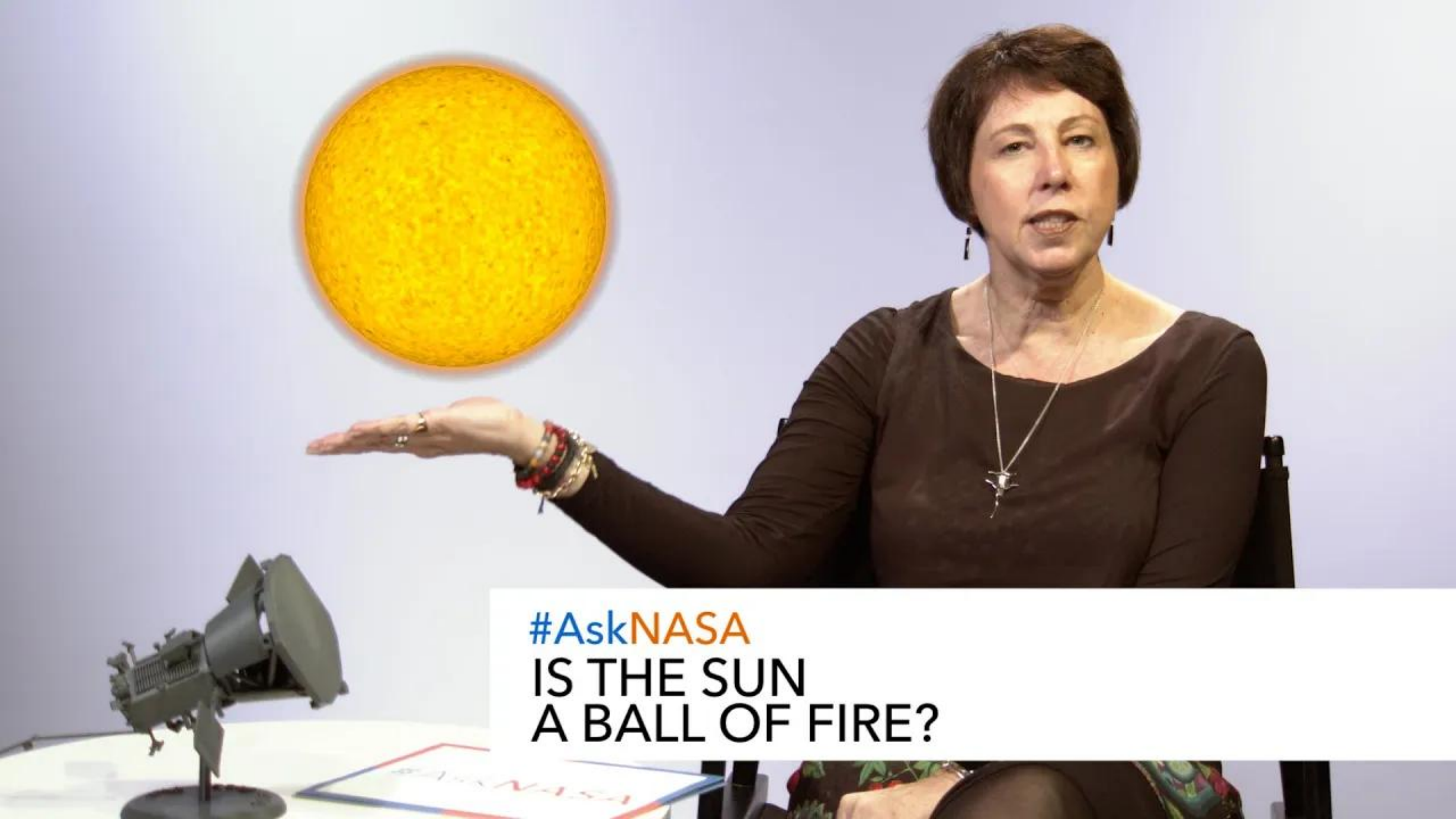
#AskNASA
IS THE SUN
A BALL OF FIRE?

1
00:00:00,333 --> 00:00:01,801
>> Hi, I'm Nicky Fox.

2
00:00:01,801 --> 00:00:02,936
And I'm in charge of all

3
00:00:02,936 --> 00:00:04,904
sun science here at NASA.

4
00:00:04,904 --> 00:00:06,272
Oh.

5
00:00:06,272 --> 00:00:07,741
This is "Ask NASA,"

6
00:00:07,741 --> 00:00:08,675
and I'm here to answer

7
00:00:08,675 --> 00:00:09,876
your questions.

8
00:00:16,149 --> 00:00:18,518
"Is the sun a ball of fire?"

9
00:00:18,518 --> 00:00:21,588
No, it's not.

10
00:00:21,588 --> 00:00:22,722
We know that the sun

11
00:00:22,722 --> 00:00:24,090
can't be a ball of fire,

12
00:00:24,090 --> 00:00:25,158
because we need oxygen

13
00:00:25,158 --> 00:00:26,826

to be able to have combustion

14
00:00:26,826 --> 00:00:29,229
and there's no oxygen in space.

15
00:00:29,229 --> 00:00:30,497
The sun, however,

16
00:00:30,497 --> 00:00:33,066
is a giant nuclear furnace.

17
00:00:33,066 --> 00:00:34,834
The core in the very center

18
00:00:34,834 --> 00:00:36,169
is very, very similar

19
00:00:36,169 --> 00:00:37,537
to a nuclear reactor.

20
00:00:37,537 --> 00:00:38,538
And all of the--

21
00:00:38,538 --> 00:00:39,406
these particles get

22
00:00:39,406 --> 00:00:41,040
squashed together and there's

23
00:00:41,040 --> 00:00:42,709
a huge amount of pressure.

24
00:00:42,709 --> 00:00:44,077
And they go--

25
00:00:44,077 --> 00:00:45,912
undergo chemical reactions.

26
00:00:45,912 --> 00:00:47,247
And so there are very different

27
00:00:47,247 --> 00:00:49,482
layers as you move out

28
00:00:49,482 --> 00:00:51,484
towards the edge of the sun.

29
00:00:51,484 --> 00:00:53,286
"Why does NASA send

30
00:00:53,286 --> 00:00:55,422
missions to the sun?"

31
00:00:55,422 --> 00:00:56,156
Because the sun

32
00:00:56,156 --> 00:00:57,791
is the most important thing

33
00:00:57,791 --> 00:00:59,459
in our solar system.

34
00:00:59,459 --> 00:01:01,461
The sun generates light

35
00:01:01,461 --> 00:01:02,462
but also a tremendous

36
00:01:02,462 --> 00:01:03,797
amount of energy.

37
00:01:03,797 --> 00:01:05,131
And it sends all of this

38
00:01:05,131 --> 00:01:07,834

material to us here on Earth,

39
00:01:07,834 --> 00:01:09,569
and so we live in the extended

40
00:01:09,569 --> 00:01:11,371
atmosphere of the sun.

41
00:01:11,371 --> 00:01:12,472
We've looked at the sun

42
00:01:12,472 --> 00:01:14,207
in every different wavelength.

43
00:01:14,207 --> 00:01:16,176
But recently, NASA launched

44
00:01:16,176 --> 00:01:17,777
the Parker Solar Probe

45
00:01:17,777 --> 00:01:19,412
which is a daring mission

46
00:01:19,412 --> 00:01:21,314
to go into the very atmosphere,

47
00:01:21,314 --> 00:01:22,582
the very heart

48
00:01:22,582 --> 00:01:24,150
of the atmosphere of the sun.

49
00:01:24,150 --> 00:01:25,418
So I have a model

50
00:01:25,418 --> 00:01:26,820
of the Parker Solar Probe

51
00:01:26,820 --> 00:01:28,188
spacecraft here.

52
00:01:28,188 --> 00:01:28,888
Can I get some sun

53
00:01:28,888 --> 00:01:30,790
in here, please?

54
00:01:30,790 --> 00:01:32,025
So the important thing

55
00:01:32,025 --> 00:01:33,460
is as the spacecraft

56
00:01:33,460 --> 00:01:35,795
moves around the sun,

57
00:01:35,795 --> 00:01:37,297
the heat shield has

58
00:01:37,297 --> 00:01:39,165
to remain pointed towards

59
00:01:39,165 --> 00:01:41,067
the sun at all times.

60
00:01:41,067 --> 00:01:42,101
So the heat shield--

61
00:01:42,101 --> 00:01:43,269
the front of the heat shield

62
00:01:43,269 --> 00:01:44,003
will get to about

63
00:01:44,003 --> 00:01:46,773

2,500 degrees Fahrenheit.

64
00:01:46,773 --> 00:01:47,607
But the main body

65
00:01:47,607 --> 00:01:49,175
of the spacecraft is nice

66
00:01:49,175 --> 00:01:50,210
and cool at about

67
00:01:50,210 --> 00:01:52,111
80 degrees Fahrenheit.

68
00:01:52,111 --> 00:01:53,780
Which is a bit like a balmy,

69
00:01:53,780 --> 00:01:55,448
Florida evening in August

70
00:01:55,448 --> 00:01:56,649
I guess!

71
00:01:56,649 --> 00:01:58,785
And that's Parker Solar Probe.

72
00:01:58,785 --> 00:01:59,452
Thank you!

73
00:02:02,288 --> 00:02:03,122
Good!

74
00:02:03,122 --> 00:02:04,057
[laughter]

75
00:02:04,057 --> 00:02:05,091
>> I love how polite you are!

76
00:02:05,091 --> 00:02:06,759
[laughter]

77
00:02:06,759 --> 00:02:07,727
>> So one of the things

78
00:02:07,727 --> 00:02:08,561
that we discovered

79
00:02:08,561 --> 00:02:09,696
with Parker Solar Probe

80
00:02:09,696 --> 00:02:11,364
on the very first orbit

81
00:02:11,364 --> 00:02:13,700
was switchbacks.

82
00:02:13,700 --> 00:02:14,834
Switchbacks...

83
00:02:14,834 --> 00:02:15,768
If only I had a model

84
00:02:15,768 --> 00:02:17,103
of The Corona.

85
00:02:17,103 --> 00:02:18,571
Oh, thank you!

86
00:02:18,571 --> 00:02:20,173
So, switchbacks are really

87
00:02:20,173 --> 00:02:22,909
reversals in the material

88
00:02:22,909 --> 00:02:24,811

coming from the sun.

89
00:02:24,811 --> 00:02:27,046
So the sun has a magnetic field

90
00:02:27,046 --> 00:02:28,248
and that is continually

91
00:02:28,248 --> 00:02:29,182
moving away--

92
00:02:29,182 --> 00:02:31,217
or so we thought, continually

93
00:02:31,217 --> 00:02:32,819
moving away from the sun.

94
00:02:32,819 --> 00:02:33,520
But what we found

95
00:02:33,520 --> 00:02:34,988
with Parker Solar Probe

96
00:02:34,988 --> 00:02:36,089
is this magnetic field

97
00:02:36,089 --> 00:02:36,823
actually kind of

98
00:02:36,823 --> 00:02:38,224
reverses on itself

99
00:02:38,224 --> 00:02:39,893
and makes an "S" shape.

100
00:02:39,893 --> 00:02:41,261
We call that a switchback.

101
00:02:41,261 --> 00:02:42,295
It's hard to twist

102
00:02:42,295 --> 00:02:43,363
a magnetic field,

103
00:02:43,363 --> 00:02:44,564
it's like trying to twist

104
00:02:44,564 --> 00:02:46,799
a rubber hose-- it's hard!

105
00:02:46,799 --> 00:02:48,134
And so, somehow there's

106
00:02:48,134 --> 00:02:49,936
this energy going into th--

107
00:02:49,936 --> 00:02:51,037
the magnetic field

108
00:02:51,037 --> 00:02:52,772
that's causing this "S" shape.

109
00:02:52,772 --> 00:02:54,040
And when it releases,

110
00:02:54,040 --> 00:02:55,542
it's letting all of this excess

111
00:02:55,542 --> 00:02:59,078
energy out into the solar wind.

112
00:02:59,078 --> 00:03:00,413
Thank you.

113
00:03:00,413 --> 00:03:02,015

Studying the sun is really

114
00:03:02,015 --> 00:03:03,650
important as we get ready

115
00:03:03,650 --> 00:03:05,585
to support the Artemis mission.

116
00:03:05,585 --> 00:03:06,586
We're really protected here

117
00:03:06,586 --> 00:03:07,487
on the planet by our

118
00:03:07,487 --> 00:03:08,922
magnetic field and all

119
00:03:08,922 --> 00:03:10,757
of that atmosphere around us.

120
00:03:10,757 --> 00:03:12,559
Our astronauts, when they--

121
00:03:12,559 --> 00:03:13,893
they will be on the moon.

122
00:03:13,893 --> 00:03:15,295
And of course, as we journey

123
00:03:15,295 --> 00:03:17,697
further to Mars and beyond,

124
00:03:17,697 --> 00:03:18,831
we'll be traveling through

125
00:03:18,831 --> 00:03:20,567
the solar wind and living

126
00:03:20,567 --> 00:03:22,168
really more in the atmosphere

127
00:03:22,168 --> 00:03:23,570
of the sun.

128
00:03:23,570 --> 00:03:25,705
And so it's key as we

129
00:03:25,705 --> 00:03:27,073
go forward to the moon,

130
00:03:27,073 --> 00:03:28,074
to Mars and beyond

131
00:03:28,074 --> 00:03:29,642
with our Artemis mission

132
00:03:29,642 --> 00:03:30,944
that we really understand

133
00:03:30,944 --> 00:03:32,145
the source of energy

134
00:03:32,145 --> 00:03:32,745
in the heart

135
00:03:32,745 --> 00:03:34,847
of our solar system.

136
00:03:34,847 --> 00:03:35,915
Parker Solar Probe

137
00:03:35,915 --> 00:03:38,151
on her final closest approach

138
00:03:38,151 --> 00:03:39,285

after she's done all

139
00:03:39,285 --> 00:03:40,787
of those Venus flybys,

140
00:03:40,787 --> 00:03:42,822
she will be about 3.9 million

141
00:03:42,822 --> 00:03:45,191
miles above the sun's surface.

142
00:03:45,191 --> 00:03:45,992
We have many materials

143
00:03:45,992 --> 00:03:47,260
on Parker Solar Probe

144
00:03:47,260 --> 00:03:48,661
that don't melt despite

145
00:03:48,661 --> 00:03:50,530
how close they are to the sun.

146
00:03:50,530 --> 00:03:51,464
In fact, that was one

147
00:03:51,464 --> 00:03:52,565
of the big technology

148
00:03:52,565 --> 00:03:54,300
challenges for us

149
00:03:54,300 --> 00:03:55,702
to find materials not only

150
00:03:55,702 --> 00:03:56,970
that don't melt,

151
00:03:56,970 --> 00:03:58,204
but can actually withstand

152
00:03:58,204 --> 00:03:59,238
the incredible change

153
00:03:59,238 --> 00:04:00,473
in temperature because

154
00:04:00,473 --> 00:04:01,741
Parker goes very close

155
00:04:01,741 --> 00:04:03,876
to the sun and then comes out

156
00:04:03,876 --> 00:04:05,545
around the orbit of Venus.

157
00:04:05,545 --> 00:04:06,646
Which means that all

158
00:04:06,646 --> 00:04:07,714
these materials go really

159
00:04:07,714 --> 00:04:09,749
hot and then really cold

160
00:04:09,749 --> 00:04:12,752
at least 24 times.

161
00:04:12,752 --> 00:04:13,620
So the critical thing

162
00:04:13,620 --> 00:04:14,487
for Parker Solar Probe,

163
00:04:14,487 --> 00:04:15,321

of course, is to keep

164
00:04:15,321 --> 00:04:16,322
that heat shield pointing

165
00:04:16,322 --> 00:04:17,457
at the sun.

166
00:04:17,457 --> 00:04:18,591
At some point,

167
00:04:18,591 --> 00:04:20,059
she will run out of fuel.

168
00:04:20,059 --> 00:04:21,594
At that point, unfortunately,

169
00:04:21,594 --> 00:04:22,895
she will start to turn.

170
00:04:22,895 --> 00:04:24,197
And the full illumination

171
00:04:24,197 --> 00:04:25,465
of the sun will hit parts

172
00:04:25,465 --> 00:04:26,966
of the spacecraft that are not

173
00:04:26,966 --> 00:04:28,968
designed to see the sun.

174
00:04:28,968 --> 00:04:29,736
And so she'll break up

175
00:04:29,736 --> 00:04:31,004
into large pieces,

176
00:04:31,004 --> 00:04:31,638
and then they will get

177
00:04:31,638 --> 00:04:33,506
gradually smaller and smaller

178
00:04:33,506 --> 00:04:35,308
until they become really tiny.

179
00:04:35,308 --> 00:04:36,009
And so I like to think

180
00:04:36,009 --> 00:04:37,243
that she will become part

181
00:04:37,243 --> 00:04:39,078
of the Corona, and she will

182
00:04:39,078 --> 00:04:40,913
orbit the sun forever.

183
00:04:40,913 --> 00:04:42,148
So honestly, we don't know

184
00:04:42,148 --> 00:04:42,915
what new science

185
00:04:42,915 --> 00:04:44,083
we're going to expect.

186
00:04:44,083 --> 00:04:44,884
We've already seen

187
00:04:44,884 --> 00:04:46,185
unbelievable stuff on

188
00:04:46,185 --> 00:04:48,121

our first couple of orbits.

189
00:04:48,121 --> 00:04:49,889
Science is a voyage

190
00:04:49,889 --> 00:04:50,923
of discovery.

191
00:04:50,923 --> 00:04:51,624
And that is what

192
00:04:51,624 --> 00:04:52,992
Parker Solar Probe is doing,

193
00:04:52,992 --> 00:04:54,594
she is going into a region

194
00:04:54,594 --> 00:04:56,162
where we've never been before.

195
00:04:56,162 --> 00:04:57,330
And so honestly?

196
00:04:57,330 --> 00:04:59,899
We expect the unexpected.

197
00:04:59,899 --> 00:05:01,401
My favorite aspect about

198
00:05:01,401 --> 00:05:03,970
the sun is it's a star.

199
00:05:03,970 --> 00:05:05,104
And it's a star that

200
00:05:05,104 --> 00:05:06,806
we can go and visit.

201
00:05:06,806 --> 00:05:07,674
And so you think, you know,

202
00:05:07,674 --> 00:05:09,042
you look up in the night sky,

203
00:05:09,042 --> 00:05:10,643
you see all of those stars

204
00:05:10,643 --> 00:05:12,078
and yet we're actually

205
00:05:12,078 --> 00:05:13,146
sending a spacecraft

206
00:05:13,146 --> 00:05:14,547
right into the atmosphere

207
00:05:14,547 --> 00:05:16,783
of a star right now.

208
00:05:16,783 --> 00:05:17,750
And that means we're going

209
00:05:17,750 --> 00:05:19,218
to understand more about

210
00:05:19,218 --> 00:05:22,388
other stars in our universe.

211
00:05:22,388 --> 00:05:24,590
And that's amazing.

212
00:05:24,590 --> 00:05:25,224
>> Do you have a question

213
00:05:25,224 --> 00:05:26,092

for NASA?

214
00:05:26,092 --> 00:05:26,926
Send your questions