00:07:30,686 --> 00:07:33,426
that probably getting a
bachelor's degree is the basic

161
00:07:33,756 --> 00:07:36,266
minimum that you might want
to do so four to five years

162
00:07:36,266 --> 00:07:40,256
in college but you could
be a computer programmer,

163
00:07:40,256 --> 00:07:42,386
you can be a scientist,
you can be an engineer,

164
00:07:43,026 --> 00:07:45,616
you can be a writer,
you can be a speaker,

165
00:07:45,616 --> 00:07:48,826
you can be a TV producer,
it all really depends

166
00:07:48,826 --> 00:07:49,476
on what you want to do.

167
00:07:49,726 --> 00:07:51,826
But I'd say a bachelor's
degree is probably the minimum.

168

00:07:51,986 --> 00:07:53,636
For some things you might
need a more advanced degree

169
00:07:53,636 --> 00:07:56,406
like a master's degree or a
PhD and that adds more years

170
00:07:56,406 --> 00:07:57,146
to your time in school.

171
00:07:57,716 --> 00:08:01,616
>> But it starts where you are
now, every course you take,

172
00:08:01,616 --> 00:08:06,496
every year, you know, that you
add more education to yourself,

173
00:08:06,496 --> 00:08:10,276
it's something that only
enhances your knowledge

174
00:08:10,326 --> 00:08:14,526
and will pave the way to where
you want to go so keep studying.

175
00:08:14,766 --> 00:08:15,646
>> Will Stefanov:
Exactly right, yes.

176
00:08:16,076 --> 00:08:17,556
>> We have another question?

177
00:08:18,096 --> 00:08:23,716
>> Is there a chance that one

178
00:08:23,716 --> 00:08:25,916
of our current continents
will split again?

179
00:08:26,046 --> 00:08:29,216
If so, which one would
be most likely to split?

180
00:08:31,226 --> 00:08:33,186
>> Will Stefanov: Well okay,
yeah, I think you're asking

181
00:08:33,776 --> 00:08:37,966
if we're going to see
any large new separations

182
00:08:37,966 --> 00:08:39,806
of continents, probably not.

183
00:08:39,806 --> 00:08:44,146
As I said earlier, the
current thinking is

184
00:08:44,146 --> 00:08:45,896
that we're actually
entering a phase

185
00:08:45,896 --> 00:08:46,966
where the continents
are starting

186
00:08:46,966 --> 00:08:48,056
to come back together again

187
00:08:48,606 --> 00:08:50,356
over the next 250
million years or so.

188
00:08:50,896 --> 00:08:54,376
That being said, there is an
active rift, an active area

189

00:08:54,376 --> 00:08:56,356
where there is a little bit
of continental splitting going

190
00:08:56,356 --> 00:08:59,536
on right now in East Africa,
the East African rift.

191
00:08:59,956 --> 00:09:02,826
And that's where the
basaltic magma is coming

192
00:09:02,826 --> 00:09:06,116
up through the earth's crust and
actually splitting off the horn

193
00:09:06,116 --> 00:09:07,826
of Africa, the eastern
most part of Africa,

194
00:09:07,866 --> 00:09:09,186
away from the rest
of the mainland.

195
00:09:09,546 --> 00:09:10,706
So that's going on right now.

196
00:09:10,706 --> 00:09:13,026
But apart from that, that's
really about the only place

197
00:09:13,026 --> 00:09:15,976
where we're seeing a large scale
continental rifting going on.

198
00:09:16,516 --> 00:09:21,606
[Noise]

199
00:09:22,106 --> 00:09:22,656
>> Any questions?

200
00:09:23,576 --> 00:09:27,956
>> If the ocean floor is a
different rock than the basalt,

201
00:09:27,956 --> 00:09:29,356
what would change about earth?

202
00:09:30,066 --> 00:09:31,966
>> They have great questions
for you, being a geologist.

203
00:09:32,346 --> 00:09:35,096
>> Will Stefanov: That
is a deep question.

204
00:09:35,416 --> 00:09:40,596
What would happen, the big
answer is plate tectonics

205
00:09:41,116 --> 00:09:44,066
probably wouldn't work, at least
it certainly wouldn't work the

206
00:09:44,066 --> 00:09:44,926
way we see it now.

207
00:09:45,366 --> 00:09:48,236
Because the big difference
between the oceanic crust

208
00:09:48,376 --> 00:09:51,006
and the continental
crust is their densities.

209
00:09:51,006 --> 00:09:54,036
Continental crust is
much less dense and light

210

00:09:54,036 --> 00:09:58,826
so it has a tendency to
float or raise higher

211
00:09:58,866 --> 00:10:00,136
on the earth's surface.

212
00:10:00,206 --> 00:10:03,866
Oceanic basalt is very dense,
very heavy and it's produced

213
00:10:03,866 --> 00:10:06,796
by magma from the
earth's mantle coming out

214
00:10:06,796 --> 00:10:08,406
and erupting along
mid ocean ridges.

215
00:10:09,016 --> 00:10:10,886
What that does is it
creates new sea floor

216
00:10:10,886 --> 00:10:13,716
and pushes the continents
apart and that's one

217
00:10:13,716 --> 00:10:15,646
of the big driving factors
behind plate tectonics.

218
00:10:15,646 --> 00:10:17,066
If it was all the same kind

219
00:10:17,066 --> 00:10:20,166
of material then it
would be very difficult

220
00:10:20,166 --> 00:10:21,316
to move them apart that way.

221
00:10:21,636 --> 00:10:26,586
Also the heavy oceanic crust
is recycled easier back

222
00:10:26,586 --> 00:10:28,336
into the mantle along
seduction zones.

223
00:10:28,706 --> 00:10:31,116
And again if the material is
the same, is that same density,

224
00:10:31,546 --> 00:10:32,806
that would be very
difficult to do

225
00:10:33,306 --> 00:10:35,256
so you wouldn't have this
whole recycling going on.

226
00:10:35,726 --> 00:10:37,886
So that would be
the major change.

227
00:10:37,886 --> 00:10:40,516
What that would mean to the way
the earth's surface would look,

228
00:10:41,276 --> 00:10:44,446
well over time you wouldn't
have new mountains being formed,

229
00:10:44,446 --> 00:10:47,076
for one thing, and so you
would expect that over millions

230
00:10:47,076 --> 00:10:48,616
of years you might see
the mountains starting

231
00:10:48,616 --> 00:10:50,436
to be eroded down
to flat plains.

232
00:10:50,966 --> 00:10:52,156
That doesn't happen on earth

233
00:10:52,416 --> 00:10:54,056
because we have active
plate tectonics.

234
00:10:54,896 --> 00:10:57,576
That would be one major
change and of course

235
00:10:57,576 --> 00:10:59,896
that would cause a whole
series of climatic differences

236
00:11:00,406 --> 00:11:02,626
and a lot of stuff
would be very different

237
00:11:02,886 --> 00:11:04,286
so very excellent question.

238
00:11:04,646 --> 00:11:06,126
There's a lot contained
in that question.

239
00:11:06,576 --> 00:11:10,096
>> Literally and figuratively,
[laughter] great question.

240
00:11:10,096 --> 00:11:12,326
Do we have another one?

241
00:11:12,946 --> 00:11:15,356

>> How do you predict
natural disasters?

242
00:11:16,056 --> 00:11:18,036
>> Will Stefanov: You
guys are just coming

243
00:11:18,036 --> 00:11:19,126
up with awesome questions.

244
00:11:20,356 --> 00:11:25,106
We can't really predict natural
disasters with any degree

245
00:11:25,106 --> 00:11:28,826
of certainty today but there
are a lot of types of disasters

246
00:11:29,356 --> 00:11:31,126
that frequently give us warnings

247
00:11:31,566 --> 00:11:33,286
that something might
be happening.

248
00:11:33,746 --> 00:11:36,966
For instance, large storm
systems like hurricanes.

249
00:11:37,506 --> 00:11:40,106
We're now pretty good
at being able to detect

250
00:11:40,106 --> 00:11:42,676
when those storms are
forming and be able to detect

251
00:11:42,676 --> 00:11:45,036
where they're going to
go, maybe not so good

252
00:11:45,036 --> 00:11:46,286
at how strong they're
going to be

253
00:11:46,656 --> 00:11:49,746
but at least we can plot their
tracks enough to let people know

254
00:11:49,746 --> 00:11:51,566
that a storm is coming
so they can evacuate

255
00:11:51,566 --> 00:11:52,756
and get out of the way.

256
00:11:52,756 --> 00:11:55,326
For other things like
volcanoes, volcanic eruptions,

257
00:11:56,056 --> 00:11:58,666
we can detect some
of them sometimes.

258
00:11:58,666 --> 00:12:01,996
Occasionally volcanoes will have
hotspots that you can detect

259
00:12:01,996 --> 00:12:04,066
from satellites in
orbit that indicate

260
00:12:04,066 --> 00:12:06,346
that there might be magma
coming to the surface

261
00:12:06,346 --> 00:12:07,526
and an eruption might
be eminent.

262
00:12:08,006 --> 00:12:11,646
Also sometimes the volcano shape
itself changes as magma comes

263
00:12:11,646 --> 00:12:13,696
into the volcano and it
causes the ground to raise.

264
00:12:13,966 --> 00:12:16,936
We can measure that
with GPS sensors.

265
00:12:18,036 --> 00:12:20,846
Things like earthquakes,
those are really difficult

266
00:12:21,026 --> 00:12:23,486
because earthquakes
quite frequently occur

267
00:12:23,486 --> 00:12:25,196
with no advanced
warning whatsoever.

268
00:12:25,966 --> 00:12:28,856
Sometimes we know where
earthquakes have occurred

269
00:12:28,856 --> 00:12:30,416
so we can assume, based

270
00:12:30,416 --> 00:12:32,026
on the last time a big
earthquake has occurred,

271
00:12:32,026 --> 00:12:34,756
we can make some idea of when
the next one might happen

272

00:12:35,366 --> 00:12:37,006
but it's really just
a prediction.

273
00:12:37,006 --> 00:12:38,296
It's really hard to
predict anything with,

274
00:12:38,716 --> 00:12:40,896
to make a real certain deduction

275
00:12:40,896 --> 00:12:41,976
of when a big earthquake
might occur.

276
00:12:42,516 --> 00:12:47,776
[Noise]

277
00:12:48,276 --> 00:12:51,246
>> How will the technologies

278
00:12:51,246 --> 00:12:54,186
of the Gozar series
satellites improve compared

279
00:12:54,186 --> 00:12:58,056
to the current Go satellites?

280
00:12:58,266 --> 00:12:59,156
>> Will Stefanov:
Excellent technical question,

281
00:12:59,576 --> 00:13:02,236
the big different
there between Gozar

282
00:13:02,236 --> 00:13:06,776
and the current satellites is in
the sensitivity of the sensors

283
00:13:06,776 --> 00:13:07,886
and their capabilities.

284
00:13:07,886 --> 00:13:12,066
The Gozar satellite will still
view the western hemisphere,

285
00:13:12,676 --> 00:13:14,126
it will collect the
same measurements

286
00:13:14,126 --> 00:13:15,676
that the current Go
satellites collect

287
00:13:16,186 --> 00:13:18,696
but it will have better
imaging capabilities,

288
00:13:18,696 --> 00:13:21,976
it will be sensitive to some
new pieces of information

289
00:13:22,116 --> 00:13:23,436
that the current
satellites aren't.

290
00:13:23,956 --> 00:13:26,486
And on the solar end it's
kind of the same story,

291
00:13:26,556 --> 00:13:30,406
better imagers, better detectors
for some of the solar particles

292
00:13:30,406 --> 00:13:32,586
that come back and all
of this is designed

293

00:13:32,586 --> 00:13:35,606
to give us better
weather forecasting

294
00:13:35,606 --> 00:13:36,656
predicting capabilities.

295
00:13:37,196 --> 00:13:44,816
>> Is it possible
for a super storm

296
00:13:44,816 --> 00:13:47,486
or multiple natural
disasters at once to occur

297
00:13:47,486 --> 00:13:49,276
and cause mass extinction
on planet earth?

298
00:13:50,896 --> 00:13:52,396
>> Will Stefanov: This is
another great question,

299
00:13:52,906 --> 00:13:57,716
I have to say the answer is
probably no and the reason I say

300
00:13:57,716 --> 00:14:00,686
that is because there's
enough spots on the earth

301
00:14:00,686 --> 00:14:02,336
that are geologically quiet.

302
00:14:02,496 --> 00:14:03,936
They're not prone
to big earthquakes.

303
00:14:04,276 --> 00:14:07,896
They don't have active volcanoes

going on, to where even

304
00:14:07,896 --> 00:14:09,146
if all the other ones went off,

305
00:14:09,326 --> 00:14:11,246
it wouldn't cause mass
extinction of the human race.

306
00:14:11,286 --> 00:14:13,406
There would still be
people left in those areas.

307
00:14:14,156 --> 00:14:15,586
What would be more likely

308
00:14:15,586 --> 00:14:18,886
to cause mass extinction would
probably be something similar

309
00:14:18,886 --> 00:14:20,556
to what caused the
dinosaurs extinction,

310
00:14:20,666 --> 00:14:23,206
like a large asteroid
impact on the surface.

311
00:14:23,536 --> 00:14:26,306
You'd need an event of
that kind of magnitude

312
00:14:26,846 --> 00:14:28,816
to create enough
environmental disturbance

313
00:14:29,336 --> 00:14:33,446
to really make the
environment so inhospitable

314
00:14:33,446 --> 00:14:34,856
that we'd be looking
at a mass extinction

315
00:14:35,456 --> 00:14:36,356
but that's a great question.

316
00:14:37,136 --> 00:14:37,706
>> Excellent.

317
00:14:38,146 --> 00:14:44,936
>> At any point in time will
any land forms erode to a point

318
00:14:44,976 --> 00:14:46,246
that there isn't enough room

319
00:14:46,246 --> 00:14:49,136
for the organisms inhabiting
it to remain stationary?

320
00:14:49,136 --> 00:14:55,296
If so will they evolve into some
other sort of life or migrate?

321
00:14:56,036 --> 00:14:59,316
>> Will Stefanov: That's another
great plate tectonic question.

322
00:14:59,316 --> 00:15:02,546
It kind of gets back to an
answer to a previous question

323
00:15:02,866 --> 00:15:05,176
about what would happen if
plate tectonics stopped working.

324
00:15:05,836 --> 00:15:07,536
That's really what you'd

need to have happen

325
00:15:07,856 --> 00:15:10,606
to cause what you're
talking about.

326
00:15:10,796 --> 00:15:13,276
There's actually a term that
geologists use for that.

327
00:15:13,376 --> 00:15:16,856
Geologists, about 100 years
ago, thought this same question,

328
00:15:16,856 --> 00:15:19,076
they said how come
we have mountains?

329
00:15:19,076 --> 00:15:21,036
It was before plate
tectonics was understood

330
00:15:21,716 --> 00:15:23,966
and they were asking why
don't the mountains just wear

331
00:15:23,966 --> 00:15:25,786
down to flat plains?

332
00:15:25,786 --> 00:15:28,346
We know now it's because
new mountains are formed due

333
00:15:28,346 --> 00:15:30,916
to plate tectonics but
if that didn't exist

334
00:15:31,416 --> 00:15:32,406
and you just had erosion,

335
00:15:32,506 --> 00:15:35,396
yeah then eventually you'd wear
everything down to a flat plain.

336
00:15:35,996 --> 00:15:38,456
Now this wouldn't
happen instantaneously.

337
00:15:38,456 --> 00:15:40,316
Of course this would take
hundreds of millions of years

338
00:15:40,696 --> 00:15:45,266
so that's plenty of time for
existing creatures to migrate,

339
00:15:45,296 --> 00:15:48,526
to adapt to new conditions
and so forth.

340
00:15:49,046 --> 00:15:51,696
So I think you would
see adaption occurring

341
00:15:51,696 --> 00:15:53,696
if plate tectonics
stopped functioning

342
00:15:54,256 --> 00:15:56,566
but things wouldn't
go completely extinct.

343
00:16:00,976 --> 00:16:02,176
>> You're getting some zingers.

344
00:16:02,326 --> 00:16:04,056
These are good.

345
00:16:04,056 --> 00:16:06,386

>> So the plates are shifting,

346
00:16:07,076 --> 00:16:11,496
so anywhere like within
the next million years,

347
00:16:11,496 --> 00:16:13,226
would there be anything
falling off,

348
00:16:13,226 --> 00:16:14,556
coming off of North America?

349
00:16:17,476 --> 00:16:21,256
>> Will Stefanov: Oops,
sorry, the answer to that,

350
00:16:21,256 --> 00:16:23,636
the short answer is no except

351
00:16:23,636 --> 00:16:25,956
for probably southern
California.

352
00:16:26,476 --> 00:16:29,376
Most of the plate
tectonic models show

353
00:16:29,376 --> 00:16:32,136
that southern California over
the next 50 million years

354
00:16:32,136 --> 00:16:35,646
or so is likely to break kind
of along the San Andreas Fault

355
00:16:36,016 --> 00:16:37,436
and start moving towards Alaska

356

00:16:38,306 --> 00:16:41,446
so California may get
smaller but that's about it.

357
00:16:43,796 --> 00:16:51,026
>> Are the teachers who train
astronaut's actual astronauts

358
00:16:51,026 --> 00:16:53,696
themselves or are they just
people who use information

359
00:16:54,146 --> 00:16:55,816
from other astronauts to teach?

360
00:16:56,006 --> 00:16:58,596
>> Will Stefanov:
That's a good question.

361
00:16:58,596 --> 00:17:02,326
I'm actually one of the
people who trains astronauts

362
00:17:02,916 --> 00:17:05,096
through the [inaudible]
project here.

363
00:17:05,536 --> 00:17:09,526
Astronauts, they do train
each other in some aspects

364
00:17:09,736 --> 00:17:13,526
but for science training they're
trained by people like me

365
00:17:13,526 --> 00:17:15,546
and others of my colleagues,
in other words scientists,

366
00:17:15,546 --> 00:17:16,796

atmospheric scientists.

367
00:17:17,246 --> 00:17:19,996
And for other technical issues
like for taking photographs

368
00:17:19,996 --> 00:17:23,556
on the ISS, they're trained by
another group that is composed

369
00:17:23,556 --> 00:17:26,716
of expert photographers
so I guess the answer

370
00:17:26,716 --> 00:17:27,736
to your question is yes and no.

371
00:17:27,736 --> 00:17:29,636
For some things the
astronauts do train themselves

372
00:17:29,636 --> 00:17:31,556
but for other things they
rely on outside experts.

373
00:17:32,886 --> 00:17:33,646
>> Very good question.

374
00:17:33,646 --> 00:17:36,576
I think we actually have a
website, maybe we can get

375
00:17:36,606 --> 00:17:40,666
that for you guys, just where
you can actually go and look

376
00:17:40,666 --> 00:17:42,666
at a lot of those
photographs that are taken.

377
00:17:42,826 --> 00:17:44,226
>> Will Stefanov:
Yep, absolutely, yeah,

378
00:17:44,326 --> 00:17:47,276
if you do a Google search on
astronaut photography of earth,

379
00:17:47,386 --> 00:17:51,916
it will take you to the
website, yeah and there is.

380
00:17:51,916 --> 00:17:52,136
>> Yeah.

381
00:17:52,136 --> 00:17:56,416
>> Does the upper atmospheric
research satellite really have

382
00:17:56,416 --> 00:17:59,536
pieces falling on earth
and wouldn't it burn

383
00:17:59,536 --> 00:18:01,146
up on the earth's atmosphere?

384
00:18:02,786 --> 00:18:06,156
>> Will Stefanov: That's an
excellent question to ask

385
00:18:06,316 --> 00:18:09,596
because kind of as I said
earlier, there's orbital debris

386
00:18:09,596 --> 00:18:13,796
and meteors falling on the
earth all the time every day.

387
00:18:14,266 --> 00:18:16,686

Most of that stuff is so
small that it does burn

388
00:18:16,686 --> 00:18:18,516
up in the atmosphere and it
never gets to the surface.

389
00:18:19,156 --> 00:18:22,396
For the UR satellite, that
was a little different case.

390
00:18:22,396 --> 00:18:24,026
That thing was the size of a bus

391
00:18:24,706 --> 00:18:26,916
and when it entered
the atmosphere,

392
00:18:27,146 --> 00:18:29,656
most of it did indeed
burn up but it was so big

393
00:18:29,656 --> 00:18:32,836
that some pieces did survive
to go through the atmosphere.

394
00:18:33,386 --> 00:18:36,536
Now most of those pieces
fell into the ocean

395
00:18:36,846 --> 00:18:39,036
because the ocean covers
70% of the earth's surface

396
00:18:39,456 --> 00:18:41,366
and this happens to most
stuff that actually makes it

397
00:18:41,366 --> 00:18:44,476
through the atmosphere, to

hit the surface of the earth.

398
00:18:45,026 --> 00:18:48,726
There's been no reports, that I
know of at least, of anyone hit

399
00:18:48,786 --> 00:18:52,796
by any kind of debris [laughter]
from space and certainly nothing

400
00:18:52,796 --> 00:18:56,066
from the UR satellite.

401
00:18:56,916 --> 00:19:01,006
>> How long does it
take for information

402
00:19:01,006 --> 00:19:02,636
to be received from
the satellite?

403
00:19:02,636 --> 00:19:06,756
Is there any delay or does
it happen in real time?

404
00:19:06,756 --> 00:19:07,876
>> Will Stefanov: That's
an excellent question.

405
00:19:07,936 --> 00:19:12,126
For most satellites there
is a slight delay time.

406
00:19:12,556 --> 00:19:16,116
Like I said earlier, if you
have a receiving station you can

407
00:19:16,116 --> 00:19:19,086
collect data from a satellite
as soon as it passes overhead

408
00:19:19,586 --> 00:19:22,306
but typically that data
is what we call raw.

409
00:19:22,376 --> 00:19:23,446
It's raw form, it needs

410
00:19:23,446 --> 00:19:26,656
to be processed before it
can be useable by scientists

411
00:19:26,656 --> 00:19:30,076
or a member of the public so
there typically is a delay time

412
00:19:30,436 --> 00:19:33,076
of a few hours before you
get data from the satellite

413
00:19:33,076 --> 00:19:34,636
to the point where
it can be distributed

414
00:19:34,636 --> 00:19:35,776
for use by the people.

415
00:19:36,416 --> 00:19:39,636
There are some other
kinds of sensors.

416
00:19:39,716 --> 00:19:43,876
Like on the ISS there are video
cameras that if there's a line

417
00:19:43,876 --> 00:19:48,186
of sight to the ground you
can transmit that information

418

00:19:48,186 --> 00:19:52,536
down in more or less real time
and there's new sensors going

419
00:19:52,536 --> 00:19:55,786
up on the ISS, high
definition external cameras,

420
00:19:56,276 --> 00:19:58,346
that will, that's the intent.

421
00:19:58,346 --> 00:19:59,996
The intent is to actually
have it in real time

422
00:19:59,996 --> 00:20:01,976
so you can view exactly
what is being seen

423
00:20:01,976 --> 00:20:03,666
from the space station
from the ground.

424
00:20:04,176 --> 00:20:04,806
>> That's excellent.

425
00:20:05,116 --> 00:20:07,096
Do you have any more questions?

426
00:20:07,396 --> 00:20:09,566
We have just a little
bit more time.

427
00:20:10,126 --> 00:20:14,986
>> Let's say a ship
passes over a sea floor

428
00:20:15,406 --> 00:20:17,996
that has a reverse
magnetic polarization,

429
00:20:18,506 --> 00:20:20,706
how would this effect
the magnetic field read?

430
00:20:22,826 --> 00:20:23,656
>> Will Stefanov:
So that question,

431
00:20:23,696 --> 00:20:25,656
and that's a great question,

432
00:20:26,856 --> 00:20:30,046
the ships compass
wouldn't see any effect.

433
00:20:30,216 --> 00:20:32,516
It would just see the regular,

434
00:20:32,766 --> 00:20:35,146
the current earth's magnetic
field and that's mainly

435
00:20:35,146 --> 00:20:37,426
because the ship is far
away, it's far enough

436
00:20:37,426 --> 00:20:39,966
above the sea floor so that
we won't get any effect

437
00:20:39,966 --> 00:20:41,486
from remnant magnetization.

438
00:20:42,146 --> 00:20:45,236
The way that was
originally discovered was

439
00:20:45,346 --> 00:20:48,016

by towing sensitive
sensors behind ships

440
00:20:48,076 --> 00:20:50,056
so they were pretty much
right over the sea floor

441
00:20:50,516 --> 00:20:52,806
and when you do that you
can see the difference

442
00:20:52,806 --> 00:20:54,956
in magnetic field
orientation from the minerals

443
00:20:55,256 --> 00:20:57,436
that were frozen into the sea
floor when it crystallized.

444
00:20:57,986 --> 00:21:00,056
But from a ship on
the surface, no,

445
00:21:00,056 --> 00:21:01,926
you wouldn't see
any effect from it.

446
00:21:02,516 --> 00:21:07,576
[Silence]

447
00:21:08,076 --> 00:21:11,766
>> If you see dangerous weather
coming to a certain area,

448
00:21:12,366 --> 00:21:15,356
who do you usually contact?

449
00:21:15,356 --> 00:21:17,586
>> Will Stefanov: Okay I
think you mean, are you asking

450
00:21:17,586 --> 00:21:21,546
if you see dangerous weather
from orbit or on the ground?

451
00:21:23,196 --> 00:21:24,336
>> On the ground.

452
00:21:25,356 --> 00:21:27,776
>> Will Stefanov: Okay well if
you see dangerous weather coming

453
00:21:27,776 --> 00:21:29,796
on the ground, like a tornado
or something like that,

454
00:21:30,366 --> 00:21:32,536
well the first thing
I would do is attend

455
00:21:32,536 --> 00:21:35,186
to your own safety first, you
know find somewhere that's

456
00:21:35,186 --> 00:21:38,526
out of the path but then you
would consider calling your

457
00:21:38,526 --> 00:21:43,396
parents or the local police
department or fire department.

458
00:21:43,956 --> 00:21:46,466
Typically though,
this is an advantage

459
00:21:46,466 --> 00:21:49,266
of the weather satellites, for
a lot of the big storm systems,

460
00:21:49,266 --> 00:21:52,186
even for tornadoes, we're
proving our ability to be able

461
00:21:52,186 --> 00:21:56,036
to detect where those might
occur from orbit so we're trying

462
00:21:56,116 --> 00:21:58,456
to improve the ability to
warn people in the path

463
00:21:58,456 --> 00:22:00,606
of say tornadoes to
keep on the lookout,

464
00:22:00,606 --> 00:22:01,376
something might be forming.

465
00:22:01,996 --> 00:22:03,996
>> Thank you.

466
00:22:08,336 --> 00:22:10,526
>> How accurate can
you measure the speed

467
00:22:10,526 --> 00:22:11,956
of the continents moving?

468
00:22:13,726 --> 00:22:16,246
>> Will Stefanov: We have a
lot of fans of plate tectonics

469
00:22:16,506 --> 00:22:19,416
in the audience today.

470
00:22:19,416 --> 00:22:22,536
With GPS satellite measurements
you can actually measure the

471
00:22:22,536 --> 00:22:26,556
speed of the continents
down to millimeters per year

472
00:22:27,286 --> 00:22:29,976
but typically geologists,
we tend to measure the rate

473
00:22:29,976 --> 00:22:31,036
in centimeters per year.

474
00:22:31,656 --> 00:22:34,386
And on average the continents
are moving between about two

475
00:22:34,386 --> 00:22:35,676
and 10 centimeters per year.

476
00:22:36,126 --> 00:22:37,966
And that's about the same
rate your fingernails grow.

477
00:22:38,516 --> 00:22:49,316
[Noise]

478
00:22:49,816 --> 00:22:52,146
>> Do we have any others?

479
00:22:53,356 --> 00:22:54,516
This is really exciting.

480
00:22:54,726 --> 00:22:57,356
I'm enjoying these
questions and answers here.

481
00:22:57,356 --> 00:23:04,206
>> Can you tell us a little
bit about your research?

482
00:23:05,026 --> 00:23:06,886
>> Will Stefanov: Oh, I
didn't know I was going

483
00:23:07,626 --> 00:23:08,616
to talk about myself here.

484
00:23:08,616 --> 00:23:09,406
I'm a geologist.

485
00:23:09,826 --> 00:23:13,766
And most of my research is
done using data from satellites

486
00:23:13,846 --> 00:23:17,146
to look at the earth's surface
and in particular I do a lot

487
00:23:17,146 --> 00:23:20,816
of work in mapping where
different minerals are,

488
00:23:20,816 --> 00:23:22,716
different rocks and minerals
so geological mapping.

489
00:23:23,046 --> 00:23:27,226
Also I do a lot of work in
human dominated systems,

490
00:23:27,226 --> 00:23:31,116
like I look at urban heat
elements where cities get hotter

491
00:23:31,116 --> 00:23:34,076
than their surrounding
environments and in particular

492

00:23:34,076 --> 00:23:36,876
where people in those
cities are most at risk

493
00:23:37,286 --> 00:23:38,476
from high heat events.

494
00:23:39,326 --> 00:23:42,776
So my thing is basically
geologic hazards in general

495
00:23:43,166 --> 00:23:46,836
but particularly looking at
geologic hazards around cities

496
00:23:47,226 --> 00:23:48,606
so that's what I spend
most of my time doing.

497
00:23:48,806 --> 00:23:50,566
>> That's one of those
good geology questions,

498
00:23:50,566 --> 00:23:51,756
one of the really
great ones today.

499
00:23:51,956 --> 00:23:52,926
>> Will Stefanov:
Exactly, thank you.

500
00:23:53,356 --> 00:23:54,976
>> Do we have any others?

501
00:23:55,516 --> 00:24:01,816
[Silence]

502
00:24:02,316 --> 00:24:05,856
>> Does anyone else
have a question?

503
00:24:06,416 --> 00:24:07,496
Okay, alright.

504
00:24:08,516 --> 00:24:17,606
[Inaudible audience comment]

505
00:24:18,106 --> 00:24:20,776
>> Okay I think that's
all the time we have.

506
00:24:20,886 --> 00:24:23,376
Guys, we really, really
appreciate those questions.

507
00:24:23,376 --> 00:24:24,446
They're really great questions.

508
00:24:24,446 --> 00:24:26,046
Thank you again,
Will, for coming out

509
00:24:26,046 --> 00:24:27,976
and talking with the students.

510
00:24:27,976 --> 00:24:29,686
>> Will Stefanov:
You're very welcome.

511
00:24:29,926 --> 00:24:31,436
>> I hope you all
learned something new.

512
00:24:31,436 --> 00:24:32,246
I know I did.

513
00:24:32,506 --> 00:24:36,306
Go back to working
there and studying hard

514
00:24:36,306 --> 00:24:38,796
and making your way to
where you want to go.