
NASA


CASSINI-HUYGENS

1
00:00:00,200 --> 00:00:02,940
Hi, I'm Doctor E, Ellen Stofan

2
00:00:02,940 --> 00:00:05,420
and Dr. Z, Dr. Thomas Zurbuchen and I,

3
00:00:05,420 --> 00:00:07,808
would like to answer
some of your questions.

4
00:00:07,808 --> 00:00:10,308
(light music)

5
00:00:14,270 --> 00:00:17,870
Let's see, it says my
11-year-old space enthusiast

6
00:00:17,870 --> 00:00:20,600
wants to know what does
NASA want to accomplish

7
00:00:20,600 --> 00:00:21,433
on the Moon

8
00:00:21,433 --> 00:00:25,040
when humans return there
in the next few years.

9
00:00:25,040 --> 00:00:27,080
- I really wanna answer
that question in two parts.

10
00:00:27,080 --> 00:00:28,020
The first one is,

11
00:00:28,020 --> 00:00:31,470
we want to create the capability,
not only to go to the Moon

12
00:00:31,470 --> 00:00:32,770
but going to Mars.

13
00:00:32,770 --> 00:00:34,810
Those technologies,
together with the commercial

14
00:00:34,810 --> 00:00:37,140
and international partners
that we work with,

15
00:00:37,140 --> 00:00:40,690
will bring us there in a
way that we can turn around

16
00:00:40,690 --> 00:00:41,650
and move towards Mars.

17
00:00:41,650 --> 00:00:44,740
We've never done that and we
want to increase the sphere

18
00:00:44,740 --> 00:00:46,870
in which we can explore with humans.

19
00:00:46,870 --> 00:00:48,380
What an amazing thing.

20
00:00:48,380 --> 00:00:50,053
But there's a second part and that is

21
00:00:50,053 --> 00:00:52,860
that we want to do science and exploration

22
00:00:52,860 --> 00:00:54,500
of the surface of the Moon.

23
00:00:54,500 --> 00:00:57,240

There are interesting questions
that we wanna answer there

24
00:00:57,240 --> 00:00:59,030
about the age of the solar system,

25
00:00:59,030 --> 00:01:01,950
about the history of the
Earth and its bombardment

26
00:01:01,950 --> 00:01:04,450
and so forth early in the Earth's history.

27
00:01:04,450 --> 00:01:06,420
We want to learn about water

28
00:01:06,420 --> 00:01:08,700
and many of the questions about this body

29
00:01:08,700 --> 00:01:10,950
that is our neighbor there in space

30
00:01:10,950 --> 00:01:13,190
and those questions we wanna
answer with experiments

31
00:01:13,190 --> 00:01:15,400
that we're developing right now.

32
00:01:15,400 --> 00:01:16,950
Okay, I'll ask you a question.

33
00:01:16,950 --> 00:01:21,140
Did Mars or Venus host
ancient watery environments

34
00:01:21,140 --> 00:01:23,270
conducive to early life

35
00:01:23,270 --> 00:01:26,052
and is there evidence that life emerged?

36
00:01:26,052 --> 00:01:28,300
- You know that's one of the
things that has really driven

37
00:01:28,300 --> 00:01:30,570
some of our exploration
of those two bodies.

38
00:01:30,570 --> 00:01:33,000
For Mars, the answer is definitely yes.

39
00:01:33,000 --> 00:01:35,570
You know we've long known
that Mars has channels

40
00:01:35,570 --> 00:01:37,868
parted by water across its surface

41
00:01:37,868 --> 00:01:40,666
but all of our spacecraft
have helped us hone in

42
00:01:40,666 --> 00:01:44,780
on the fact that Mars probably
had surface liquid water

43
00:01:44,780 --> 00:01:46,260
as much as an ocean's worth

44
00:01:46,260 --> 00:01:48,840
from about 3.9 or so billion years ago

45
00:01:48,840 --> 00:01:51,430
to about 3.5 billion years.

46

00:01:51,430 --> 00:01:54,320
During that time, the conditions existed

47
00:01:54,320 --> 00:01:56,610
in which life could have arisen

48
00:01:56,610 --> 00:01:58,720
and we're still trying to figure out

49
00:01:58,720 --> 00:02:01,740
did life actually evolve on Mars or not?

50
00:02:01,740 --> 00:02:04,620
And with our next mission to Mars

51
00:02:04,620 --> 00:02:06,400
that's gonna be launched this summer,

52
00:02:06,400 --> 00:02:08,600
we're going to be looking
into that very question

53
00:02:08,600 --> 00:02:10,750
of can we find more evidence.

54
00:02:10,750 --> 00:02:14,040
Did something looking
towards life actually evolve

55
00:02:14,040 --> 00:02:15,530
on Mars or not?

56
00:02:15,530 --> 00:02:17,320
So we have a lot of questions about that.

57
00:02:17,320 --> 00:02:19,690
Venus is an actually interesting story

58

00:02:19,690 --> 00:02:22,060
because back in the early '80s,

59
00:02:22,060 --> 00:02:25,840
have a spacecraft that measured
the isotopes of hydrogen

60
00:02:25,840 --> 00:02:27,230
in the atmosphere of Venus

61
00:02:27,230 --> 00:02:30,600
which told us that Venus
probably early in its history,

62
00:02:30,600 --> 00:02:33,420
lost an ocean's worth of water.

63
00:02:33,420 --> 00:02:35,500
So it had a lot of water

64
00:02:35,500 --> 00:02:38,280
but as Venus evolved, it lost that water.

65
00:02:38,280 --> 00:02:40,920
Some models suggest that Venus indeed

66
00:02:40,920 --> 00:02:42,390
could have had an ocean

67
00:02:42,390 --> 00:02:44,890
but we wanna go back to
Venus and really measure

68
00:02:44,890 --> 00:02:46,810
the chemistry of the rocks on Venus

69
00:02:46,810 --> 00:02:49,830
because that's what's gonna
help us answer that question.

70
00:02:49,830 --> 00:02:52,130
- Talking about places
with potential life,

71
00:02:52,130 --> 00:02:54,520
let me ask one more question which is

72
00:02:54,520 --> 00:02:58,170
I'm interested if we ever
go and send a real probe

73
00:02:58,170 --> 00:03:00,770
to Europa to see if
there's really anything

74
00:03:00,770 --> 00:03:03,623
in that ocean under all that ice.

75
00:03:04,460 --> 00:03:05,470
- One of the things we wanna do

76
00:03:05,470 --> 00:03:07,360
with the Europa Clipper mission

77
00:03:07,360 --> 00:03:10,970
is actually go look at where
we think there are plumes

78
00:03:10,970 --> 00:03:14,630
of liquid that are erupting
from that subsurface ocean

79
00:03:14,630 --> 00:03:15,800
out into space

80
00:03:15,800 --> 00:03:18,270
and if we can analyze
some of those materials

81
00:03:18,270 --> 00:03:20,940
that are coming out of
the interior of Europa,

82
00:03:20,940 --> 00:03:23,880
well on the surface where
the material from those

83
00:03:23,880 --> 00:03:25,680
erupting plumes will fall,

84
00:03:25,680 --> 00:03:28,700
we're hoping that we can
understand more of the chemistry

85
00:03:28,700 --> 00:03:30,710
of that subsurface ocean.

86
00:03:30,710 --> 00:03:32,770
Eventually, obviously
what we would love to do,

87
00:03:32,770 --> 00:03:34,820
is land on the surface of Europa

88
00:03:34,820 --> 00:03:36,910
where we could make better measurements

89
00:03:36,910 --> 00:03:39,030
and try to understand could there be life

90
00:03:39,030 --> 00:03:40,970
in Europa's subsurface ocean

91
00:03:40,970 --> 00:03:43,500
and scientists and
technologists have even come up

92
00:03:43,500 --> 00:03:46,720
with concepts for spacecraft
that could land on the surface

93
00:03:46,720 --> 00:03:48,690
and maybe melt their way through the ice

94
00:03:48,690 --> 00:03:52,020
to go and explore that subsurface ocean,

95
00:03:52,020 --> 00:03:55,350
but those missions are
probably a couple decades out.

96
00:03:55,350 --> 00:03:57,410
This is a fun question for right now

97
00:03:57,410 --> 00:04:00,540
and in fact, I was just
thinking of doing this today.

98
00:04:00,540 --> 00:04:04,700
How would sourdough
starter thrive in space?

99
00:04:04,700 --> 00:04:06,070
Do you know that one?

100
00:04:06,070 --> 00:04:08,140
- I'm actually interested
what you came up with

101
00:04:08,140 --> 00:04:10,520
when you thought about that earlier today.

102
00:04:10,520 --> 00:04:11,500
- It's interesting because

103

00:04:11,500 --> 00:04:13,330
I've gone out to classrooms before

104
00:04:13,330 --> 00:04:15,470
and done an experiment with yeast

105
00:04:15,470 --> 00:04:18,270
to help kids understand the
idea of the different conditions

106
00:04:18,270 --> 00:04:21,020
on different planets can affect life.

107
00:04:21,020 --> 00:04:23,160
And so we've done an experiment where we

108
00:04:23,160 --> 00:04:25,460
put yeast in hot vinegar

109
00:04:25,460 --> 00:04:30,320
and we put yeast in ice
water that is super cold,

110
00:04:30,320 --> 00:04:33,740
we microwave it and then put in water.

111
00:04:33,740 --> 00:04:35,050
And it's amazing.

112
00:04:35,050 --> 00:04:36,930
Actually, the yeast still is active.

113
00:04:36,930 --> 00:04:39,780
All those harsh conditions
make it a little less active

114
00:04:39,780 --> 00:04:41,860
so it bubbles a little less

115
00:04:41,860 --> 00:04:46,550
but yeast actually only needs
sugar and moisture and warmth

116
00:04:46,550 --> 00:04:49,440
to start activity and so,

117
00:04:49,440 --> 00:04:51,420
it doesn't really need oxygen.

118
00:04:51,420 --> 00:04:53,713
So I thought that was
an interesting thing.

119
00:04:53,713 --> 00:04:55,320
I didn't realize it didn't need oxygen.

120
00:04:55,320 --> 00:04:57,170
I did think it needed oxygen.

121
00:04:57,170 --> 00:05:00,370
- You know what's amazing is
how general these principles

122
00:05:00,370 --> 00:05:02,250
are applicable throughout the universe

123
00:05:02,250 --> 00:05:04,770
and actually going on a space station line

124
00:05:04,770 --> 00:05:07,900
where of course the astronauts
have baked cookies out there

125
00:05:07,900 --> 00:05:10,990
is gonna one of those
exciting experiments.

126

00:05:10,990 --> 00:05:12,440
There's many others.

127
00:05:12,440 --> 00:05:13,370
- Thanks so much.

128
00:05:13,370 --> 00:05:14,700
This has been really fun

129
00:05:14,700 --> 00:05:17,470
and I can't wait to do our next episode