



Lisa Ruth Rand

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1
00:00:20,070 --> 00:00:23,580
HELLO EVERYONE, MY NAME IS MARTIN COLLINS
I AM THE CURATOR AT THE

2
00:00:23,580 --> 00:00:26,730
NATIONAL AIR AND SPACE MUSEUM
AND WELCOME TO AEROSPACE.

3
00:00:26,730 --> 00:00:31,430
FIRST I WOULD LIKE TO THANK THE
SPONSOR OF THIS PRESENTATION

4
00:00:31,430 --> 00:00:34,120
SERIES, THE FOLLOWING COMPANY.

5
00:00:34,120 --> 00:00:38,340
AND TODAY WE WILL BE TALKING
ABOUT CLEANING UP SPACE.

6
00:00:38,340 --> 00:00:42,920
AND THAT CLEANING UP SPACE IS
AN ISSUE OF DEALING WITH

7
00:00:42,920 --> 00:00:46,780
DEBRIS, JUNK, AND OTHER STUFF
THAT WE DON'T WANT TO BE UP

8
00:00:46,780 --> 00:00:48,300
THERE.

9
00:00:48,300 --> 00:00:52,300
WITH THE CONSIDERATION THAT IT
MIGHT INTERFERE WITH ALL THE

10
00:00:52,300 --> 00:00:55,470
THINGS THAT WE DO WANT TO BE UP
THERE AND WORKING ON OUR

11
00:00:55,470 --> 00:00:56,470

BEHALF.

12

00:00:56,470 --> 00:00:59,850

IF WE COULD HAVE THE FIRST
SLIDE, PLEASE.

13

00:00:59,850 --> 00:01:03,750

I WANT TO SET UP THE CONTEXT OF
THE STORY A LITTLE BIT.

14

00:01:03,750 --> 00:01:09,650

THIS IS AN IMAGE, AN ARTIST
IMAGE OF A DEBRIS FIELD AROUND

15

00:01:09,650 --> 00:01:10,650

THE PLANET EARTH.

16

00:01:10,650 --> 00:01:14,789

OF COURSE AT THE VERY CENTER IS
EARTH.

17

00:01:14,789 --> 00:01:18,490

AND YOU WILL NOTICE THAT THE
DENSEST AMOUNT OF DEBRIS IS

18

00:01:18,490 --> 00:01:20,630

AROUND IMMEDIATELY AROUND THE
PLANET.

19

00:01:20,630 --> 00:01:24,580

BUT THERE ARE RINGS A BIT THAT
GO MUCH FARTHER OUT.

20

00:01:24,580 --> 00:01:28,720

AND WHY DOES THE DEBRIS FIELD
LOOK LIKE THIS: WELL, ON THE

21

00:01:28,720 --> 00:01:34,030

NEXT SLIDE WE WILL SEE HOW THE
SATELLITES ARE DEPLOYED AROUND

22

00:01:34,030 --> 00:01:35,100

THE EARTH.

23

00:01:35,100 --> 00:01:38,420

AND THIS SCHEMATIC LET YOU
UNDERSTAND WHY THAT DEBRIS

24

00:01:38,420 --> 00:01:41,210

FIELD HAS THE CONCENTRATIONS
THAT IT DOES.

25

00:01:41,210 --> 00:01:44,540

THIS SPOT, LET'S SEE, FOR OUT
HERE IF YOU LOOK AT THIS FOR

26

00:01:44,540 --> 00:01:48,751

PERIMETER LINE THAT WAS THE
FARTHEST SET OF DEBRIS YOU CAN

27

00:01:48,751 --> 00:01:50,110

SEE AROUND THE EARTH.

28

00:01:50,110 --> 00:01:53,750

BUT THAT MORE INTENSE FIELD OF
DEBRIS THAT YOU SAW AROUND THE

29

00:01:53,750 --> 00:01:55,900

EARTH, THIS WAS HERE.

30

00:01:55,900 --> 00:01:58,920

AND WHAT THAT REPRESENTS IS THE
DIFFERENT KINDS OF SATELLITES

31

00:01:58,920 --> 00:02:04,320

THAT WE HAVE AROUND THE PLANET
EARTH AND HOW OVERTIME THEY

32

00:02:04,320 --> 00:02:07,490

HAVE CREATED THIS DEBRIS FIELD
THANK YOU SAUL FOR THE VERY

33

00:02:07,490 --> 00:02:09,489
FIRST GRAPHIC.

34

00:02:09,489 --> 00:02:11,380
NEXT SLIDE, PLEASE.

35

00:02:11,380 --> 00:02:14,209
AND WHY DOES THE MUSEUM HAVE AN
INTEREST IN THIS:AS A MUSEUM

36

00:02:14,209 --> 00:02:16,950
THAT TALKS ABOUT THE HISTORY OF
SPACEFLIGHT WE HAVE LONG HAD

37

00:02:16,950 --> 00:02:22,060
THE AN ISSUE IN THE ISSUE OF
DEBRIS OR SPACE JUNK AND THIS

38

00:02:22,060 --> 00:02:25,390
IS AN EXAMPLE FROM HIS SOVIET
SATELLITE THAT WAS LAUNCHED IN

39

00:02:25,390 --> 00:02:34,549
1969, THIS DEBRIS FELL DOWN ON
THE SOUTHWEST, AND IT WAS

40

00:02:34,549 --> 00:02:38,570
COLLECTED AS PART OF OUR
COLLECTIONS HERE AT THE MUSEUM.

41

00:02:38,570 --> 00:02:40,770
WE HAVE OTHER ITEMS IN THE
COLLECTION THAT ALSO, SORT OF

42

00:02:40,770 --> 00:02:42,130
SPEAK TO THIS QUESTION.

43

00:02:42,130 --> 00:02:45,169

I JUST WANTED TO SHARE THAT
WITH YOU.

44

00:02:45,169 --> 00:02:49,730

TODAY OUR PRESENTATION WILL GO
IN THREE PHASES.

45

00:02:49,730 --> 00:02:52,329

THERE WILL BE A QUESTION AND
ANSWER WITH OUR GUEST SPEAKER

46

00:02:52,329 --> 00:02:54,989

WHO WILL I WILL INTRODUCE IN
JUST A MOMENT.

47

00:02:54,989 --> 00:03:00,459

AND THEN WE WILL HAVE A
PRESENTATION BY HER WHICH WELL,

48

00:03:00,459 --> 00:03:04,510

SORT OF FOCUS ON THE HISTORY OF
THE QUESTION OF DEBRIS.

49

00:03:04,510 --> 00:03:07,920

AND THEN WE WILL HAVE SOME
BREAK FOR QUESTIONS AND ANSWERS

50

00:03:07,920 --> 00:03:10,370

IN BETWEEN WITH THE AUDIENCE.

51

00:03:10,370 --> 00:03:14,720

WITH OUR ONLINE AUDIENCE AS
WELL AS THE NASA T.V.

52

00:03:14,720 --> 00:03:15,720

AUDIENCE.

53

00:03:15,720 --> 00:03:18,260

AND THEN WE WILL, SORT OF WRAP
UP WITH THE QUESTION OF WHAT DO

54

00:03:18,260 --> 00:03:21,500
WE DO ABOUT THIS DEBRIS
QUESTION AND ENTERTAIN FURTHER

55

00:03:21,500 --> 00:03:24,510
QUESTIONS AND ANSWERS FROM THE
AUDIENCE.

56

00:03:24,510 --> 00:03:28,730
SO LET ME INTRODUCE LISA RAND,
OUR SPEAKER TODAY.

57

00:03:28,730 --> 00:03:32,449
SHE IS A HISTORIAN PURSUING HER
DOCTORATE DEGREE THE UNIVERSITY

58

00:03:32,449 --> 00:03:36,110
OF PENNSYLVANIA AND SHE IS ALSO
A RESEARCH ASSOCIATE HERE AT

59

00:03:36,110 --> 00:03:37,110
THIS MISSONI AND INSTITUTION.

60

00:03:37,110 --> 00:03:38,110
WELCOME, LISA.

61

00:03:38,110 --> 00:03:40,979
>> GLAD TO BE HERE.

62

00:03:40,979 --> 00:03:44,200
>> LET'S START OFF WITH THAT
BASIC QUESTION, WHAT IS SPACE

63

00:03:44,200 --> 00:03:45,200
JUNK?

64

00:03:45,200 --> 00:03:47,729
>>Lisa: I, THAT IS A GREAT
QUESTION BUT I AM GOING TO

65
00:03:47,729 --> 00:03:48,729
AVOID ANSWERING IT.

66
00:03:48,729 --> 00:03:52,040
BECAUSE I WANT TO KNOW IF ANY
OF YOU HAVE ANY QUESTIONS.ANY

67
00:03:52,040 --> 00:03:53,040
OF YOU?

68
00:03:53,040 --> 00:03:54,040
DON'T BE SHY?

69
00:03:54,040 --> 00:03:58,600
JUNK IN SPACE.

70
00:03:58,600 --> 00:04:00,310
>> OLD SATELLITES.

71
00:04:00,310 --> 00:04:09,790
>>Lisa: OLD SATELLITES, GREAT
SAY AGAIN, MODELS, SO MODEL

72
00:04:09,790 --> 00:04:11,950
ROCKETS.

73
00:04:11,950 --> 00:04:15,600
THAT WOULD HAVE TO GET PRETTY
HIGH TO GO ALL THE WAY IN SPACE

74
00:04:15,600 --> 00:04:19,070
BUT YOU ARE THINKING IN THE
RIGHT TRACK.

75
00:04:19,070 --> 00:04:22,669

SO WE HAVE JUNK IN SPACE, WE
HAVE OLD SATELLITES.

76

00:04:22,669 --> 00:04:24,970
WE HAVE SOME ROCKETS.

77

00:04:24,970 --> 00:04:26,740
THOSE ALL COUNT AS SPACE JUNK.

78

00:04:26,740 --> 00:04:30,950
CAN YOU PASS ME THE CLICKER
HERE: THANK YOU.

79

00:04:30,950 --> 00:04:35,560
SO WHAT IS SPACE JUNK?

80

00:04:35,560 --> 00:04:40,530
IT IS CURRENTLY DEFINED BY BOTH
NASA AND THE INTERAGENCY SPACE

81

00:04:40,530 --> 00:04:45,480
RECONNAISSANCE COMMITTEE AS ANY
OPTION THAT HUMANS HAVE MADE

82

00:04:45,480 --> 00:04:48,430
AND PUT INTO OUTER SPACE THAT
IS EITHER IN SPACE CURRENTLY

83

00:04:48,430 --> 00:04:50,271
WORK GOES BACK TO EARTH,
FALLING INTO THE ATMOSPHERE

84

00:04:50,271 --> 00:04:54,370
INTO THE EARTH THAT DOES NOT
SERVE A DESIGNATED PURPOSE.

85

00:04:54,370 --> 00:04:58,160
WELL THAT PURPOSE IS OPEN TO
SOME INTERPRETATION BUT THAT IS

86

00:04:58,160 --> 00:04:59,650

THE OFFICIAL DESIGNATION.

87

00:04:59,650 --> 00:05:03,380

SO EACH OF THOSE THREE ANSWERS
YOU CAME FROM THE AUDIENCE, ALL

88

00:05:03,380 --> 00:05:07,140

FIT UNDER THAT DEFINITION.

89

00:05:07,140 --> 00:05:11,660

THERE ARE SOME IDEAS OF SOME
SPACE JUNK THAT ARE CURRENTLY

90

00:05:11,660 --> 00:05:13,870

IN OUTER SPACE.

91

00:05:13,870 --> 00:05:16,290

DEAD SATELLITES, THAT IS A
DOMINANT THREAT, THAT IS ONE

92

00:05:16,290 --> 00:05:19,431

SOURCE. ONE OF THE MOST
DANGEROUS SOURCE OF SPACE

93

00:05:19,431 --> 00:05:21,600

DEBRIS IS PIECES OF ROCKETS.

94

00:05:21,600 --> 00:05:25,510

SO ANYTHING WE PUT INTO ORBIT,
ANY SATELLITE REQUIRES WE GET

95

00:05:25,510 --> 00:05:26,510

IT THERE.

96

00:05:26,510 --> 00:05:28,960

SO THE ROCKETS THAT WE SENT OF
THEIR OFTEN HAVE STAGES AND

97

00:05:28,960 --> 00:05:31,160

SOME OF THOSE STAGES REMAIN IN ORBIT.

98

00:05:31,160 --> 00:05:34,620

PIECES THAT EITHER STILL HAVE FUEL IN THEM THAT CAN MAKE THEM

99

00:05:34,620 --> 00:05:40,200

DANGEROUS GOODS THEY COULD EXPLODE AND CREATE MORE DEBRIS.

100

00:05:40,200 --> 00:05:44,630

OBJECTS THAT ARE REQUIRED TO PUT OUR SPACE INTO DEBRIS IS A

101

00:05:44,630 --> 00:05:45,630

SOURCE OF DEBRIS.

102

00:05:45,630 --> 00:05:48,140

AND THEN YOU HAVE VERY SMALL DEBRIS.

103

00:05:48,140 --> 00:05:51,570

THINGS LIKE MICROCHIPS OR SHED PARTS OF PAIN.

104

00:05:51,570 --> 00:05:57,490

OBSERVATION TELESCOPES, THERE ARE ALL TYPES OF DEBRIS THAT

105

00:05:57,490 --> 00:05:58,490

COULD BE UP THERE.

106

00:05:58,490 --> 00:06:01,110

AS LONG IS IT IS SOMETHING WE MADE AND IS NOT CURRENTLY

107

00:06:01,110 --> 00:06:04,900

FUNCTIONING IT IS SPACE DEBRIS.

108

00:06:04,900 --> 00:06:08,170

>> SO YOU CAN ALMOST ANSWER
THE QUESTION FOR WHERE TO SPACE

109

00:06:08,170 --> 00:06:10,430

JUNK COME FROM?

110

00:06:10,430 --> 00:06:14,930

>>Lisa: IT CAN COME FROM OUR
BASICALLY THE WAY TO THINK OF

111

00:06:14,930 --> 00:06:19,620

IT IS JUST LIKE ANY INDUSTRY ON
EARTH, OUR SPACE INDUSTRY HAS

112

00:06:19,620 --> 00:06:20,660

WASTE BYPRODUCTS.

113

00:06:20,660 --> 00:06:25,710

SO IF YOU ARE THE SPACE
INDUSTRY HAS ITS OWN FORM OF

114

00:06:25,710 --> 00:06:27,889

INDUSTRIAL WAYS BUT YOU DON'T
HAVE SPACE TECHNOLOGY WITHOUT

115

00:06:27,889 --> 00:06:29,530

SPACE WEIGHTS.

116

00:06:29,530 --> 00:06:34,330

SO ANY OF THESE TYPES OF
DEBRIS'S WE TALKED ABOUT IS ONE

117

00:06:34,330 --> 00:06:38,680

SOURCE, OR LAUNCHING
SATELLITES, SATELLITES DIE,

118

00:06:38,680 --> 00:06:39,810
THOSE ARE ALL FROM THE SPACE
DEBRIS.

119
00:06:39,810 --> 00:06:45,780
BUT I THOUGHT OF MORE FUN IDEAS
WHICH IS, FOR INSTANCE,

120
00:06:45,780 --> 00:06:49,139
ASTRONAUTS LITTER AND THEY
CREATE SPACE DEBRIS.

121
00:06:49,139 --> 00:06:52,640
MOST FAMOUSLY AND WHITE IN HIS
VERY FIRST SPACEWALK, THE VERY

122
00:06:52,640 --> 00:06:57,400
FIRST SPACE FLIGHT, HE LOST AN
EXTRA GLOVE AND WENT THROUGH

123
00:06:57,400 --> 00:07:00,000
THE HATCH, AND ENTERED THE
ORBIT.

124
00:07:00,000 --> 00:07:02,170
FOR MANY YEARS.

125
00:07:02,170 --> 00:07:09,480
PEOPLE HAVE LOST WILL BE 06,
CAMERAS, WE HAVE EVEN LEFT

126
00:07:09,480 --> 00:07:11,020
GARBAGE BAGS ON THE MOON.

127
00:07:11,020 --> 00:07:13,680
THIS IS THE FIRST PHOTOGRAPH
THAT NEIL ARMSTRONG TOOK ON HIS

128
00:07:13,680 --> 00:07:18,380
FIRST MAJOR MOONWALK IN 1,969

AND THAT IMAGE, IN THE

129

00:07:18,380 --> 00:07:21,492

FOREGROUND, THAT'S BAD IS
CALLED A JETTISONED BACK AND IT

130

00:07:21,492 --> 00:07:24,060

IS FULL OF GARBAGE THINK THE
ASTRONAUTS DID NOT WANT TO TAKE

131

00:07:24,060 --> 00:07:25,300

BACK WITH THEM.

132

00:07:25,300 --> 00:07:27,940

IT WASN'T JUST ON THE SURFACE
OF THE MOON THAT ASTRONAUTS BUT

133

00:07:27,940 --> 00:07:28,940

THESE.

134

00:07:28,940 --> 00:07:31,280

THEY ALSO LEFT THESE IN ORBIT.

135

00:07:31,280 --> 00:07:35,669

SO IN APOLLO 16 THEY OPENED FOR
A SPACEWALK OF THE THROUGH ONE

136

00:07:35,669 --> 00:07:37,819

OF THESE OUT AND SAID BUY, BUY
BACK.

137

00:07:37,819 --> 00:07:42,271

AND IT IS SOMEWHERE IN SPACE
BETWEEN US AND THE MOON, NOT

138

00:07:42,271 --> 00:07:43,940

SURE WHERE.

139

00:07:43,940 --> 00:07:49,300

SO, ONE OF THE BIGGEST SOURCES
OF THE DEBRIS WE ARE WORRIED

140

00:07:49,300 --> 00:07:50,800

ABOUT, HOWEVER.

141

00:07:50,800 --> 00:07:55,760

IS THINGS THAT EXPLOIT ON HER
BED, FOR INSTANCE IN JANUARY A

142

00:07:55,760 --> 00:08:00,880

RUSSIAN ROCKET EXPLODED AT A
PRETTY HIGH ORBIT AND THERE WAS

143

00:08:00,880 --> 00:08:03,890

CONCERN ABOUT HOW THE DEBRIS
CREATED THAT EXPLOSION MIGHT

144

00:08:03,890 --> 00:08:06,790

IMPACT SOME OF OUR MOST
VALUABLE SATELLITES.

145

00:08:06,790 --> 00:08:09,610

SO AS YOU CAN SEE HERE, THIS IS
A CHART OF SOME OF THE BIGGEST

146

00:08:09,610 --> 00:08:12,650

DEBRIS CREATORS OVER THE SOURCE
OF SPACE-AGE AND MOST OF THEM

147

00:08:12,650 --> 00:08:13,850

ARE ACCIDENTAL EXPLOSIONS.

148

00:08:13,850 --> 00:08:17,139

ONE FUEL IS STILL OUT THERE IT
IS VOLATILE, IT COULD EXPLODE,

149

00:08:17,139 --> 00:08:19,949

WE CAN'T DO MUCH ABOUT IT.

150

00:08:19,949 --> 00:08:21,800

SOMETIMES WE GENERATE DEBRIS
WHEN WE TRIED TO CLEAN UP

151

00:08:21,800 --> 00:08:22,800

DEBRIS BUT FAILED.

152

00:08:22,800 --> 00:08:27,639

IN 2,007 CHINA INTENDED TO
BRING DOWN ONE OF ITS OWN

153

00:08:27,639 --> 00:08:30,760

WEATHER SATELLITES AND IN DOING
SO CREATED ONE OF THE LARGEST

154

00:08:30,760 --> 00:08:33,810

DEBRIS EVER CREATED IN ORBIT.

155

00:08:33,810 --> 00:08:37,089

AND THIS IS A SCHEMATIC OF THE
PATTERNS OF THOSE DEBRIS THAT

156

00:08:37,089 --> 00:08:40,110

WAS CREATED FROM THAT
PARTICULAR EVENT ABOUT A MONTH

157

00:08:40,110 --> 00:08:41,149

AFTER.

158

00:08:41,149 --> 00:08:42,860

SO THIS KIND OF DEBRIS
SOMETIMES WE ARE TRYING TO DO

159

00:08:42,860 --> 00:08:45,570

THE RIGHT THING TO CLEAN UP BUT
THAT CREATES MORE DEBRIS.

160

00:08:45,570 --> 00:08:49,130

KIND OF LIKE, SOMETIMES THE

THINGS HAPPEN ON ECOSYSTEMS ON

161

00:08:49,130 --> 00:08:51,089

THE EARTH LETTERS THREATENED.

162

00:08:51,089 --> 00:08:52,749

THERE ARE CONSEQUENCES.

163

00:08:52,749 --> 00:08:56,450

>> WELL LET'S SAY A LITTLE BIT
MORE ABOUT WHY SPACE DEBRIS IS

164

00:08:56,450 --> 00:08:58,110

DANGEROUS.

165

00:08:58,110 --> 00:09:02,980

>>Lisa: WELL, THE FUNNY THING
ABOUT SPACE DEBRIS IS IT IS

166

00:09:02,980 --> 00:09:04,230

MOVING VERY, VERY QUICKLY.

167

00:09:04,230 --> 00:09:09,770

DOESN'T MATTER HOW HIGH IT IS
BUT OBJECTS THAT ARE AT VERY,

168

00:09:09,770 --> 00:09:10,770

VERY LOW ALTITUDES.

169

00:09:10,770 --> 00:09:15,250

THAT ARE ONLY A FEW HUNDRED
KILOMETERS UP CAN MOVE UPWARDS

170

00:09:15,250 --> 00:09:18,620

OF 7-8 KILOMETERS PER SECOND.

171

00:09:18,620 --> 00:09:21,810

SO THE ANALOGY THAT NASA USES
TO DESCRIBE HOW DESTRUCTIVE

172

00:09:21,810 --> 00:09:26,420

THAT IS THAT EVEN AN OBJECT
HALF A CENTIMETER ACROSS

173

00:09:26,420 --> 00:09:31,240

TRAVELING AT SIX MILES PER HOUR
CAN HIT WITH THE FORCE OF A

174

00:09:31,240 --> 00:09:33,760

BOWLING BALL TRAVELING 600
MILES PER HOUR.

175

00:09:33,760 --> 00:09:37,870

SO IMAGINE, COMING ACROSS
SOMETHING TINY, THE SIZE OF A

176

00:09:37,870 --> 00:09:40,520

MARBLE CAN DESTROY A ENTIRE
SATELLITE AT THE SPEED FOR THIS

177

00:09:40,520 --> 00:09:44,390

IS OF DEBRIS STAT WHICH IS TO
SHOW HOW PROJECTILES WOULD

178

00:09:44,390 --> 00:09:47,200

AFFECT THE STANDARD SATELLITE.

179

00:09:47,200 --> 00:09:50,290

SO, THE THREAT IS VERY, VERY
REAL.

180

00:09:50,290 --> 00:09:54,880

AND THE INTERNATIONAL SPACE
STATION MOVES ABOUT ONCE PER

181

00:09:54,880 --> 00:09:57,260

YEAR OR SO TO GET OUT OF THE
WAY OF DEBRIS BECAUSE OF

182

00:09:57,260 --> 00:09:59,330

SOMETHING IS LARGE ENOUGH IT
CAN REALLY DESTROY CASE

183

00:09:59,330 --> 00:10:01,140

FOOTBALL SIZE FIELD OF
SPACECRAFT.

184

00:10:01,140 --> 00:10:06,740

RECENTLY SOME OF YOU MAY HAVE
SEEN AN ASTRONAUT TAKE A

185

00:10:06,740 --> 00:10:10,890

PICTURE OF THIS SITTING IN THE
WINDOW OF THE CUMULATE WHICH IS

186

00:10:10,890 --> 00:10:13,400

THE PLACE WHERE THEY TAKE THE
AMAZING PHOTOS OF THE EARTH.

187

00:10:13,400 --> 00:10:17,871

LUCKILY THIS CLASS IS 14 INCH
THICK SO THEY ARE NOT IN

188

00:10:17,871 --> 00:10:18,890

DANGER.

189

00:10:18,890 --> 00:10:24,720

BUT NASA SAYS THIS PROBABLY
HAPPENED FROM A FLIGHT OF

190

00:10:24,720 --> 00:10:25,720

PAINT.

191

00:10:25,720 --> 00:10:29,140

LOOK AT THIS IMAGE, WHAT LOOKS
LIKE A GUNSHOT HOLE IN A WINDOW

192

00:10:29,140 --> 00:10:31,190

HAVE IT FROM A PLUCKO PAINT
SOMETHING WE WOULDN'T THINK

193

00:10:31,190 --> 00:10:33,250
TWICE ABOUT HERE ON EARTH.

194

00:10:33,250 --> 00:10:36,390
THINGS MOVING THAT QUICKLY,
EVEN TINY, TINY OBJECTS CAN

195

00:10:36,390 --> 00:10:38,540
PACK A BIG PUNCH.

196

00:10:38,540 --> 00:10:41,920
>> AND TO CONSIDER WISE THIS
IS A PROBLEM.

197

00:10:41,920 --> 00:10:47,260
THERE ARE OVER 1,000 USEFUL
SATELLITES ORBITING AROUND THE

198

00:10:47,260 --> 00:10:50,550
EARTH, THAT VERY FIRST IMAGE I
SHOWED YOU, SOME ARE VERY CLOSE

199

00:10:50,550 --> 00:10:51,550
TO THE EARTH.

200

00:10:51,550 --> 00:10:54,690
SOME ARE WHAT IS CALLED THE
GEOSTATIONARY ORBIT ABOUT

201

00:10:54,690 --> 00:10:56,850
22,000 MILES AWAY.

202

00:10:56,850 --> 00:11:02,380
BUT ALL OF THAT SPACE HAS BOTH
USEFUL THINGS IN IT AND THESE

203

00:11:02,380 --> 00:11:05,530

OBJECTS OF DEBRIS.

204

00:11:05,530 --> 00:11:10,210

SO OTHER ISSUES IN TERMS OF
INSTANCES IN WHICH DEBRIS HAS

205

00:11:10,210 --> 00:11:12,410

IMPACTED OBJECTS.

206

00:11:12,410 --> 00:11:14,640

USEFUL OBJECTS IN ANY OF THESE
OBJECTS.

207

00:11:14,640 --> 00:11:18,360

>>Lisa: SURE, SO ONE OF THE
MOST CATASTROPHIC INSTANCES

208

00:11:18,360 --> 00:11:20,280

HAPPENED IN 20,09..

209

00:11:20,280 --> 00:11:23,540

AND I HAVE BEEN AT ANIMATION
SHOWING.

210

00:11:23,540 --> 00:11:29,170

A FUNCTIONING RADIO SATELLITE
COLLIDED HEAD ON WITH A DEFUNCT

211

00:11:29,170 --> 00:11:32,279

SOVIET ERA COSMO SATELLITE.

212

00:11:32,279 --> 00:11:36,820

AND JUST A HEAD ON COLLISION
AND THEY BOTH SATELLITES WERE

213

00:11:36,820 --> 00:11:37,820

DESTROYED.

214

00:11:37,820 --> 00:11:42,399
AND THEY CREATED ANOTHER SET OF
DEBRIS FIELDS LIKE THE CHINESE

215
00:11:42,399 --> 00:11:44,960
SATELLITE TEST FROM A FEW YEARS
EARLIER.

216
00:11:44,960 --> 00:11:47,970
THAT CURRENTLY THREATEN
FUNCTIONING SATELLITES IN ORBIT

217
00:11:47,970 --> 00:11:58,610
FOR THAT IS ONE OF THE BIG
ONES.

218
00:11:58,610 --> 00:12:02,300
THERE WAS AN INCIDENT IN 2012
WHEN THE FERMI GAMMA RAY

219
00:12:02,300 --> 00:12:08,570
SATELLITE WAS EXPECTED TO BE IN
THE SAME PLACE AT THE SAME TIME

220
00:12:08,570 --> 00:12:10,500
AS A PIECE OF SPACE DEBRIS.

221
00:12:10,500 --> 00:12:14,470
AND IT'S OPERATORS MADE A VERY
RISKY DECISION TO LIGHT UP THE

222
00:12:14,470 --> 00:12:16,990
INSTRUCTORS, MOVING AHEAD IN
SPACE SO INSTEAD OF GOING LIKE

223
00:12:16,990 --> 00:12:21,899
THIS AND HITTING EACH OTHER
FERMI WOULD PASS AHEAD SOONER

224
00:12:21,899 --> 00:12:25,000

SO IT WAS NOT ACTUALLY COME IN
CONTACT WITH THIS DEBRIS.

225

00:12:25,000 --> 00:12:29,209

SO IT WAS REALLY RISKY BECAUSE
IT HADN'T BEEN USED BUT WITH

226

00:12:29,209 --> 00:12:33,260

TELEPATHY POSSIBLY OCCUPY THE
SAME SPACE AT THE SAME TIME AS

227

00:12:33,260 --> 00:12:35,029

ANOTHER PIECE OF COMPETING
SPACE JUNK.

228

00:12:35,029 --> 00:12:38,540

SO LUCKILY FERMI AVOIDED A
CATASTROPHE WITH A PIECE OF

229

00:12:38,540 --> 00:12:44,860

SPACE JUNK HERE AT THE MUSEUM,
AFTER THE TALKS IF YOU LOOK TO

230

00:12:44,860 --> 00:12:48,450

THE LEFT YOU CAN SEE OUR
REPAIRING HUBBLE EXHIBIT.

231

00:12:48,450 --> 00:12:51,760

AND YOU CAN SEE THE SUBJECT
RIGHT HERE, THIS ARTIFACT WHICH

232

00:12:51,760 --> 00:12:57,020

IS THE RADIATOR COVER OF THE
WILD CARE CAMERA OR WISI ii, IT

233

00:12:57,020 --> 00:13:00,510

LOOKS LIKE CREAM CHEESE FILLED
WITH THOSE.

234

00:13:00,510 --> 00:13:03,300

THOSE HOLES ARE EXAGGERATED
BECAUSE THEY ARE SAMPLED AFTER

235

00:13:03,300 --> 00:13:04,300
THE CAME BACK.

236

00:13:04,300 --> 00:13:09,610
WHEN THE HUBBLE REPAIR MISSION
FROM THE ASTRONAUTS AND THE

237

00:13:09,610 --> 00:13:11,440
HOLDS WERE SAMPLED TO SEE WHAT
MADE THEM.

238

00:13:11,440 --> 00:13:16,110
WHETHER IT WAS HUMAN MADE,
SPACE DEBRIS, OR

239

00:13:16,110 --> 00:13:17,140
MICROMETEORITES.

240

00:13:17,140 --> 00:13:21,490
SOME OF IT IS NATURAL, LIKE IN
ENVIRONMENTAL BIRTH THERE ARE A

241

00:13:21,490 --> 00:13:24,640
MIX OF ARTIFICIAL AND NATURAL.

242

00:13:24,640 --> 00:13:29,640
AND SO YOU HAVE, WITH THIS
WIDE-FIELD PLANETARY CAMERA 2

243

00:13:29,640 --> 00:13:33,790
YOU HAVE A RARE OPPORTUNITY TO
SEE AN ARTIFACT THAT WAS

244

00:13:33,790 --> 00:13:36,520
EXPOSED TO THE SPACE
ENVIRONMENT AND TO SEE THE

245

00:13:36,520 --> 00:13:38,350

IMPACT THAT THAT KIND OF DEBRIS
CAN HAVE FOR NOW IT DIDN'T

246

00:13:38,350 --> 00:13:42,430

AFFECT THE OPERATIONS OF THE
TELESCOPE, THEY WERE FINE AND

247

00:13:42,430 --> 00:13:43,779

CONTINUES TO BE FINE.

248

00:13:43,779 --> 00:13:47,850

IT JUST KIND OF DEMONSTRATES
THE KIND OF SMALL IMPACT, THAT

249

00:13:47,850 --> 00:13:51,410

SMALL KINDS OF DEBRIS COULD
HAVE ON FUNCTIONING SATELLITES.

250

00:13:51,410 --> 00:13:55,740

>> SHALL WE TAKE A LITTLE
BREAK IN OUR DISCUSSION HERE

251

00:13:55,740 --> 00:13:57,180

AND HAVE SOME QUESTIONS.

252

00:13:57,180 --> 00:14:01,481

EITHER FROM OUR AUDIENCE HERE
OR FROM THE ONLINE VIEWERS: IS

253

00:14:01,481 --> 00:14:04,390

THERE ANYONE WHO WOULD LIKE TO
HAVE A QUESTION, IF YOU HAVE A

254

00:14:04,390 --> 00:14:07,300

QUESTION PLEASE COME UP TO THE
MICROPHONE.

255

00:14:07,300 --> 00:14:21,250

>>Lisa: IF YOU HAVE A QUESTION
YOU COULD JUST OKAY.

256

00:14:21,250 --> 00:14:24,970

>> THE ONLY QUESTION IS, DO
THESE OBJECTS POSE ANY PROBLEMS

257

00:14:24,970 --> 00:14:27,120

TO THE INTERNATIONAL SPACE
STATION?

258

00:14:27,120 --> 00:14:30,080

>>Lisa: THANK YOU FOR THAT
QUESTION.

259

00:14:30,080 --> 00:14:33,170

AS YOU SAID EARLIER YOU SAW
THAT DING ON THE WINDOW OF THE

260

00:14:33,170 --> 00:14:37,560

CUPULA WHICH IS NOT REALLY A
THREAT TO THE ISS.

261

00:14:37,560 --> 00:14:43,430

IT IS SHIELDED FROM DEBRIS AND
IT HAS THE ABILITY TO MOVE IF

262

00:14:43,430 --> 00:14:46,310

IT IS PREDICTED THAT IT WILL
COME IN CONTACT WITH A PIECE OF

263

00:14:46,310 --> 00:14:47,310

DEBRIS.

264

00:14:47,310 --> 00:14:50,649

WE ARE TRACKING LOTS AND LOTS
OF DEBRIS AND I WILL GO INTO

265

00:14:50,649 --> 00:14:51,649

MORE DETAIL ON THAT LATER.

266

00:14:51,649 --> 00:14:55,490

BUT WE CAN OFTEN TIME ADDICT
WHEN THE SPACE STATION IS

267

00:14:55,490 --> 00:14:59,300

APPROACHING DEBRIS.HOWEVER,
SOMETIMES WE CAN'T AND WHEN IT

268

00:14:59,300 --> 00:15:02,890

IS HARD TO NOTICE, THE
ASTRONAUTS WILL TAKE SHELTER IN

269

00:15:02,890 --> 00:15:05,209

THEIR MODULE.

270

00:15:05,209 --> 00:15:08,510

THAT IS BECAUSE OF THEM, THEIR
LIVES COULD BE SAVED EVEN IF

271

00:15:08,510 --> 00:15:10,360

THE STRUCTURE ITSELF IS
DAMAGED.

272

00:15:10,360 --> 00:15:15,390

SO YES, DEBRIS THREATENS BUT
THERE IS A LOT OF THINGS TO

273

00:15:15,390 --> 00:15:21,959

PREDICT THE STRUCTURE AND THE
ASTRONAUTS.

274

00:15:21,959 --> 00:15:23,580

>> ANOTHER ONLINE QUESTION.

275

00:15:23,580 --> 00:15:25,860

WHAT COULD BE DONE TO CLEAN UP
THE DEBRIS?

276

00:15:25,860 --> 00:15:29,400
>>Lisa: THANK YOU, BARBARA.

277

00:15:29,400 --> 00:15:34,570
IF YOU STATE AND I WILL BE
TALKING ABOUT SOME OF THE IDEAS

278

00:15:34,570 --> 00:15:38,680
THAT HAVE COME UP ABOUT HOW TO
DEAL WITH DEBRIS BOTH REAL AND

279

00:15:38,680 --> 00:15:40,700
IMAGINED AND PLANNED.

280

00:15:40,700 --> 00:15:43,510
SO THERE ARE A COUPLE OF
DIFFERENT THINGS THAT COULD BE

281

00:15:43,510 --> 00:15:44,510
DONE.

282

00:15:44,510 --> 00:15:47,050
ONE OF THE MOST IMPORTANT
LESSON WE HAVE IS JUST TO STOP

283

00:15:47,050 --> 00:15:48,310
MAKING SO MUCH DEBRIS.

284

00:15:48,310 --> 00:15:54,230
SOME NEW SATELLITES CAN BE
MADE, WITH EXTRA FUEL WHEN THE

285

00:15:54,230 --> 00:15:56,390
ROCKET IS DONE WATCHING THEM.

286

00:15:56,390 --> 00:15:58,780
OUR MOVE TO A SAFER ORBIT
WHERE IT WILL BE THREATENING

287

00:15:58,780 --> 00:16:00,690

OTHER ORBITS.

288

00:16:00,690 --> 00:16:06,519

SO JUST LIKE WITH THE POLLUTING
INDUSTRIES, JUST STOP CREATING

289

00:16:06,519 --> 00:16:07,620

SO MUCH.

290

00:16:07,620 --> 00:16:10,600

SOMETIMES THE ENVIRONMENT
ITSELF CAN DO SOME OF THE WORK

291

00:16:10,600 --> 00:16:11,600

FOR YOU.

292

00:16:11,600 --> 00:16:15,070

IN OUTER SPACE, YOU CAN'T JUST
AVOID THE IMAGINATIVE CITY IT

293

00:16:15,070 --> 00:16:19,660

IS A PHYSICAL ECOSYSTEM OF
SORTS WITH EXCHANGING FORCES.

294

00:16:19,660 --> 00:16:25,860

AND EVEN MATERIALS, NATURALLY
ROCKY OBJECTS, MAGNETISM,

295

00:16:25,860 --> 00:16:30,360

GRAVITY, AND THAT ALL IMPACTS
OBJECTS THAT WE PUT UP THERE.

296

00:16:30,360 --> 00:16:35,209

SO THE ORBIT HAS ITS OWN
SELF-CLEANING MECHANISM WHERE

297

00:16:35,209 --> 00:16:37,860

IT TRACKS THINGS NOW THAT ARE
TOO LOW IN ORBIT THAT ARE NO

298

00:16:37,860 --> 00:16:39,570

LONGER PUSHING FURTHER AND
FURTHER.

299

00:16:39,570 --> 00:16:43,450

SO THE EARTH ITSELF ACTUALLY
DOES SOME WORK TO REMOVE

300

00:16:43,450 --> 00:16:44,450

DEBRIS.

301

00:16:44,450 --> 00:16:45,450

IT IS PRETTY INCREDIBLE IF YOU
THINK ABOUT IT.

302

00:16:45,450 --> 00:16:51,070

FOR THIS ONE OF THE MOST THE
BEST CLEANER OF POLLUTION BOTH

303

00:16:51,070 --> 00:16:53,459

ON EARTH AND IN OUTER SPACE.

304

00:16:53,459 --> 00:16:55,690

>> THAT POINT MIGHT BE
ELABORATED.

305

00:16:55,690 --> 00:16:59,180

IF YOU RECALL THE TITLE OF THE
PRESENTATION TODAY IS CLEANING

306

00:16:59,180 --> 00:17:00,180

UP SPACE.

307

00:17:00,180 --> 00:17:05,539

AND AS LISA JUST SUGGEST THIS
IS NOT JUST AN ISSUE OF SPACE

308

00:17:05,539 --> 00:17:06,750

IN AND OF ITSELF.

309

00:17:06,750 --> 00:17:09,410
BUT SPACE IS PART OF OUR
PERCEPTION OF WHAT THE EARTH'S

310

00:17:09,410 --> 00:17:11,220
ENVIRONMENT IS.

311

00:17:11,220 --> 00:17:14,500
SO WE TALK ABOUT THE
ENVIRONMENTAL AND WHAT HAPPENS

312

00:17:14,500 --> 00:17:17,750
ON PLANT, WHAT HAPPENS ON
WATER, WHAT HAPPENS IN THE AIR

313

00:17:17,750 --> 00:17:20,110
WE BREATHE, THEY TRAVEL
THROUGH.

314

00:17:20,110 --> 00:17:24,010
SPACE ITSELF IS ALSO A CERTAIN
PART OF THIS LARGER OF OUR

315

00:17:24,010 --> 00:17:25,870
RESPONSIBILITY TO THE
ENVIRONMENT.

316

00:17:25,870 --> 00:17:30,059
>>Lisa: AND THIS IS SOMETHING
AROUND THE SAME TIME WHEN WE

317

00:17:30,059 --> 00:17:34,230
FIRST STARTED PUTTING UP OUR
SATELLITES IN SPACE SCIENTIFIC

318

00:17:34,230 --> 00:17:38,779
UNDERSTANDING OF EARTH'S PLACE
IN THE COSMOS REALLY CHANGE.

319

00:17:38,779 --> 00:17:41,909

SUDDENLY WE USED TO THINK THAT
EARTH WAS A PHYSICALLY ISOLATED

320

00:17:41,909 --> 00:17:42,909

SPACE.

321

00:17:42,909 --> 00:17:46,230

BUT WITH SATELLITES AND WE
SUDDENLY REALIZE WE ARE PART OF

322

00:17:46,230 --> 00:17:50,690

AN INTERACTIVE, GIGANTIC SOLAR
SYSTEM.

323

00:17:50,690 --> 00:17:53,460

THAT INFLUENCE THE PHYSICAL
FLOWS OF THE EARTH.

324

00:17:53,460 --> 00:17:56,460

IT EXPANDS THOUSANDS OF
THOUSANDS OF KILOMETERS.

325

00:17:56,460 --> 00:18:00,149

SO REALLY, THE IDEA OF OUTER
SPACE IS A NATURAL ENVIRONMENT

326

00:18:00,149 --> 00:18:02,649

IS ONE THAT IS TOTALLY
RELEVANT, WHEN WE HAVE BEEN

327

00:18:02,649 --> 00:18:06,179

THINKING ABOUT SINCE THE LATE
50s WHEN WE FIRST STARTED

328

00:18:06,179 --> 00:18:08,450

SETTING SATELLITES INTO SPACE.

329

00:18:08,450 --> 00:18:11,539
>> I THINK THAT IS A GREAT
SEGUE INTO THE NEXT PART OF OUR

330
00:18:11,539 --> 00:18:15,409
PROGRAM HERE IN WHICH YOU TALK
ABOUT THE HISTORY OF THIS IDEA.

331
00:18:15,409 --> 00:18:17,889
>>Lisa: OKAY, GREAT.

332
00:18:17,889 --> 00:18:20,379
HERE WE GO.

333
00:18:20,379 --> 00:18:23,129
I AM GOING TO SHOW YOU THAT I
WOULD LIKE TO TALK TO YOU ABOUT

334
00:18:23,129 --> 00:18:25,559
HOW LONG WE HAVE BEEN WORRIED
ABOUT SPACE JUNK.

335
00:18:25,559 --> 00:18:28,690
IT IS A LITTLE BIT LONGER THAN
YOU MIGHT THINK.

336
00:18:28,690 --> 00:18:33,330
SO THIS IS AN ANIMATION THAT
NASA PUT OUT SHOWING THE

337
00:18:33,330 --> 00:18:35,360
CURRENT DEBRIS ENVIRONMENT IN
OUTER SPACE.

338
00:18:35,360 --> 00:18:39,059
RATHER THE CURRENT BODY OF
HUMAN MADE OBJECTS IN OUTER

339
00:18:39,059 --> 00:18:40,059
SPACE.

340

00:18:40,059 --> 00:18:46,320

NASA'S STATES WE HAVE 1,100 OR
SO FUNCTIONING SATELLITES.

341

00:18:46,320 --> 00:18:50,299

THE REST OF ALL THIS IS DEBRIS,
SPACE JUNK, THINGS THAT DON'T

342

00:18:50,299 --> 00:18:51,879

SERVE A PURPOSE.

343

00:18:51,879 --> 00:18:53,789

THAT WE DON'T HAVE A NEED FOR.

344

00:18:53,789 --> 00:18:59,169

SO AS OF APRIL, 2016, LAST
MONTH THE ESTIMATED TOTAL

345

00:18:59,169 --> 00:19:02,600

OBJECTS LARGER THAN 10
CENTIMETERS WAS A LITTLE OVER

346

00:19:02,600 --> 00:19:09,129

17,000 ALTHOUGH NASA VISITS
CLOSER TO 21,000 TOTAL.

347

00:19:09,129 --> 00:19:12,770

AND THAT IS ONLY OBJECTS THAT
ARE LARGER THAN 10 CENTIMETERS.

348

00:19:12,770 --> 00:19:14,020

THOSE ARE THE ONES WE CONTRACT.

349

00:19:14,020 --> 00:19:18,049

THERE ARE A WHOLE LOT OF OTHER
STUFF UP THERE THAT IS MUCH

350

00:19:18,049 --> 00:19:19,049

SMALLER.

351

00:19:19,049 --> 00:19:21,419

SO I THAT ARE 1-10 CENTIMETERS
THERE ARE 100,000, ESTIMATE.

352

00:19:21,419 --> 00:19:25,419

ESTIMATE REMEMBER BECAUSE WE
CAN'T SEE THEM.

353

00:19:25,419 --> 00:19:29,160

SMALLER THAN A CENTIMETER ABOUT
100 MILLION AND EVEN THOSE

354

00:19:29,160 --> 00:19:34,330

SMALL THINGS LIKE YOU TALK IN
FACT A PUNCH.

355

00:19:34,330 --> 00:19:37,779

AS WE SAW EARLIER.

356

00:19:37,779 --> 00:19:39,929

SO, LET'S SEE HERE.

357

00:19:39,929 --> 00:19:41,200

HERE WE GO.

358

00:19:41,200 --> 00:19:49,509

IN 2011 THE PROCEDURES FOR
ORBITING THE ENVIRONMENT.

359

00:19:49,509 --> 00:19:57,149

IT WAS A BLEAK, THEY CONCLUDED
WE ARE NOT EXACTLY PREPARED FOR

360

00:19:57,149 --> 00:19:58,580

A DEBRIS CRISIS IF IT SHOULD
HAPPEN.

361

00:19:58,580 --> 00:20:01,429
I DON'T KNOW IF YOU SAW THE
MOVIE "GRAVITY" WHEN IT CAME

362
00:20:01,429 --> 00:20:07,789
OUT IN 2013, NOW SOME HAVE SAID
IT IS PHYSICALLY IMPOSSIBLE

363
00:20:07,789 --> 00:20:10,679
THAT SOMETHING COULD HAPPEN THE
WAY IT HAPPENED, BUT WITH THAT

364
00:20:10,679 --> 00:20:14,159
SAID THE IDEA OF IT IS QUITE
POSSIBLE.

365
00:20:14,159 --> 00:20:19,019
THAT AT ROOT WE COULD WANT THE
GOOD COLLIDE TO ANOTHER THING

366
00:20:19,019 --> 00:20:21,799
IT COULD CREATE DEBRIS THAT
AFFECTS OTHER THINGS THAT COULD

367
00:20:21,799 --> 00:20:25,859
CREATE A CASCADING COLLISION.

368
00:20:25,859 --> 00:20:29,549
WHICH IS THE TERM THAT WAS USED
BY DONALD TEMPLER IN THE 1,928

369
00:20:29,549 --> 00:20:32,649
FICTION THAT AT THE END OF THE
20TH CENTURY WE CAN SEE OUR

370
00:20:32,649 --> 00:20:34,809
FIRST MAJOR COLLISIONS IN OUTER
SPACE AND HE WAS RIGHT.

371
00:20:34,809 --> 00:20:38,690

WE ENDED UP STARTING TO SEE
COLLISIONS AROUND THE TURN OF

372

00:20:38,690 --> 00:20:39,690
THE CENTURY.

373

00:20:39,690 --> 00:20:44,049
AND IN THIS NATURAL RESEARCH
DOCUMENT IT CLAIMS IN THE

374

00:20:44,049 --> 00:20:46,149
INTRODUCTION THAT WE HAVE
CROSSED THE TIPPING POINT.

375

00:20:46,149 --> 00:20:49,279
NOW FOR THOSE OF YOU WHO HAVE
READ ABOUT OTHER ENVIRONMENTAL

376

00:20:49,279 --> 00:20:53,250
CRISIS, THAT IS A REALLY SCARY
TRUMPET WHAT THAT MEANS IS THAT

377

00:20:53,250 --> 00:20:56,190
WE HAVE CROSSED THE POINT OF NO
RETURN. IF WE CROSSED THE

378

00:20:56,190 --> 00:20:59,889
TIPPING POINT, AND THEY HAVE
ARGUED WE HAVE ALREADY CROSSED

379

00:20:59,889 --> 00:21:00,889
IT.

380

00:21:00,889 --> 00:21:05,059
NO MATTER WHAT WE DO THE FIRST
ENVIRONMENT IS TOO CLUTTERED

381

00:21:05,059 --> 00:21:10,470
WITH LITTER TO FIX.

382

00:21:10,470 --> 00:21:21,570

SO THIS IS COMING UP.

383

00:21:21,570 --> 00:21:25,679

NOT SURE WHAT EXACTLY IS
SUPPOSED TO BE UP HERE.

384

00:21:25,679 --> 00:21:29,820

ALL RIGHT, SO I WILL JUST WAIT
UNTIL THIS NEXT THING COMES UP.

385

00:21:29,820 --> 00:21:41,840

SO, THE DO WE HAVE A NEXT
SLIDE?

386

00:21:41,840 --> 00:21:43,770

THE PROBLEM IS WE CAN'T SEE IT.

387

00:21:43,770 --> 00:21:45,899

THOSE WATCHING THIS ON NASA
T.V.

388

00:21:45,899 --> 00:21:48,289

OR STREAMING ONLINE YOU
CAN SEE THIS BUT HERE WE ARE

389

00:21:48,289 --> 00:21:49,840

HAVING A HARD TIME SO I AM
GOING TO DESCRIBE IT FOR THOSE

390

00:21:49,840 --> 00:21:54,710

WHO ARE HERE. WHAT I WANT TO
SAY IS THAT THAT IS THE IMAGE

391

00:21:54,710 --> 00:21:57,429

WE HAD UP THERE AT THE
ANIMATION OF ALL THE DEBRIS,

392

00:21:57,429 --> 00:21:59,320

THAT IS A RECENT IMAGE.

393

00:21:59,320 --> 00:22:01,450
BUT WE HAVE BEEN THINKING ABOUT
SPACE DEBRIS FOR MUCH, MUCH

394

00:22:01,450 --> 00:22:02,899
LARGER.

395

00:22:02,899 --> 00:22:05,039
WHAT YOU CAN'T SEE IN THE
AUDIENCE IS WHAT LOOKS LIKE A

396

00:22:05,039 --> 00:22:07,340
TINY LITTLE STAR IN THE NIGHT
SKY.

397

00:22:07,340 --> 00:22:10,529
I SHOW THIS IMAGE FROM
PHILADELPHIA WHERE I LIVE.

398

00:22:10,529 --> 00:22:13,009
IT IS OF THE INTERNATIONAL
SPACE STATION CROSSING

399

00:22:13,009 --> 00:22:14,009
OVERHEAD.

400

00:22:14,009 --> 00:22:17,500
IT IS CROSSING BETWEEN TWO
WIRES, ELECTRICITY WIRES, AND

401

00:22:17,500 --> 00:22:20,660
IT IS VERY BEAUTIFUL BECAUSE IT
IS A SHINING BRIGHT STAR.

402

00:22:20,660 --> 00:22:23,179
IT IS NOT FLASHING YOU KNOW IT
IS NOT AN AIRPLANE.

403

00:22:23,179 --> 00:22:25,740

IT IS THE INTERNATIONAL SPACE
STATION.

404

00:22:25,740 --> 00:22:30,799

ANYONE WHO ARE INTERESTED, IF
YOU ARE DARTS FOR ME, IF YOU

405

00:22:30,799 --> 00:22:32,399

PUT IN YOUR ZIP CODE YOU COULD
GET ALERTS FOR WHATEVER THE

406

00:22:32,399 --> 00:22:33,399

SPACE STATION CROSSES OVERHEAD.

407

00:22:33,399 --> 00:22:34,970

I THINK IT IS BEAUTIFUL.

408

00:22:34,970 --> 00:22:40,369

IN 1967 ONE NEWS BROKE THAT THE
SOVIET UNION HAD LAUNCHED THE

409

00:22:40,369 --> 00:22:44,609

FIRST ARTIFICIAL MAN PEOPLE ALL
OVER THE WORLD RAN OUTSIDE TO

410

00:22:44,609 --> 00:22:47,340

SEE IF THEY COULD GET A GLIMPSE
OF IT.

411

00:22:47,340 --> 00:22:50,370

THERE WAS AN ARTICLE IN THE
LOCAL PAPER SAYING IF YOU LOOK

412

00:22:50,370 --> 00:22:53,549

AT THIS PLACE AT THIS TIME AT
DAWN OR DESK YOU CAN SEE THIS

413

00:22:53,549 --> 00:22:55,910

TINY MOVING STAR MOVING THROUGH
THE STAR VERY MUCH LIKE THE

414

00:22:55,910 --> 00:23:00,869
IMAGE VIEWING AT HOME SHOULD BE
ABLE TO SEE.

415

00:23:00,869 --> 00:23:04,360
AND SO ABOUT FOUR PERCENT OF
AMERICANS REPORTED SEEING IT

416

00:23:04,360 --> 00:23:05,360
FROM THE NAKED EYE.

417

00:23:05,360 --> 00:23:11,760
BUT IT WAS ONLY ABOUT THE SIZE
OF A BEACH BALL, PRETTY SMALL.

418

00:23:11,760 --> 00:23:14,519
EVEN THOUGH IT WAS POLISHED TO
A BRIGHT SHINE NOT PICKING UP

419

00:23:14,519 --> 00:23:17,729
TO SEE WITH THE NAKED EYE
WITHOUT ANY SORT OF

420

00:23:17,729 --> 00:23:18,729
APPOINTMENT.

421

00:23:18,729 --> 00:23:23,499
AND THE SOVIET ENGINEERS KNEW
THIS AND SO THEY RIGGED UP PART

422

00:23:23,499 --> 00:23:27,070
OF THE ROCKET THAT SENT IT
ALOFT INTO SPACE WITH PRISMS

423

00:23:27,070 --> 00:23:30,210
THAT WOULD CATCH EXTRA SUNLIGHT
AND MAKE IT THAT MUCH MORE

424

00:23:30,210 --> 00:23:31,210

SUNNIER.

425

00:23:31,210 --> 00:23:35,070

THESE ARE NOT TO SCALE, BUT THE
SIZE OF A BEACH BALL FOR THE

426

00:23:35,070 --> 00:23:39,399

CORE OF THE ROCKET WHICH THE
CENTRAL AREA RIGHT HERE.

427

00:23:39,399 --> 00:23:43,840

ABOUT 20 METERS LONG, MUCH,
MUCH BIGGER AND SHINIER.SO

428

00:23:43,840 --> 00:23:45,379

WITH THOSE FOUR PERCENT OF
AMERICANS REPORTED SEEING

429

00:23:45,379 --> 00:23:50,399

SPUTNIK THEY WERE NOT SEEING
THAT ROUND OBJECT.

430

00:23:50,399 --> 00:23:53,690

THEY WERE SEEKING ARGUABLY THE
FIRST PIECE OF SPACE JUNK.

431

00:23:53,690 --> 00:23:54,690

BUT DID IT MATTER?

432

00:23:54,690 --> 00:23:59,309

WHAT THEY WERE SEEING WAS THE
RUSSIAN MOON, IT WAS STILL

433

00:23:59,309 --> 00:24:01,109

EVIDENCE THEY HAD GOTTEN THERE
FIRST.

434

00:24:01,109 --> 00:24:05,399
SO THIS OBJECT, EVEN THOUGH IT
WAS SPACE JUNK STILL START A

435
00:24:05,399 --> 00:24:06,399
PURPOSE.

436
00:24:06,399 --> 00:24:11,269
IT WAS STRIKING FEAR OR PRIDE
DEPENDING ON YOUR POLITICAL

437
00:24:11,269 --> 00:24:12,269
AFFILIATION.

438
00:24:12,269 --> 00:24:17,289
SO THE VERY FIRST ENCOUNTER
THAT MOST HUMAN KIND HAD WITH

439
00:24:17,289 --> 00:24:20,580
THE OUTERSPACE ENVIRONMENT WAS
THE SPACE AGE WAS THROUGH SPACE

440
00:24:20,580 --> 00:24:21,899
JUNK.

441
00:24:21,899 --> 00:24:23,999
WE HAVE BEEN THINKING ABOUT IT
FOR A WHILE.

442
00:24:23,999 --> 00:24:28,580
NASA, AS YOU CAN SEE IN THIS
CHART, THE NUMBER OF OBJECTS

443
00:24:28,580 --> 00:24:30,270
HAVE GROWN EXPONENTIALLY.

444
00:24:30,270 --> 00:24:39,779
HERE IN 2007, AND IN 2009, THIS
IS THE COLLISION I SPOKE ABOUT,

445

00:24:39,779 --> 00:24:44,240

THE MAJOR SPIKE IN THE NUMBER
OF LITTLE OBJECTS IN ORBIT.

446

00:24:44,240 --> 00:24:46,840

SO IT IS OBVIOUSLY GROWN QUITE
A BIT.

447

00:24:46,840 --> 00:24:51,980

BUT EVEN IN THIS EARLY STAGE IN
THE EARLY 1950S AND 60S, LOTS

448

00:24:51,980 --> 00:24:55,850

OF DIFFERENT COMMUNITIES WERE
AWARE OF SPACE DEBRIS AND

449

00:24:55,850 --> 00:24:56,850

WORRIED ABOUT IT.

450

00:24:56,850 --> 00:24:59,360

HERE ARE SOME OF THE HEADLINES
THAT CAME OUT IN THE EARLY

451

00:24:59,360 --> 00:25:03,830

1960'S IN RESPONSE TO PROJECT
THE JOURNALIST IN EVERYDAY

452

00:25:03,830 --> 00:25:05,799

AMERICANS WERE CONCERNED ABOUT.

453

00:25:05,799 --> 00:25:08,809

THAT THEY THOUGHT WERE CREATING
LITTER IN OUTER SPACE OVER

454

00:25:08,809 --> 00:25:11,320

CRATING THE SAME ENVIRONMENT OF
PROBLEMS THAT WERE CAUSING ON

455

00:25:11,320 --> 00:25:12,610

EARTH.

456

00:25:12,610 --> 00:25:15,840

AND ASTRONOMERS IN PARTICULAR
WERE EXTREMELY CONCERNED ABOUT

457

00:25:15,840 --> 00:25:19,019

SPACE DEBRIS EARLY ON.

458

00:25:19,019 --> 00:25:21,419

SOME OF THEM THOUGHT THEY
SHOULD ORGANIZE TOGETHER AND

459

00:25:21,419 --> 00:25:26,840

TRY TO BUILD A SPACE POLLUTION
BOARD.

460

00:25:26,840 --> 00:25:29,549

SPACE POLLUTION CONTROL AGENCY
TO MAKE SURE THAT WE WEREN'T

461

00:25:29,549 --> 00:25:31,130

CREATING SO MUCH DEBRIS IN
ORBIT.

462

00:25:31,130 --> 00:25:34,629

THEY WERE CONCERNED BECAUSE
THEY'RE VIEWING FROM THE

463

00:25:34,629 --> 00:25:37,759

GROUND, IF THE ORBIT GETS TOO
CLUTTERED WITH SHINY MATERIAL

464

00:25:37,759 --> 00:25:39,960

THEY CAN'T OBSERVE AS WELL AS
THEY ONCE DID.

465

00:25:39,960 --> 00:25:42,070

WERE ALSO ABOUT TO LAUNCH THEIR
SPACE TELESCOPE AND THEY DIDN'T

466

00:25:42,070 --> 00:25:44,190

WANT ANYTHING COLLIDING WITH
THEIR TELESCOPE.

467

00:25:44,190 --> 00:25:49,340

THEY TOOK THIS SO SERIOUSLY ONE
COMPARED NOT ACTING ON THE

468

00:25:49,340 --> 00:25:52,450

CREATION OF SPACE DEBRIS IN THE
EARLY 1960S TO THE PIECES OF

469

00:25:52,450 --> 00:25:54,419

HITLER IN WORLD WAR II.

470

00:25:54,419 --> 00:26:00,980

SO IT SEEMS TO ME LIKE IT
SEEMED TO BE A PREDECESSOR TO

471

00:26:00,980 --> 00:26:04,390

THE ONLINE LOT THAT WAS ENOUGH
COMMENTARY ON THE NAZIS BUT IT

472

00:26:04,390 --> 00:26:09,379

HAPPENED IN 1962 BETWEEN
ASTRONOMERS.

473

00:26:09,379 --> 00:26:15,259

THE MINUTE WE GOT ACCESS TO
SPACE WE STARTED DOING WHAT WE

474

00:26:15,259 --> 00:26:17,639

WOULD THINK IS QUESTIONABLE
ACTIVITY.

475

00:26:17,639 --> 00:26:21,169

SO FROM 1968-1972, THE UNITED
STATES AND SOVIET UNION

476

00:26:21,169 --> 00:26:29,059

EXPLODED, WE HAD SENSIBLE
SCIENTIFIC REASONS BUT ALSO TO

477

00:26:29,059 --> 00:26:32,279

TEST MILITARY COUNTERMEASURES.

478

00:26:32,279 --> 00:26:39,580

EVENTUALLY WE HAD A FAN IN 1963
AND THESE BUT NOT WITHOUT FIRST

479

00:26:39,580 --> 00:26:43,159

LEARNING THAT A NUCLEAR WEAPON
IN OUTER SPACE COULD BOTH

480

00:26:43,159 --> 00:26:47,250

DESTROY ACTIVE SATELLITES, THE
SATELLITES WE USE EVERY DAY AND

481

00:26:47,250 --> 00:26:51,369

ALSO CHANGE THE ENVIRONMENT OF
OUTERSPACE IN A WAY THAT COULD

482

00:26:51,369 --> 00:26:52,909

BE PRETTY CRUCIAL.

483

00:26:52,909 --> 00:26:55,629

AND I WILL TALK ABOUT THAT NOW.

484

00:26:55,629 --> 00:26:59,349

THAT THIS IMAGE RIGHT HERE, IT
IS A SCHEMATIC FOR WHAT SEEMS

485

00:26:59,349 --> 00:27:02,940

TO BE KNOWN AS PROJECT
WESTFORD, AND IT WAS LAUNCHED

486

00:27:02,940 --> 00:27:10,700

IN 1961 AND 1963, WHAT IT WAS

WAS A FIELD OF 400 MILLION TINY

487

00:27:10,700 --> 00:27:15,169

COPPER FIBERS, YOU CAN SEE THEM
HERE.

488

00:27:15,169 --> 00:27:18,289

BUT 400 MILLION OF THESE IN A
RING AROUND THE EARTH:AND BE

489

00:27:18,289 --> 00:27:21,879

USED AS AN ARTIFICIAL IONIC
SPIRIT.

490

00:27:21,879 --> 00:27:24,999

THE IONOSPHERE IS CRITICAL FOR
LONG-DISTANCE RADIO

491

00:27:24,999 --> 00:27:26,359

COMMUNICATION.

492

00:27:26,359 --> 00:27:30,269

SO THE REASON WESTFORD WAS
IMPORTANT BECAUSE, LET'S SAY,

493

00:27:30,269 --> 00:27:35,190

THE SOVIET HAD A SPACE NEW AND
DESTROY THE IONOSPHERE AND MADE

494

00:27:35,190 --> 00:27:37,390

IT HARD TO COMMUNICATE, HARD TO
COMMUNICATE WITH NUCLEAR

495

00:27:37,390 --> 00:27:42,250

ARSENALS THIS WOULD BE A CHEAP,
EFFECTIVE BACKUP METHOD FOR AND

496

00:27:42,250 --> 00:27:47,899

IT HAD AN ARTIFACT FROM
WESTFORD ON DISPLAY, IT IS AN

497

00:27:47,899 --> 00:27:51,389

UNASSUMING DISPLAY TO THE RIGHT
REAR IF YOU ARE LOOKING AT THE

498

00:27:51,389 --> 00:27:55,210

SPACE SHUTTLE LOOK AT IT.LOOK
AT ALL THE ZIPOLDS IN THAT

499

00:27:55,210 --> 00:27:56,210

CANISTER.

500

00:27:56,210 --> 00:28:03,809

THAT IS MY HAND FOR SCALE, IT
IS ACTUALLY QUITE SMALL.

501

00:28:03,809 --> 00:28:08,849

SO THIS WAS SEEN AS AN
IMPORTANT POSSIBILITY FOR

502

00:28:08,849 --> 00:28:11,029

MILITARY COMMUNICATION BACKUP.

503

00:28:11,029 --> 00:28:15,429

BUT ASTRONOMERS BEGAN FIGHTING
THIS AND THE FIGHT WENT TO THE

504

00:28:15,429 --> 00:28:18,320

POPULAR PRESS AND THEN TO THE
U.N. AND ENDED UP LEADING TO

505

00:28:18,320 --> 00:28:21,249

SOME OF THE VERY FIRST
INTERNATIONAL DISCUSSIONS.

506

00:28:21,249 --> 00:28:25,149

AND SAFEGUARDS PUT INTO PLACE
TO COUNTERACT THE CREATION OF

507

00:28:25,149 --> 00:28:28,240
NEW DEBRIS.

508
00:28:28,240 --> 00:28:32,289
THE OTHER HISTORY OF WANT TO
TALK ABOUT IS TO THE FALLS BACK

509
00:28:32,289 --> 00:28:33,289
TO EARTH.

510
00:28:33,289 --> 00:28:35,929
WHEN I MENTIONED THE SPACE JUNK
IT IS THE KIND THAT GOES UP AND

511
00:28:35,929 --> 00:28:36,929
THE KIND THAT COMES BACK DOWN.

512
00:28:36,929 --> 00:28:40,299
IF YOU THROW A BASEBALL WHAT
GOES UP COMES BACK DOWN FOR

513
00:28:40,299 --> 00:28:44,830
SATELLITES AS WELL.OBJECTS
THAT ARE IN LOWER ORBITS, DAYS

514
00:28:44,830 --> 00:28:46,009
OR WEEKS.

515
00:28:46,009 --> 00:28:48,479
IF THEY ARE IN HIGH ORBIT IT
COULD TAKE DECADES, EVEN

516
00:28:48,479 --> 00:28:51,349
MILLENNIA BUT EVERYTHING WILL
COME BACK DOWN EVENTUALLY.

517
00:28:51,349 --> 00:28:57,149
ONE OF THE FIRST INTERNATIONAL
INCIDENTS ABOUT REENTERING

518

00:28:57,149 --> 00:29:01,299

SPACE DEBRIS HAPPENED IN CUBA
AND 1963 WHEN A PIECE OF ROCKET

519

00:29:01,299 --> 00:29:09,919

FROM CAPE CANAVERAL FELL OVER A
PROVINCE, AND STRUCK A COW FOR

520

00:29:09,919 --> 00:29:13,039

THIS IS RIGHT AFTER CASTRO CAME
TO POWER IT WAS THE FIRST

521

00:29:13,039 --> 00:29:20,379

STUDENT LED PROTESTS, AND THEY
SAID IF YOU MESS WITH OUR COWS

522

00:29:20,379 --> 00:29:22,219

YOU ANSWER WITH OUR POLLS.

523

00:29:22,219 --> 00:29:27,139

SO THAT WAS ONE OF THE FIRST
REENTRY ISSUES, ONE OF THE

524

00:29:27,139 --> 00:29:30,159

FIRST OBJECTS TO FALL OVER
AMERICA BECAUSE SPACE DEBRIS

525

00:29:30,159 --> 00:29:33,629

DOES OCCASIONALLY FALL OVER OUR
SOVEREIGN LANDS.

526

00:29:33,629 --> 00:29:38,609

THAT WAS ■ FOR THAT LANDED IN
WISCONSIN AND EVERY YEAR THEY

527

00:29:38,609 --> 00:29:41,120

HAVE A SPUTNIK AS TO
COMMEMORATE WHEN THIS HAPPENED

528

00:29:41,120 --> 00:29:44,960
INCLUDING EVENTS IN A SPACE
DEBRIS CONTEST.

529
00:29:44,960 --> 00:29:46,679
WHICH IS VERY EXCITING AND I
WILL BE THERE THIS YEAR AND

530
00:29:46,679 --> 00:29:49,649
VERY EXCITED ABOUT IT.

531
00:29:49,649 --> 00:29:57,239
IN 1,978 A NUCLEAR GENERATOR
POWERED SPACECRAFT RUN BY THE

532
00:29:57,239 --> 00:30:01,969
SOVIET UNION LOST CONTROL AND
FELL AND LANDED OVER THE

533
00:30:01,969 --> 00:30:04,639
NORTHWEST TERRITORY OF CANADA.

534
00:30:04,639 --> 00:30:08,960
THE DEBRIS FIELD WAS VERY LARGE
AND VERY RADIOACTIVE.

535
00:30:08,960 --> 00:30:13,559
SO THIS WAS ONE OF THE FIRST,
AND TO DATE ONLY IMPLICATIONS

536
00:30:13,559 --> 00:30:17,299
OF THE SO-CALLED LIABILITY
TREATY MAINTAINED TO THE U.N.

537
00:30:17,299 --> 00:30:21,019
WHERE IN CANADA ATTEMPTED TO
GET THE SOVIET UNION TO PAY FOR

538
00:30:21,019 --> 00:30:24,340
THE DAMAGES, PAY FOR THE

CLEANUP AFTER WHICH TOOK

539

00:30:24,340 --> 00:30:27,489

MILLIONS OF DOLLARS TO TRY TO
CLEAN UP THIS SYSTEM.

540

00:30:27,489 --> 00:30:30,860

AND LUCKILY, EVEN THOUGH SOME
OF THE PARTICULATE MATTER

541

00:30:30,860 --> 00:30:37,019

SPREAD TO POPULATE AREAS, THE
AREA WAS RETURNED TO A SAFE

542

00:30:37,019 --> 00:30:38,019

STATE OF NATURE.

543

00:30:38,019 --> 00:30:43,559

WHICH IS A VERY PUBLIC IDEA BUT
THIS TURNS OUT THAT THIS VERY

544

00:30:43,559 --> 00:30:46,519

HARSH ENVIRONMENT WAS VERY GOOD
FOR SYNCING SPACE DEBRIS IN A

545

00:30:46,519 --> 00:30:47,960

GOOD WAY.

546

00:30:47,960 --> 00:30:51,010

IT WORKED OUT WELL THAT IT WAS
A LESS POPULATED AREA BUT THERE

547

00:30:51,010 --> 00:30:52,969

WERE STILL PEOPLE THERE,
ESPECIALLY FOR STATION GROUPS

548

00:30:52,969 --> 00:30:56,859

THAT WERE THERE AND HUNTING
ANIMALS AND FISHING AND WERE

549

00:30:56,859 --> 00:30:59,330

CONCERNED ABOUT THEIR BODILY
INTEGRITY.

550

00:30:59,330 --> 00:31:02,729

INGESTING POSSIBLY THIS
RADIOACTIVE MATERIAL.

551

00:31:02,729 --> 00:31:07,700

THE MOST FAMOUS SPACE JUNK
REENTRY WAS SKYLAB AND 1979

552

00:31:07,700 --> 00:31:10,200

OVER WESTERN AUSTRALIA.

553

00:31:10,200 --> 00:31:12,029

AND BECAME A CELEBRITY IN ITS
OWN RIGHT.

554

00:31:12,029 --> 00:31:18,159

IT WAS IN THE UNIVERSE PAGEANT
IN 1969, AND THEY FAMOUSLY SUED

555

00:31:18,159 --> 00:31:21,299

NASA FOR LITTERING.

556

00:31:21,299 --> 00:31:23,450

ONLY A COUPLE OF HUNDRED
DOLLARS AND WENT AND PAID UNTIL

557

00:31:23,450 --> 00:31:28,139

1979, INTEL A RADIO STATION
PAID FOR IT.

558

00:31:28,139 --> 00:31:40,759

AND 1961 WHEN SPACE STATION
MIR, AND TACO BELL TO GET

559

00:31:40,759 --> 00:31:46,309

INTERESTING GAMBIT AND PROMISED
TO GIVE ONE TACO SHOULD THE

560

00:31:46,309 --> 00:31:50,769

MAIN BODY OF THE SUNLIGHT HIT A
SMALL 40 BY 40 FOOT IN THE

561

00:31:50,769 --> 00:31:51,769

OCEAN.

562

00:31:51,769 --> 00:32:02,409

THEY DO GOT A HUGE INSURANCE
POLICY BUT IT NEVER HAPPENED.

563

00:32:02,409 --> 00:32:13,149

THIS IS 90WWS, WE'RE STILL NOT
SURE WHAT IT WAS BUT IT WAS A

564

00:32:13,149 --> 00:32:16,119

WEIRD ORBIT THAT WAS GOING
CLOSE TO THE SUN AND CAME BACK

565

00:32:16,119 --> 00:32:17,119

TO EARTH.

566

00:32:17,119 --> 00:32:18,119

AND EVENTUALLY REENTERED.

567

00:32:18,119 --> 00:32:21,720

AND ON THE SAME DAY THAT MISSY
ELLIOTT DROPPED HER SONG OF THE

568

00:32:21,720 --> 00:32:25,690

SAME NAME WTS, SO I LIKE TO
THINK THAT MISSY ELLIOTT LIKE

569

00:32:25,690 --> 00:32:28,589

AS SPACE NERDS, PUTTING IT OUT
THERE.

570

00:32:28,589 --> 00:32:31,370

SO WHEN THIS OBJECT WE ENTERED
THERE WAS SPECULATION, WHAT IF

571

00:32:31,370 --> 00:32:39,641

THIS IT'S LAND:IT TENDS TO
BREAK UP IN OUR ATMOSPHERE, OUR

572

00:32:39,641 --> 00:32:42,999

ATMOSPHERE IS TERRIFIC.

573

00:32:42,999 --> 00:32:45,039

BECAUSE OF FRICTION AND
PRESSURE ANYTHING THAT FALLS IS

574

00:32:45,039 --> 00:32:46,039

USUALLY GOING TO BREAK UP.

575

00:32:46,039 --> 00:32:49,180

IT IS THE TYPE OF SHIELDING
THAT WILL BREAK UP AND MOSTLY

576

00:32:49,180 --> 00:32:51,090

DISSIPATE IN THE ATMOSPHERE.

577

00:32:51,090 --> 00:32:55,979

AT OBJECTS THAT ARE BIG, LIKE
FOR INSTANCE MIR, OBJECTS WILL

578

00:32:55,979 --> 00:32:59,409

SURVIVE BUT THEY ALL INTO THE
OCEANS OF COVER MOST OF THE

579

00:32:59,409 --> 00:33:00,409

PLANET.

580

00:33:00,409 --> 00:33:03,519

WITH THAT SAID THAT DOESN'T
MEAN THESE THINGS DISAPPEAR IT

581

00:33:03,519 --> 00:33:07,950

JUST MEANS THAT THEY ARE NOT
SIGNIFICANT IN THE WAY THAT WE

582

00:33:07,950 --> 00:33:08,950

BELLEVUE.

583

00:33:08,950 --> 00:33:09,950

THE WAY WE BELLEVUE THEM.

584

00:33:09,950 --> 00:33:14,389

THEY ARE NOT HARMING HUMAN
LIFE.BUT FOR THE MOST PART

585

00:33:14,389 --> 00:33:18,320

BECAUSE OF SO MUCH OF THE
PLANET IS STILL UNINHABITED.

586

00:33:18,320 --> 00:33:20,749

WE ARE SAFE FOR MOST REENTRY
SPACE DEBRIS.

587

00:33:20,749 --> 00:33:23,360

BUT OCCASIONALLY WE WILL SEE
SOMETHING IS COMING BACK AND WE

588

00:33:23,360 --> 00:33:24,509

DON'T KNOW WHERE THAT IS GOING
TO LEAVE.

589

00:33:24,509 --> 00:33:28,249

THAT COULD BE SCARY FOR PEOPLE
WHICH MAKES SENSE.

590

00:33:28,249 --> 00:33:34,009

MOST NEW SATELLITES ARE BEING
EQUIPPED WITH THE POSSIBILITY

591

00:33:34,009 --> 00:33:39,779
OF BEING GUIDED BACK INTO THE
ATMOSPHERE IN A CONTROLLED WAY.

592
00:33:39,779 --> 00:33:41,759
SO IT DOESN'T FALL WILLY-NILLY.

593
00:33:41,759 --> 00:33:43,350
BUT THERE ARE PLENTY OF THINGS
THAT ARE OUT THERE THAT CANNOT

594
00:33:43,350 --> 00:33:45,380
BE CONTROLLED THAT WE ARE
WATCHING.

595
00:33:45,380 --> 00:33:48,679
WE CAN'T PREDICT WHERE THEY ARE
GOING TO GO.

596
00:33:48,679 --> 00:33:53,739
THEY SOMETIMES CAN JUST SCARE
US INTO REMEMBERING THEY ARE

597
00:33:53,739 --> 00:33:54,739
THERE.

598
00:33:54,739 --> 00:33:57,249
BECAUSE SO MUCH OF SPACE IS
INVISIBLE TO US BUT WE DON'T

599
00:33:57,249 --> 00:34:01,119
THINK ABOUT ALL THE SATELLITES,
AND INFRASTRUCTURE BY NATURE IS

600
00:34:01,119 --> 00:34:02,119
INVISIBLE.

601
00:34:02,119 --> 00:34:06,220
AND THEY ONLY BECOME VISIBLE
WHEN THEY BECOME A THREAT TO

602

00:34:13,399 --> 00:34:07,220

US.

603

00:34:13,399 --> 00:34:17,169

SO THAT IS SOME OF THE HISTORY
OF AND WHAT WE THOUGHT ABOUT

604

00:34:17,169 --> 00:34:19,220

SPACE DEBRIS OVER THE PAST
HALF-CENTURY.

605

00:34:19,220 --> 00:34:23,191

AND GO TO A SHORT Q AND A. AND
IF YOU HAVE A QUESTION PLEASE

606

00:34:23,191 --> 00:34:25,800

COME TO THE MICROPHONE SO
EVERYONE CAN HEAR YOU.

607

00:34:25,800 --> 00:34:28,010

>> ARE FOR ONLINE FOR OUR
ONLINE AUDIENCE.

608

00:34:28,010 --> 00:34:31,290

SPEED I HAVE GOT ONE FOR YOU.

609

00:34:31,290 --> 00:34:32,290

>>Lisa: GREAT.

610

00:34:32,290 --> 00:34:36,470

>>Audience: JUST WONDERING HOW
THE TRACKING IS HAPPENING.

611

00:34:36,470 --> 00:34:38,659

IS THIS GROUND-BASED,
SATELLITE-BASED, RADAR, HOW ARE

612

00:34:38,659 --> 00:34:40,550

WE KEEPING TRACK OF ALL THESE
MOVING PIECES?

613

00:34:40,550 --> 00:34:43,160

>>Lisa: THAT IS A GREAT
QUESTION I WILL SPEAK ABOUT IT

614

00:34:43,160 --> 00:34:44,160

MORE IN DEPTH.

615

00:34:44,160 --> 00:34:46,910

BUT JUST TO ANSWER THAT
EXCELLENT QUESTION.I AM GLAD

616

00:34:46,910 --> 00:34:51,669

WE ARE PROVOKING QUESTIONS I
WOULD HOPE YOU WOULD ASK.

617

00:34:51,669 --> 00:34:56,460

AND THAT IS THAT WE, IN THE END
SPACE THE DEPARTMENT OF

618

00:34:56,460 --> 00:35:09,020

DEFENSE, THE SATELLITES AND
SPACE, NOTHING IS GOOD ENOUGH

619

00:35:09,020 --> 00:35:12,140

TO TRACK THAT SMALL DEBRIS
ENVIRONMENT.AND WHAT IS GREAT

620

00:35:12,140 --> 00:35:14,770

ABOUT THAT IS IF YOU GO ONLINE
I AM FORGETTING THE NAME OF THE

621

00:35:14,770 --> 00:35:15,770

PROGRAM.

622

00:35:15,770 --> 00:35:19,380

SPACE TRACK:YOU CAN GO ONLINE
AND PUT IN THE NAME OF

623

00:35:19,380 --> 00:35:20,550

SOMETHING.

624

00:35:20,550 --> 00:35:22,760

AND SEE WHERE IT IS IN ORBIT IN
REAL-TIME.I THINK THAT IS

625

00:35:22,760 --> 00:35:23,760

FUN.

626

00:35:23,760 --> 00:35:26,010

I DO IT ALL THE TIME FOR
WESTWARD, THE NEEDLES.

627

00:35:26,010 --> 00:35:28,990

SOME OF THEM CLUMPED TOGETHER
AND THEY COME TOGETHER SO YOU

628

00:35:28,990 --> 00:35:29,990

CAN SEE THEM.

629

00:35:29,990 --> 00:35:33,240

THEY ARE PRETTY HIGH UP BUT IT
IS A FUN THING TO DO.

630

00:35:33,240 --> 00:35:36,370

IF YOU ARE A NERD LIKE ME OR
MISSY ELLIOTT YOU CAN GO ON

631

00:35:36,370 --> 00:35:39,170

THERE AND CHECK OUT WHAT THEY
SEE.

632

00:35:39,170 --> 00:35:42,360

YOU CAN SEE FOR YOURSELF WHAT
THE SPACE SURVEILLANCE SEES.

633

00:35:42,360 --> 00:35:45,970

>> ARE WE THE ONLY COUNTRIES
THAT ARE DOING ANYTHING ABOUT

634

00:35:45,970 --> 00:35:47,250
THE SPACE JUNK?

635

00:35:47,250 --> 00:35:50,850
>>Lisa: NO, GREAT QUESTION.

636

00:35:50,850 --> 00:35:55,480
THE SPACE CLUB HAS GROWN QUITE
A BIT FOR THE MAJORITY DO HAVE

637

00:35:55,480 --> 00:35:57,250
PROPERTIES IN OUTER SPACE NOW.

638

00:35:57,250 --> 00:36:00,620
AND THERE ARE SEVERAL
DIFFERENT NATIONS FOR DIFFERENT

639

00:36:00,620 --> 00:36:04,820
COMPANIES THAT ARE WORKING ON
COMING UP WITH WAYS TO REMOVE

640

00:36:04,820 --> 00:36:05,820
DEBRIS.

641

00:36:05,820 --> 00:36:07,930
UNFORTUNATELY WE DON'T
CURRENTLY HAVE INTERNATIONAL

642

00:36:07,930 --> 00:36:10,320
BINDING TREATY ABOUT SPACE
JUNK.

643

00:36:10,320 --> 00:36:12,640
WE HAVE A SERIES OF GUIDELINES,
MOST HAVE A SERIES OF

644

00:36:12,640 --> 00:36:18,550
GUIDELINES AND THEY ARE MEANT
TO NOT CREATE MORE DEBRIS.BUT

645
00:36:18,550 --> 00:36:25,160
SO FAR, THERE IS NO RULES AND
NO CONSEQUENCES FOR THOSE THAT

646
00:36:25,160 --> 00:36:26,160
VIOLATE.

647
00:36:26,160 --> 00:36:27,880
SO FOR INSTANCE, EVEN WITH THE
MITIGATION GUIDELINES WE HAVE

648
00:36:27,880 --> 00:36:30,770
IN PLACE IN AMERICA, THE
DEPARTMENT OF DEFENSE HAVE A

649
00:36:30,770 --> 00:36:34,550
CERTAIN NUMBER OF WAIVERS THEY
CAN USE TO CREATE A NORMAL

650
00:36:34,550 --> 00:36:37,350
AMOUNT OF DEBRIS BECAUSE IT IS
CRUCIAL TO THE NATIONAL DEFENSE

651
00:36:37,350 --> 00:36:40,480
THEY ARE ALLOWED TO DO THAT,
THEY HAVE WAIVERS.

652
00:36:40,480 --> 00:36:45,460
EVEN THOSE GUIDELINES ARE NOT
EXTREME, THEY ARE NOT 100

653
00:36:45,460 --> 00:36:47,870
PERCENT EFFECTIVE IN CREATING
LESS DEBRIS.

654
00:36:47,870 --> 00:36:50,620

>>Audience: YOU SAID EARLIER
THE ATMOSPHERE PRETTY MUH

655

00:36:50,620 --> 00:36:53,200
BLENDS ITSELF ANYWAY?

656

00:36:53,200 --> 00:36:58,660
>>Lisa: ESPECIALLY IN LOWER
ORBITS.

657

00:36:58,660 --> 00:37:02,190
SO THE SUN IS ON AN 11 YEAR
CYCLE WHERE IT SAYS THAT MORE

658

00:37:02,190 --> 00:37:03,210
ENERGY AND MAXIMUM.

659

00:37:03,210 --> 00:37:04,270
AND LESS ENERGY.

660

00:37:04,270 --> 00:37:07,840
IT IS SENDING OUT A LOT OF
ENERGY THE EARTH'S ATMOSPHERE

661

00:37:07,840 --> 00:37:11,890
EXPANDS AND ALL THESE PARTICLES
ARE IN SO IF YOU DON'T HAVE

662

00:37:11,890 --> 00:37:16,730
CONTROL ON IT, WE CAN'T BOOST
TO A HIGHER ALTITUDE.

663

00:37:16,730 --> 00:37:20,420
THE OBJECTS WILL SUCCUMB TO
FRICTION AND THAT EXPANDED

664

00:37:23,030 --> 00:37:21,420
ATMOSPHERE.

665

00:37:23,030 --> 00:37:26,780
>>Audience: THAT WE DON'T HAVE
ANYTHING IN PLACE AS FAR AS

666
00:37:26,780 --> 00:37:28,240
OTHER THAN THAT.

667
00:37:28,240 --> 00:37:30,980
ANYTHING ABOUT THE PROBLEM WITH
THE SPACE JUNK?

668
00:37:30,980 --> 00:37:32,560
>>Lisa: WE DO.

669
00:37:32,560 --> 00:37:36,000
ESPECIALLY FOR SOME OF THE
LARGER OBJECTS, I WILL SHOW YOU

670
00:37:36,000 --> 00:37:37,770
WHAT WE ARE GOING TO DO WITH
SOME OF THE LARGER ARE PRETTY

671
00:37:37,770 --> 00:37:40,760
SUCH AS THE INTERNATIONAL SPACE
STATION AND THE HUBBLE I WILL

672
00:37:40,760 --> 00:37:42,320
GET TO THAT IN THE NEXT
SECTION.

673
00:37:42,320 --> 00:37:44,290
>>Audience: THANK YOU.

674
00:37:44,290 --> 00:37:51,570
>> AN ONLINE QUESTION, HOW IS
NASA WORKING TO NOT CREATE

675
00:37:51,570 --> 00:37:56,230
SPACE JUNK TO WHAT IS ALREADY
OUT THERE.

676

00:37:56,230 --> 00:38:01,420

>>Lisa: SO NASA HAS A SERIES
OF GUIDELINES, BEST PRACTICES

677

00:38:01,420 --> 00:38:03,170

TO TRY TO REMOVE THE AMOUNT OF
DEBRIS.

678

00:38:03,170 --> 00:38:10,260

AND REALLY, AGAIN, NASA IS NOT
AS MUCH OF A PROBLEM AS THE

679

00:38:10,260 --> 00:38:11,920

NATIONAL DEFENSE.

680

00:38:11,920 --> 00:38:15,560

BECAUSE OF THE RULES.

681

00:38:15,560 --> 00:38:18,640

THE DEPARTMENT OF DEFENSE DOES
HAVE THOSE WAIVERS.

682

00:38:18,640 --> 00:38:24,300

SO NASA IS TRYING TO FOLLOW
SUCH PROCEDURES AS MAKING SURE

683

00:38:24,300 --> 00:38:28,200

THE ROCKETS ARE ENDED, ANY FUEL
IS ENDED, THERE IS NOT A ROCKET

684

00:38:28,200 --> 00:38:30,420

BODY FLOATING OUT THERE THAT IS
UNDER HIGH PRESSURE WITH

685

00:38:30,420 --> 00:38:33,980

VOLATILE FUEL THAT COULD
EXPLODE AT ANY MOMENT.

686

00:38:33,980 --> 00:38:39,740
SO THERE ARE THOSE STEPS THAT
NASA IS TAKING AND I WILL, AS I

687
00:38:39,740 --> 00:38:42,940
SAID ANSWER A QUESTION VERY
MUCH LIKE THAT WAS US IN THE

688
00:38:42,940 --> 00:38:43,940
AUDIENCE.

689
00:38:43,940 --> 00:38:46,490
I WILL GO INTO MORE ABOUT THE
CONCRETE ACTIONS THAT HAVE BEEN

690
00:38:46,490 --> 00:38:52,180
TAKEN TO PREVENT SOME OF OUR
OLDER, POTENTIALLY DANGEROUS

691
00:38:52,180 --> 00:38:55,010
PROPERTIES FROM BECOMING,
REENTERING SPACE TRACK AT THE

692
00:38:55,010 --> 00:39:00,720
END OF THEIR USEFUL LIVES.>>
AND OTHER ONLINE QUESTION.

693
00:39:00,720 --> 00:39:04,600
HOW PROFITABLE MIGHT SPACE
CLEANUP BE AS A BUSINESS

694
00:39:04,600 --> 00:39:05,600
VENTURE?

695
00:39:05,600 --> 00:39:08,200
IS ANYONE WILLING TO PAY FOR
SUCH SERVICES?

696
00:39:08,200 --> 00:39:11,880
>>Lisa: THAT IS A GREAT

QUESTION, LAURA.

697

00:39:11,880 --> 00:39:14,950

THERE ARE A COUPLE OF STARTUPS
WORKING ON THIS.

698

00:39:14,950 --> 00:39:16,450

I WAS PLEASED TO SEE THIS.

699

00:39:16,450 --> 00:39:20,600

THERE IS ONE IN ITALY I WAS
LOOKING AT EARLIER TODAY THAT

700

00:39:20,600 --> 00:39:24,730

ARE ALL TRYING TO COME UP WITH
SPACE DEBRIS REMOVAL

701

00:39:24,730 --> 00:39:28,770

TECHNOLOGY.NOW THAT SAID, IT
IS A VERY LEGALLY TRICKY THING

702

00:39:28,770 --> 00:39:31,850

TO DO.AND I WILL TALK ABOUT
THAT A LITTLE BIT MORE.

703

00:39:31,850 --> 00:39:36,040

IF YOU ARE A STARTUP IN ITALY
AND YOU HAVE TECHNOLOGY THAT

704

00:39:36,040 --> 00:39:39,120

TAKES UP SPACE DEBRIS, WHOSE
SPACE DEBRIS ARE YOU TAKING

705

00:39:39,120 --> 00:39:40,120

DOWN?

706

00:39:40,120 --> 00:39:42,630

WHAT IF ITALY SPACE DEBRIS IS
DANGEROUS TO WHAT WE CREATED?

707

00:39:42,630 --> 00:39:48,270

IF THEY GO UP THERE AND TAKE
DOWN OUR SATELLITE BECAUSE THEY

708

00:39:48,270 --> 00:39:50,050

THINK IT IS JUNK THAT IS NOT
GOOD.

709

00:39:50,050 --> 00:39:52,810

IT COULD BE SEEN AS AN ACT OF
WAR.

710

00:39:52,810 --> 00:39:55,870

SO, INCORPORATED YOU.

711

00:39:55,870 --> 00:39:57,690

THERE ARE PRIVATE COMPANIES
THAT ARE WORKING ON IT.

712

00:39:57,690 --> 00:40:02,640

ONE OF THE INTERESTING THINGS
IS THAT MOST OF THE MAIN

713

00:40:02,640 --> 00:40:06,720

COMMERCIAL SPACEFLIGHT
COMPANIES WE THINK OF DON'T

714

00:40:06,720 --> 00:40:10,450

SEEM TO BE AS CONCERNED ABOUT
DEBRIS AS A RULE.

715

00:40:10,450 --> 00:40:13,990

SO I SEEM TO THINK OF THIS AS A
FLEDGLING INDUSTRY AND SEE WHAT

716

00:40:13,990 --> 00:40:18,540

COMES OUT OF THE NEXT FEW YEARS
AS FAR AS SPACE DEBRIS REMOVAL.

717

00:40:18,540 --> 00:40:23,640
I THINK THE FIRST PROTOTYPE, BY
2019 AND WE WILL SEE HOW THAT

718
00:40:23,640 --> 00:40:24,640
GOES.

719
00:40:24,640 --> 00:40:27,060
>> LET'S DO ONE MORE ONLINE
QUESTION BUT WE HAVE ANOTHER

720
00:40:27,060 --> 00:40:28,430
ONE, WE ARE GOOD.

721
00:40:28,430 --> 00:40:32,900
WHY DON'T WE MOVE INTO THE LAST
SECTION OF OUR PRESENTATION

722
00:40:32,900 --> 00:40:35,790
WHICH HAS ALREADY BEEN A TOPIC
OF THESE QUESTIONS, WHAT DO WE

723
00:40:35,790 --> 00:40:37,010
DO ABOUT SPACE DEBRIS?

724
00:40:37,010 --> 00:40:40,700
>>Lisa: I AM SO GLAD YOU WERE
ASKING THESE ONLINE AND IN

725
00:40:40,700 --> 00:40:46,350
PERSON BECAUSE THAT MEANS WE
ARE HAVING A CONVERSATION THAT

726
00:40:46,350 --> 00:40:56,390
HAS RELEVANCE ACROSS...SO HOW
DO WE KNOW WHAT WE KNOW ABOUT

727
00:40:56,390 --> 00:40:58,410
SPACE JUNK, HOW CAN WE SEE IT?

728

00:40:58,410 --> 00:41:01,930

I MENTIONED THE BASE DEBRIS RUN
BY THE DEPARTMENT OF DEFENSE.

729

00:41:01,930 --> 00:41:08,080

AND THIS IS A SPACE ENDS OF A
RADAR OF THE SOUTHWESTERN

730

00:41:08,080 --> 00:41:11,370

UNITED STATES THAT WAS USED AS
A RADAR DRAGNET.

731

00:41:11,370 --> 00:41:14,130

SETTING UP SIGNALS, ANYTHING
THAT CROSSES HIS PATH YOU KNOW

732

00:41:14,130 --> 00:41:16,340

IT IS THERE.

733

00:41:16,340 --> 00:41:20,160

UNFORTUNATELY, THIS IS ONE PART
OF A PASTOR WORLDWIDE NETWORK

734

00:41:20,160 --> 00:41:21,440

DETECTION DEVICES.

735

00:41:21,440 --> 00:41:24,300

UNFORTUNATELY DUE TO
SEQUESTRATION IT GOT CLOSED AND

736

00:41:24,300 --> 00:41:28,530

2013 AND WAS CLOSE DOWN
INDEFINITELY.

737

00:41:28,530 --> 00:41:30,620

HOWEVER LOCKHEED IS BUILDING A
NEW ONE, A NEXT GENERATION

738

00:41:30,620 --> 00:41:34,770

SPACE NET AND THAT WILL USE
X-BAND RADAR THAT WILL DETECT

739

00:41:34,770 --> 00:41:37,510
SMALLER OBJECTS ACROSS THE
OVERHEAD.

740

00:41:37,510 --> 00:41:40,560
THAT IS GOOD BUT WE ARE NEVER
REALLY GOING TO SEE THIS REALLY

741

00:41:40,560 --> 00:41:41,660
SMALL OBJECTS.

742

00:41:41,660 --> 00:41:44,640
I CAN'T IMAGINE AS EVER HAVING
THE ABILITY TO BE ABLE TO SEE

743

00:41:44,640 --> 00:41:49,230
THAT THEY ARE MOVING SO QUICKLY
AND SO SMALL IT WILL BE REALLY

744

00:41:49,230 --> 00:41:53,240
IMPOSSIBLE TO SEE AND THEREFORE
CONTROL THEM.

745

00:41:53,240 --> 00:41:58,830
SO, ONCE WE ARE ABLE TO SEE THE
OBJECT TO SEE WHERE THEY ARE,

746

00:41:58,830 --> 00:42:01,470
PARTICULARLY WHERE THEY ARE
GOING TO BE, WHAT ARE SOME OF

747

00:42:01,470 --> 00:42:03,350
THE WAYS WE COULD FIX THE
PROBLEM?

748

00:42:03,350 --> 00:42:09,530
ONE OF THE MOST IMPORTANT STEPS

THAT MOST SPACE AGENCIES IS

749

00:42:09,530 --> 00:42:12,790

TAKING IS WHAT WE DISCUSSED
BEFORE, WHICH IS MITIGATION.

750

00:42:12,790 --> 00:42:15,000

SLOWING THE CREATION OF NEW
DEBRIS.

751

00:42:15,000 --> 00:42:18,290

PUTTING STUFF UP THERE TO MAKE
THE PROBLEM WORSE AND TO REDUCE

752

00:42:18,290 --> 00:42:21,350

THE LIKELIHOOD OF ORBIT
BREAKUPS.

753

00:42:21,350 --> 00:42:23,200

MAKE SURE THERE ARE NOT
VOLATILE FUELS UNDER PRESSURE

754

00:42:23,200 --> 00:42:26,410

THAT COULD EXPLODE AND CREATE
NEW FRAGMENTS.

755

00:42:26,410 --> 00:42:30,280

AND THIS REALLY MAKE SENSE AS A
FIRST STEP.

756

00:42:30,280 --> 00:42:34,590

IT IS SOMETHING THAT DOESN'T
REQUIRE REALLY ANY LEGAL

757

00:42:34,590 --> 00:42:36,580

COMPROMISES.

758

00:42:36,580 --> 00:42:38,980

IT HAPPENS AT THE POINT OF
CREATION, AT THE POINT OF

759

00:42:38,980 --> 00:42:39,980

LAUNCH.

760

00:42:39,980 --> 00:42:43,020

YOU CAN HAVE SOME CONTROL OF
MAKING SURE THAT SOME OF THE

761

00:42:43,020 --> 00:42:45,611

STEPS ARE TAKEN SO THESE
OBJECTS AREN'T AS VOLATILE IN

762

00:42:45,611 --> 00:42:47,180

OUTER SPACE.

763

00:42:47,180 --> 00:42:49,950

THE TRICKIER FIX IS
REMEDICATION.

764

00:42:49,950 --> 00:42:53,620

WHICH IS THE ACTIVE REMOVAL OF
DEBRIS THAT IS CURRENTLY IN

765

00:42:53,620 --> 00:42:55,550

ORBIT.

766

00:42:55,550 --> 00:42:58,870

AND THAT IS UNFORTUNATELY ON
THE LEFT FOR THE GENTLEMAN ON

767

00:42:58,870 --> 00:43:03,620

THE LEFT, THE QUESTION OF SOME
OF THE METHODS OF REMOVAL ALL

768

00:43:03,620 --> 00:43:05,800

FALL INTO THAT ADR CATEGORY.

769

00:43:05,800 --> 00:43:09,820

AND THERE ARE QUITE A FEW THAT

HAVE PROPOSED OVER THE YEARS.

770

00:43:09,820 --> 00:43:14,700

DIFFERENT ACTIVE DEBRIS REMOVAL
IDEAS HAVE BEEN SWIRLING AROUND

771

00:43:14,700 --> 00:43:18,340

FOR DECADES.THEY RANGE FROM
HARPOONS TO NETS AS YOU SEE

772

00:43:18,340 --> 00:43:23,980

HERE IN THIS ORBIT PROGRAM THAT
IS BEING CREATED BY NASA.

773

00:43:23,980 --> 00:43:27,970

TWO THINGS LIKE SPACE LASER, A
LASER ROOM.

774

00:43:27,970 --> 00:43:32,950

AS YOU CAN IMAGINE LASERS ARE
KINDA SCARY.

775

00:43:32,950 --> 00:43:38,640

IF YOU SAW, YOU WILL BE UP TO
SEE THIS, BUT THIS IMAGE HERE

776

00:43:38,640 --> 00:43:41,360

CAN YOU TELL IF THIS IS AN ACT
OF WAR OR AN ACTIVE CLEANING?

777

00:43:41,360 --> 00:43:44,740

IT LOOKS LIKE AN ACT OF WAR TO
BE IT LOOKS LIKE THE DEATH AND

778

00:43:44,740 --> 00:43:46,300

START SHOOTING.

779

00:43:46,300 --> 00:43:51,480

SO REALLY THE SHOOTING THINGS
FROM THE GROUND, LIKE WITH THAT

780

00:43:51,480 --> 00:43:54,840

CHINESE SATELLITE TEST IN 2007
WHERE THEY DESTROY THAT OBJECT

781

00:43:54,840 --> 00:43:58,100

IT COULD BE TRICKY AND SEEN AS
AGGRESSIVE.

782

00:43:58,100 --> 00:44:03,460

SO THIS IS ORIGINALLY A PERFECT
EXAMPLE OF WHAT IS A GOOD IDEA

783

00:44:03,460 --> 00:44:07,230

FOR ACTIVE DEBRIS THAT COULD BE
LEGALLY TRICKY.

784

00:44:07,230 --> 00:44:11,570

ONE OF MY FAVORITE
POSSIBILITIES THAT CAME OUT, IS

785

00:44:11,570 --> 00:44:16,490

THIS IDEA OF USING GECKO
GRIPPERS.

786

00:44:16,490 --> 00:44:19,690

GECKO'S EACH HAVE A VERY UNIQUE
PROPERTY OF GRABBING AND

787

00:44:19,690 --> 00:44:20,690

RELEASING.

788

00:44:20,690 --> 00:44:25,610

IT IS VERY FASCINATING AND
THESE GRIPPERS WORKED WELL IN

789

00:44:25,610 --> 00:44:26,830

DIFFERENT ENVIRONMENTS.

790

00:44:26,830 --> 00:44:32,500
SO THEY ARE THINKING THEY CAN
RE-CREATE THE BEAT EXACTLY BUT

791
00:44:32,500 --> 00:44:35,250
AS YOU CAN SEE HERE IN THAT
ANIMATED IMAGE.

792
00:44:35,250 --> 00:44:38,800
THAT IS ONE RESEARCHER
ATTEMPTING TO GRASP ANOTHER

793
00:44:38,800 --> 00:44:43,450
RESEARCHER FROM A 250 POUNDS
SATELLITE IN THE MICROGRAVITY

794
00:44:43,450 --> 00:44:47,440
SIMULATOR NOT AS A VOMITS
COMMENTS.

795
00:44:47,440 --> 00:44:52,740
THEY ARE TESTING THIS GECKO
GRIPPER IN AN ANTI- ENVIRONMENT

796
00:44:52,740 --> 00:45:00,680
LIKE AND WHICH IS WHERE THIS
TECHNOLOGY WOULD BE USED.

797
00:45:00,680 --> 00:45:04,550
THE SWISS ARE CREATING
SOMETHING CALLED A CLEAN SPACE

798
00:45:04,550 --> 00:45:05,550
ONE.

799
00:45:05,550 --> 00:45:08,200
I LOVE IT BECAUSE THIS WAS WHO
ARE CLEANING UP AFTER

800
00:45:08,200 --> 00:45:09,200

THEMSELVES.

801

00:45:09,200 --> 00:45:16,510
SO THEY ARE PLANNING TO PICK UP
THEIR OWN CUBE SETS, IN A KIND

802

00:45:16,510 --> 00:45:19,550
OF BASKET SHAPED SATELLITE.

803

00:45:19,550 --> 00:45:21,620
WHICH WILL THEN TRACK IT BACK
INTO THE ATMOSPHERE TO BE

804

00:45:21,620 --> 00:45:22,620
DESTROYED.

805

00:45:22,620 --> 00:45:25,820
AND AGAIN, IT IS COMPLICATED.

806

00:45:25,820 --> 00:45:27,710
IN THIS THE SWISS ARE PICKING
UP THEIR OWN OBJECTS.

807

00:45:27,710 --> 00:45:30,540
IT IS CLEAR IT IS THEIR OWN
OBJECT THEY HAVE CLEARED

808

00:45:30,540 --> 00:45:32,760
SOMETHING THAT IS THEIR OWN
SOVEREIGNTY OVER.

809

00:45:32,760 --> 00:45:36,080
BUT HOW EFFECTIVE WILL THAT BE
OF CLEANING UP A DEBRIS PROJECT

810

00:45:36,080 --> 00:45:40,970
WHERE YOU HAVE HUNDREDS OF
THOUSANDS OF OBJECTS LAUNCHED

811

00:45:40,970 --> 00:45:44,510
BY MULTIPLE DIFFERENT ENTITIES
AND STATES.

812
00:45:44,510 --> 00:45:47,100
IT IS NOT JUST ONE CUBE THAT IS
THE PROBLEM.

813
00:45:47,100 --> 00:45:51,360
THEY ARE CLAIMING IT WILL BE
LAUNCHED BY 2019 SO WE WILL SEE

814
00:45:51,360 --> 00:45:54,440
WHAT HAPPENS THEN.

815
00:45:54,440 --> 00:46:01,590
AS FAR AS MORE IMMEDIATE PLANS,
MORE IMMEDIATE IDEAS.

816
00:46:01,590 --> 00:46:04,620
NASA AND SOME SPECIAL PARTNERS
ARE COMING UP WITH PLANS OF HOW

817
00:46:04,620 --> 00:46:09,940
TO SAFELY DEORBIT OBJECTS LIKE
THE HUBBLE SPACE TELESCOPE AT

818
00:46:09,940 --> 00:46:12,810
THE END OF ITS LIFE WHICH BREAK
MY HEART A LITTLE BIT OF THE

819
00:46:12,810 --> 00:46:15,750
IDEA OF THE HUBBLE BEING
DESTROYED.

820
00:46:15,750 --> 00:46:17,740
WHAT THEY HAVE TO MAKE SURE
THEY DO IT CAREFULLY.

821
00:46:17,740 --> 00:46:20,430

THERE IS NO WAY OF BRINGING A
BACKUP OF THE SPACE SHUTTLE IS

822

00:46:20,430 --> 00:46:23,580
OUT OF COMMISSION THOUGH IT
WILL BECOME SPACE JUNK WAS A

823

00:46:23,580 --> 00:46:25,310
GHOST D ACTIVE.

824

00:46:25,310 --> 00:46:30,000
IN THE MOST RECENT 2009 IN THE
FINAL REPAIR MISSION THE

825

00:46:30,000 --> 00:46:37,980
ASTRONAUTS INSTALLED THIS SOFT,
THAT CAN BE CLASSIFIED, AND IT

826

00:46:37,980 --> 00:46:41,990
CAN COME DOWN IN A CONTROLLED
AREA AND FALL DOWN TO THE OCEAN

827

00:46:41,990 --> 00:46:44,790
IN AN UNINHABITED AREA.

828

00:46:44,790 --> 00:46:48,590
SIMILARLY THE INTERNATIONAL
SPACE STATION WILL HAVE TO BE

829

00:46:48,590 --> 00:46:52,390
GUIDED BACK TO THE ATMOSPHERE
AT THE END OF ITS LIFE.

830

00:46:52,390 --> 00:46:55,010
THAT IS THE SIZE OF A FOOTBALL
FIELD YOU DO NOT WANT IT AND

831

00:46:55,010 --> 00:46:58,380
LETTING OVER ANY LANDMASS OR
WHERE PEOPLE MIGHT BE.

832

00:46:58,380 --> 00:47:03,260

A SYSTEM OF ADDING FUEL TO THE
THRUSTERS AND ADDING ADDITIONAL

833

00:47:03,260 --> 00:47:05,900

SPACECRAFT TO GET BACK TO THE
ATMOSPHERE IN A CONTROLLED

834

00:47:05,900 --> 00:47:08,360

FASHION AT THE END OF HIS LIFE.

835

00:47:08,360 --> 00:47:11,370

UNFORTUNATELY WE CAN'T SAY
THESE ARTIFACTS AWAY WE SAY

836

00:47:11,370 --> 00:47:13,760

THAT WHITEFIELD PLANETARY
CAMERA.

837

00:47:13,760 --> 00:47:17,140

YOU ARE ALL HERE AT THE HISTORY
MUSEUM IT WOULD BE GREAT TO SEE

838

00:47:17,140 --> 00:47:20,070

THESE ARTIFACTS THAT HAVE MAJOR
CULTURAL SIGNIFICANCE BUT IN

839

00:47:20,070 --> 00:47:22,740

THE END THEY WILL ALL BECOME
SPACE JUNK.

840

00:47:22,740 --> 00:47:30,180

SO THERE IS ONE OTHER FORM, AND
OTHER FIX THAT DOESN'T FIT INTO

841

00:47:30,180 --> 00:47:33,990

THESE TWO CATEGORIES WHICH IS
REUSE AND RECYCLING.

842

00:47:33,990 --> 00:47:41,030

SOME OF YOU MAY HAVE NOTICED
RECENTLY AT THE END OF 2015 ONE

843

00:47:41,030 --> 00:47:46,690

COMMERCIAL SPACE X AND BLUE
ORIGIN LAUNCH ROCKETS AND THEN

844

00:47:46,690 --> 00:47:48,690

LANDED THEM VERTICALLY FOR
REUSE.

845

00:47:48,690 --> 00:47:52,330

WHICH IS A BIG DEAL THAT HADN'T
BEEN DONE BEFORE.

846

00:47:52,330 --> 00:47:56,050

AND THEIR IDEA IS THAT REUSE
WILL CREATE LESS DEBRIS BUT BE

847

00:47:56,050 --> 00:48:03,260

MORE FINANCIALLY VIABLE. THE
ONLY ISSUE WITH THAT IS THAT

848

00:48:03,260 --> 00:48:07,030

ROCKETS AREN'T THE ONLY THING
THAT GENERATE DEBRIS.

849

00:48:07,030 --> 00:48:10,510

SO THIS IS THE FIRST TIME WE
TRIED TO GET TO A REUSABILITY

850

00:48:10,510 --> 00:48:14,170

PARADIGM IN THE 70s AND 80s
WHEN THE SPACE SHUTTLE WAS

851

00:48:14,170 --> 00:48:18,600

FIRST BEING DESIGNED THEY WERE
INTENDED TO BE A WAY OF

852

00:48:18,600 --> 00:48:21,370

SALVAGING, EVERY USING THE
ARTIFACTS WE HAVE IN SPACE.

853

00:48:21,370 --> 00:48:25,160

SO INSTEAD OF SENDING OUT A
BRAND-NEW SATELLITE THAT BREAKS

854

00:48:25,160 --> 00:48:28,420

YOU SEND UP ASTRONAUTS OR A
ROBOTIC DOG AND PULL THAT

855

00:48:28,420 --> 00:48:31,360

SATELLITE BACK IN, YOU
REFURBISH IT, SALVAGE WHAT YOU

856

00:48:31,360 --> 00:48:33,580

CAN THAT CAN'T BE REFURBISHED,
YOU SEND IT BACK OUT AND BRING

857

00:48:33,580 --> 00:48:36,060

IT BACK TO EARTH AND REUSE IT.

858

00:48:36,060 --> 00:48:40,640

SO YOU DON'T HAVE THIS
POPULATION OF DEAD SATELLITES.

859

00:48:40,640 --> 00:48:44,140

YOU WOULD ALSO NEED FEWER
BECAUSE THEY ARE REUSABLE THERE

860

00:48:44,140 --> 00:48:46,300

WOULD BE FEWER ROCKET BODIES
ROCKING AROUND.

861

00:48:46,300 --> 00:48:49,270

EVERYTHING WILL BE LAUNCH FROM
THE SPACE STATION BUT

862

00:48:49,270 --> 00:48:52,230
EVERYTHING WOULD BE CHEAPER AND
CLEANER FOR EVERYBODY.

863
00:48:52,230 --> 00:48:57,170
WITH THAT SAID, AS MANY OF YOU
PROBABLY KNOW IF YOU HAVE BEEN

864
00:48:57,170 --> 00:49:01,130
AROUND THE EXHIBITS, THE SPACE
SHUTTLES ARE VERY EXPENSIVE.

865
00:49:01,130 --> 00:49:03,580
LIKE ANY OTHER RECYCLING
PROGRAM IF HE GETS TOO

866
00:49:03,580 --> 00:49:07,900
EXPENSIVE IT IS GOING TO GO.

867
00:49:07,900 --> 00:49:11,500
SO FOR INSTANCE IF CLASSES TOO
EXPENSIVE IN YOUR AREA TO BE

868
00:49:11,500 --> 00:49:13,570
RECYCLED CHANCES ARE YOU DON'T
HAVE A GLASS RECYCLING PROGRAM.

869
00:49:13,570 --> 00:49:14,900
THAT IS JUST THE WAY IT WORKS.

870
00:49:14,900 --> 00:49:19,380
AND EVENTUALLY THE SPACE
SHUTTLE ONLY SERVICES A HANDFUL

871
00:49:19,380 --> 00:49:20,380
OF SATELLITES.

872
00:49:20,380 --> 00:49:23,910
FOR THE MOST PART WE WENT BACK
TO LAUNCHING SINGLE USE

873

00:49:23,910 --> 00:49:28,610

SATELLITES AND SINGLE USE
ROCKETS.AND THAT IS A VERY

874

00:49:28,610 --> 00:49:32,760

TRICKY PART OF THE RECYCLING
IDEA.

875

00:49:32,760 --> 00:49:36,920

BUT IT IS ONE THAT DARPA IS
TRYING TO WORK WITH.

876

00:49:36,920 --> 00:49:41,880

NOT JUST SENT OUT ROCKETS BUT
HAVE SATELLITES THAT CAN GRAB

877

00:49:41,880 --> 00:49:49,640

NEW ROCKETS, AND REFUEL THEM,
THESE AGILE ROCKETS ATTACHED TO

878

00:49:49,640 --> 00:49:53,560

AN EXPENSIVE TELESCOPE LENS
THAT CAN COMPLETELY REUSE IT

879

00:49:53,560 --> 00:49:56,780

RATHER THAN GO TO WASTE IN
ORBIT.

880

00:49:56,780 --> 00:50:00,110

SO THIS REUSABILITY IDEA IS
COMING BACK INTO FASHION BUT WE

881

00:50:00,110 --> 00:50:01,110

WILL SEE.

882

00:50:01,110 --> 00:50:03,860

IT ALREADY HAPPENED BEFORE.

883

00:50:03,860 --> 00:50:08,300
SO WE WILL SEE WHAT HAPPENS
WITH THIS PARTICULAR NEW

884
00:50:08,300 --> 00:50:10,330
MOVEMENT TOWARDS REUSE IN OUTER
SPACE.

885
00:50:10,330 --> 00:50:12,850
NOW WITH ALL THIS BEING SAID WE
TALKED ABOUT WHAT NASA IS

886
00:50:12,850 --> 00:50:13,950
TRYING TO DO.

887
00:50:13,950 --> 00:50:15,941
WHAT THE PARTICULAR OF SPACE
AND TRYING TO DO, WITH THE

888
00:50:15,941 --> 00:50:17,770
COMMERCIAL SPACE IS TRYING TO
DO.

889
00:50:17,770 --> 00:50:21,880
WHAT CAN WE DO IN TERMS OF
THINKING OF OUTER SPACE?

890
00:50:21,880 --> 00:50:24,110
WE THINK ABOUT
ENVIRONMENTALISM, WE THINK

891
00:50:24,110 --> 00:50:27,800
ABOUT REDUCE, REUSE, RECYCLE
THE 3R'S.

892
00:50:27,800 --> 00:50:31,510
THERE IS NOT A LOT WE CAN DO AS
INDIVIDUALS FOR OUTER SPACE.

893
00:50:31,510 --> 00:50:33,890

WE'RE NOT THE ONE CREATING
MITIGATION, WE ARE NOT

894

00:50:33,890 --> 00:50:38,440
DESIGNING ROCKETS, SO WHAT CAN
WE DO?

895

00:50:38,440 --> 00:50:44,630
AS I MENTIONED BEFORE, THE
SPACE ENVIRONMENT, THE

896

00:50:44,630 --> 00:50:47,680
ATMOSPHERIC HAS A SELF-CLEANING
METHOD.

897

00:50:47,680 --> 00:50:50,170
AND THE ONE THING THAT IS
INTERESTING ABOUT THAT ISN'T

898

00:50:50,170 --> 00:50:55,560
2012 A GROUP OF CHEMIST AND
GEOSCIENCE CLAIM THAT HUMAN

899

00:50:55,560 --> 00:51:01,070
CLOSED CLIMATE CHANGE IS
REDUCING THE EFFICIENCY OF THAT

900

00:51:01,070 --> 00:51:03,030
SELF-CLEANING METHOD.

901

00:51:03,030 --> 00:51:06,430
SO CLIMATE CHANGE IS CAUSING
THE OUTER LAYERS OF THE

902

00:51:06,430 --> 00:51:09,810
ATMOSPHERE TO CONTRACT WHICH
MEANS LESS OF OUR JUNK IS BEING

903

00:51:09,810 --> 00:51:12,170
DRAWN BACK INTO SPACE ON A

REGULAR BASIS.

904

00:51:12,170 --> 00:51:14,330

SO WE HAVE A LARGER DEBRIS
ENVIRONMENT AND WE WILL SEE A

905

00:51:14,330 --> 00:51:18,660

LARGER DEBRIS ENVIRONMENT
BECAUSE OF CLIMATE CHANGE.

906

00:51:18,660 --> 00:51:24,710

SO ONE THING YOU CAN DO TO HELP
SUPPORT THE REDUCTION OF DEBRIS

907

00:51:24,710 --> 00:51:29,290

IS TO ELECT LAWMAKERS, TO
SUPPORT LAWMAKERS TO FIGHT

908

00:51:29,290 --> 00:51:30,290

CLIMATE CHANGE.

909

00:51:30,290 --> 00:51:34,110

BECAUSE THAT IS NOT JUST
AFFECTING OUR ECOSYSTEMS ON

910

00:51:34,110 --> 00:51:36,600

EARTH BUT IT IS AFFECTING OUR
ECOSYSTEM IN OUTER SPACE WHICH

911

00:51:36,600 --> 00:51:38,210

IS KIND OF INCREDIBLE WHEN YOU
THINK ABOUT IT.

912

00:51:38,210 --> 00:51:41,730

THIS IS A GLOBAL NOMINAL, IT IS
AN EXTRA GLOBAL PHENOMENON.

913

00:51:41,730 --> 00:51:45,580

THAT IS ONE THING WE CAN DO AS
INDIVIDUAL CITIZENS TO HELP

914

00:51:45,580 --> 00:51:46,950
WITH THE DEBRIS PROBLEM.

915

00:51:46,950 --> 00:51:50,540
OF COURSE THERE IS THE QUESTION
OF SHOULD WE EVEN FIX A PROBLEM

916

00:51:50,540 --> 00:51:54,470
OR SHOULD WE BE WORRIED?

917

00:51:54,470 --> 00:51:59,180
AS I MENTIONED, FIXING OR AT
LEAST REMEDIATING DEBRIS CAN BE

918

00:51:59,180 --> 00:52:01,330
LEGALLY COMPLEX, YOU DON'T WANT
IT TO SEEM LIKE IT IS AN ACT OF

919

00:52:01,330 --> 00:52:03,060
WAR.

920

00:52:03,060 --> 00:52:06,710
AND ONE GRAND STUDY CAME TO THE
CONCLUSION THAT DEBRIS REMEDY

921

00:52:06,710 --> 00:52:10,110
ISN'T A MAJOR FOCUS AMONG MAJOR
SPACE OPERATOR SO THAT THEY ARE

922

00:52:10,110 --> 00:52:11,980
NOT WORRIED ABOUT IT MAYBE WE
SHOULD NOT, TOO.

923

00:52:11,980 --> 00:52:18,270
IT IS QUITE POSSIBLE THAT MAYBE
THERE IS MORE SPACE LEFT IN

924

00:52:18,270 --> 00:52:20,670

SPACE AND WE INITIALLY THOUGHT.

925

00:52:20,670 --> 00:52:23,420

SO DOES THE PROBLEM REALLY
EXIST IS THE QUESTION.

926

00:52:23,420 --> 00:52:26,540

WHEN THE COSMOS COLLISION THERE
WAS VIRTUALLY NO LOSS OF

927

00:52:26,540 --> 00:52:31,170

SERVICE.THEY HAD BACKUPS AND
THERE WAS ONLY A SHORT BLIP IN

928

00:52:31,170 --> 00:52:35,730

SERVICE FOR THOSE WHO USED AND
NO ONE WAS EVER THE WISER.

929

00:52:35,730 --> 00:52:41,800

AND THE COSMOS SATELLITE WAS
DEFUNCT SO NOBODY WAS USING IT.

930

00:52:41,800 --> 00:52:46,630

HOWEVER, THAT SAID, I MEAN HOW
MANY OF YOU HAVE USED A

931

00:52:46,630 --> 00:52:47,880

SATELLITE TODAY?

932

00:52:47,880 --> 00:52:52,960

ONLY SEEING A FEW HANDS BUT
CHANCES ARE YOU ALL HAVE.

933

00:52:52,960 --> 00:52:56,060

BECAUSE SATELLITE TECHNOLOGY IS
EVERYWHERE.

934

00:52:56,060 --> 00:52:58,760

WE DON'T SEE IT BECAUSE IT IS
INFRASTRUCTURE BUT IF YOU USE

935

00:52:58,760 --> 00:53:00,830

YOUR CELL PHONE TODAY, NOT JUST
A SMART PHONE BUT A DUMB PHONE

936

00:53:00,830 --> 00:53:01,830

TOO.

937

00:53:01,830 --> 00:53:06,271

CHECK THE WEATHER REPORT, GPS,
ANYTHING WE USE SATELLITES FOR.

938

00:53:06,271 --> 00:53:11,440

SO ALTHOUGH THERE IS STILL A
LOT OF SPACE IN OUTER SPACE IT

939

00:53:11,440 --> 00:53:13,960

IS SOMETHING HAPPENS IN GRAVITY
IF A BOTTLER SATELLITES.

940

00:53:13,960 --> 00:53:15,640

QUICKLY WE WOULD KNOW.

941

00:53:15,640 --> 00:53:19,270

WE WOULDN'T SEE ANYTHING THE
WORLD WOULD LOOK THE SAME TO

942

00:53:19,270 --> 00:53:20,270

US.

943

00:53:20,270 --> 00:53:24,690

THE FINANCIAL SECTOR, THE
COMMUNICATIONS, EVEN ATMS,

944

00:53:24,690 --> 00:53:29,140

TRAVELS, COMMERCE, BASICALLY
GLOBALISM AS WE KNOW IT WOULD

945

00:53:29,140 --> 00:53:31,270

BE CHANGED IN THE BLINK OF AN EYE.

946

00:53:31,270 --> 00:53:33,340

IT IS SOMETHING WE WOULDN'T SEE BUT SOMETHING WE WOULD

947

00:53:33,340 --> 00:53:37,420

EXPERIENCE AND FEEL IN OUR DAILY LIVES.THANK YOU.

948

00:53:37,420 --> 00:53:41,800

>> WE ARE GETTING TO THE VERY LAST PART OF OUR PROGRAM.

949

00:53:41,800 --> 00:53:47,180

AND ARE LOOKING FORWARD TO A FEW MORE ONLINE QUESTIONS.

950

00:53:47,180 --> 00:53:59,150

THERE WE GO, IS THERE DEBRIS SUCH AS THE NUCLEAR EXPLOSIONS

951

00:53:59,150 --> 00:54:03,100

THAT AFFECT THE CHEMICAL QUALITY OF SPACE AND DOES IT

952

00:54:03,100 --> 00:54:04,100

MATTER?

953

00:54:04,100 --> 00:54:07,200

FROM TODD.>>Lisa: THAT IS A GREAT QUESTION.

954

00:54:07,200 --> 00:54:10,000

WHEN THE NUCLEAR EXPLOSIONS OF HAPPEN ANYMORE, THOSE ARE OVER.

955

00:54:10,000 --> 00:54:14,860

BUT THERE WAS A MAJOR, MAJOR

EXPLOSION IN 1962 CALLED

956

00:54:14,860 --> 00:54:19,880

STARFISH CRIME THAT CREATED AND
HOLD NEW ARTIFICIAL RADIATION

957

00:54:19,880 --> 00:54:23,390

BAND ON THE BELT.

958

00:54:23,390 --> 00:54:25,700

AND IT CHANGE THE CHEMICAL
COMPOSITION.

959

00:54:25,700 --> 00:54:29,640

THERE WAS BIOMATERIAL THAT WAS
ALL OVER THE UPPER LAYERS OF

960

00:54:29,640 --> 00:54:30,770

THE ATMOSPHERE.

961

00:54:30,770 --> 00:54:34,100

IT DID EVENTUALLY DISSIPATE BUT
IT DID CREATE AN ARTIFICIAL

962

00:54:34,100 --> 00:54:37,820

RADIATION BELT THAT EITHER
TEMPORARILY DISABLED OR

963

00:54:37,820 --> 00:54:40,540

DESTROYED SEVERAL OF OUR
FUNCTIONING SATELLITES AND

964

00:54:40,540 --> 00:54:43,740

OUTER SPACE WHICH ONE OF THEM
WAS HEALTH STAR A VENERABLE.

965

00:54:43,740 --> 00:54:55,050

THAT EVENTUALLY WENT INTO THE
COMMISSION.

966

00:54:55,050 --> 00:55:01,240

THE ELECTROMAGNETIC STABILITY
OF THE REGION, THEY DON'T

967

00:55:01,240 --> 00:55:02,240

HAPPEN ANYMORE.

968

00:55:02,240 --> 00:55:04,550

THEY ARE NOT SUPPOSED TO
BECAUSE WE HAVE A TREATY BUT

969

00:55:04,550 --> 00:55:07,380

THEY DEFINITELY HAVE A MAJOR,
ESPECIALLY THE LAST ONE

970

00:55:07,380 --> 00:55:12,820

STARFISH CRIME HAD A IMPACT ON
SPACE.

971

00:55:12,820 --> 00:55:17,530

IT DOES CONTINUE TO HAPPEN WE
WOULD NO LONGER BE ABLE TO USE

972

00:55:17,530 --> 00:55:21,890

SATELLITES IN HISTORY WILL BE
VERY DIFFERENT.

973

00:55:21,890 --> 00:55:25,200

>> I BELIEVE WE HAVE ANOTHER
ONLINE QUESTION.

974

00:55:25,200 --> 00:55:28,790

HOW CAN WE EXPLORE OTHER
PLANETS WITHOUT LEAVING A TRAIL

975

00:55:28,790 --> 00:55:29,790

OF SPACE JUNK?

976

00:55:29,790 --> 00:55:30,790

BY LAURA.

977

00:55:30,790 --> 00:55:33,030

>>Lisa: THAT IS A VERY GOOD QUESTION.

978

00:55:33,030 --> 00:55:36,650

WE BASICALLY ARE LEAVING A TRAIL OF SPACE JUNK.

979

00:55:36,650 --> 00:55:37,650

WE HAVE TO.

980

00:55:37,650 --> 00:55:41,840

EXPLORING THE MOON, EXPLORING MARS, WE HAVE ARTIFACTS THAT

981

00:55:41,840 --> 00:55:43,210

ARE NOT FUNCTIONING THEY ARE JUST THERE.

982

00:55:43,210 --> 00:55:47,770

THERE IS REALLY NO WAY TO.

983

00:55:47,770 --> 00:55:50,740

IF YOU THINK ABOUT IT WE ARE LEAVING A TRAIL OF WHERE TO GO

984

00:55:50,740 --> 00:55:51,740

OTHERWISE.

985

00:55:51,740 --> 00:55:52,740

DO WE BRING IT BACK HERE?

986

00:55:52,740 --> 00:55:56,380

DO WE HAVE ENOUGH FUEL TO SEND IT BACK TO EARTH:CAN WE SHOOT

987

00:55:56,380 --> 00:56:01,850

IT TO THE SUN THAT HAS BEEN,
BUT NUCLEAR WASTE INTO THE SUN

988

00:56:01,850 --> 00:56:06,700
BECAUSE THAT WOULD BE A WAY TO
DISPOSE OF IT.

989

00:56:06,700 --> 00:56:07,700
I SAY THAT SURREPTITIOUSLY.

990

00:56:07,700 --> 00:56:14,420
BUT I DON'T THINK THERE IS NOT
ANY WAY, EVENTUALLY OUR PROBES

991

00:56:14,420 --> 00:56:21,501
TO GO OUT DEEP INTO SPACE
BECOME SPACE JUNK WHEN THEY

992

00:56:21,501 --> 00:56:22,501
STOP FUNCTIONING.

993

00:56:22,501 --> 00:56:23,501
UNLESS, THERE IS ONE EXAMPLE.

994

00:56:23,501 --> 00:56:27,320
FOR INSTANCE WAS A GALILEO, I
BELIEVE.

995

00:56:27,320 --> 00:56:32,801
GALILEO WHICH WAS EXPLORING
JUPITER WAS SENT INTO THE

996

00:56:32,801 --> 00:56:34,770
ATMOSPHERE OF JUPITER AT THE
END OF ITS MISSION TO BE

997

00:56:34,770 --> 00:56:39,270
DESTROYED SO IT WOULDN'T
POTENTIALLY CONTAMINATE SOME OF

998

00:56:39,270 --> 00:56:40,510

JUPITER'S MOONS.

999

00:56:40,510 --> 00:56:43,520

SO SOMETIMES WE THINK AHEAD AND
TRY TO CLEAN UP AFTER

1000

00:56:43,520 --> 00:56:44,520

OURSELVES.

1001

00:56:44,520 --> 00:56:46,550

IF THERE IS A DANGER WE MIGHT
BE THREATENING OTHER

1002

00:56:46,550 --> 00:56:49,090

ECOSYSTEMS, EXTRA TERRESTRIAL
ECOSYSTEMS.

1003

00:56:49,090 --> 00:56:52,630

THAT IS AN EXAMPLE OF ONE TIME
WE HAVE DONE THAT.

1004

00:56:52,630 --> 00:56:54,860

>> WE ARE GOOD.

1005

00:56:54,860 --> 00:56:59,240

I THINK WE ARE, UNLESS WE HAVE
ANY QUESTIONS HERE FROM THE

1006

00:56:59,240 --> 00:57:00,870

AUDIENCE IN HOUSE.

1007

00:57:00,870 --> 00:57:03,070

ALL RIGHT, THANK YOU.

1008

00:57:03,070 --> 00:57:06,820

I THINK WE ARE AT THE END OF
OUR PROGRAM BUT I WANT TO THANK

1009

00:57:06,820 --> 00:57:09,360

OUR SPONSOR, THE BOEING
COMPANY.

1010

00:57:09,360 --> 00:57:14,050

I WANT TO THANK OUR AUDIENCES
ON NASA T.V., ONLINE, AND HERE

1011

00:57:14,050 --> 00:57:15,900

WITH US AROUND THE STAGE.