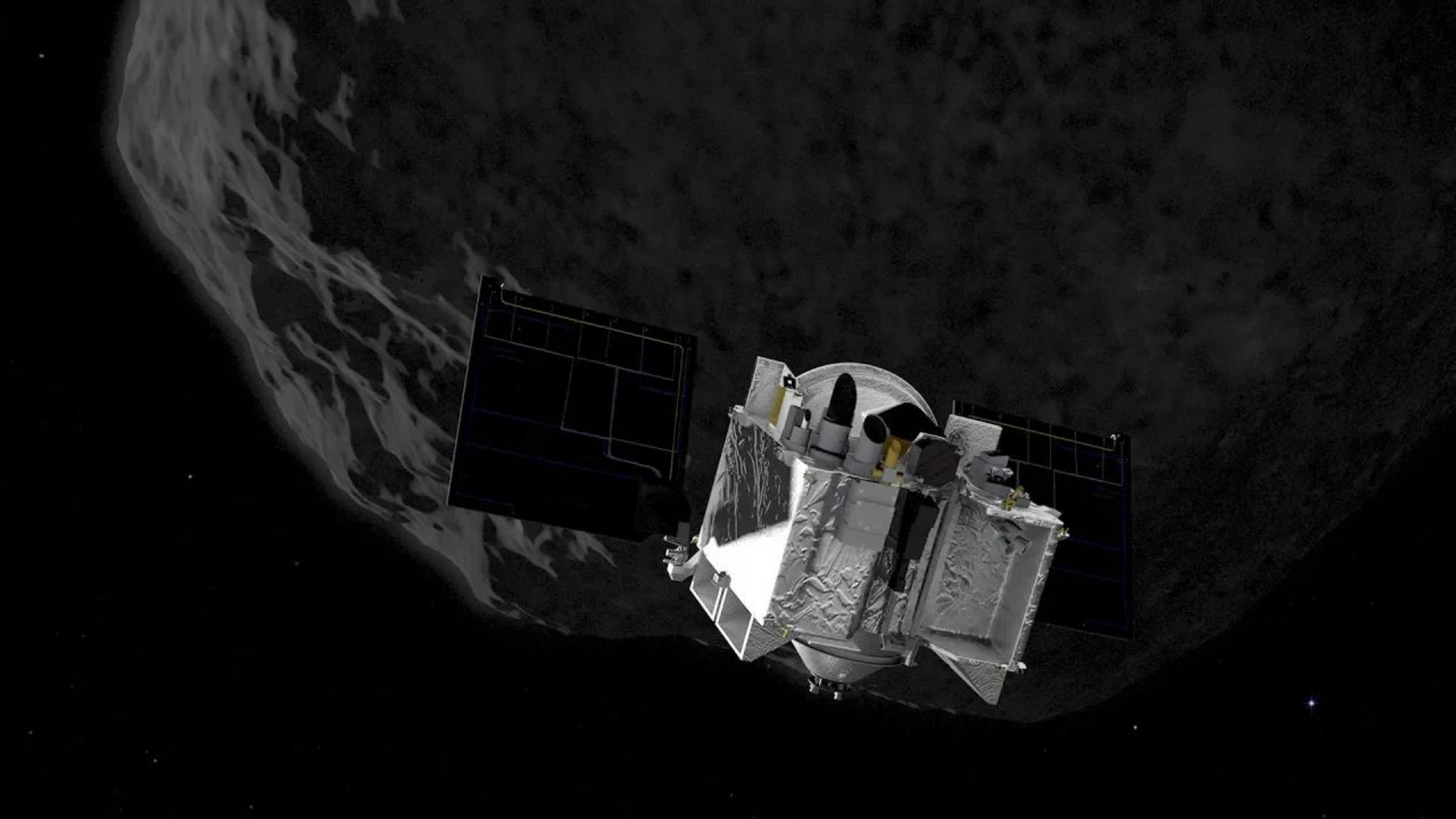

1
00:00:00,200 --> 00:00:04,938
[Music]

2
00:00:04,938 --> 00:00:07,841
There are many important
reasons for studying asteroids

3
00:00:07,841 --> 00:00:10,744
like the target of
OSIRIS-REx, asteroid Bennu.

4
00:00:10,744 --> 00:00:13,814
First and foremost, for me
especially, they're geologic

5
00:00:13,814 --> 00:00:16,116
remnants from the dawn
of our solar system.

6
00:00:16,116 --> 00:00:19,052
They're literally the first
material that formed around our

7
00:00:19,052 --> 00:00:22,890
star, and they represent the
building blocks of planets, and

8
00:00:22,890 --> 00:00:26,326
we hope, in the case of Bennu of
life, and the reason that Earth

9
00:00:26,326 --> 00:00:28,996
may be a habitable planet in
the form of delivering water and

10
00:00:28,996 --> 00:00:31,198
other important
volatile material.

11

00:00:31,198 --> 00:00:33,934
When we look at asteroids which
are these primitive objects,

12
00:00:33,934 --> 00:00:37,704
these little leftover pieces
from solar system formation, and

13
00:00:37,704 --> 00:00:40,707
we find they may have organics,
then that tells us perhaps the

14
00:00:40,707 --> 00:00:43,110
conditions for life could have
erupted anywhere in the solar

15
00:00:43,110 --> 00:00:45,312
system, and Earth
was just right.

16
00:00:45,312 --> 00:00:48,682
When we study meteorites, we
think they represent these

17
00:00:48,682 --> 00:00:51,385
asteroids and their different
histories, but they've all

18
00:00:51,385 --> 00:00:55,088
interacted with the Earth's
atmosphere, its biosphere, its

19
00:00:55,088 --> 00:00:57,758
hydrosphere, and so we
don't know what effect just

20
00:00:57,758 --> 00:01:01,061
interacting with the Earth
has had on these meteorites.

21

00:01:01,061 --> 00:01:05,032
We really want to get samples
that are pristine, and so we can

22
00:01:05,032 --> 00:01:07,601
do all of those things
through this mission.

23
00:01:07,601 --> 00:01:11,805
OSIRIS-REx is a mission in
the NASA New Frontiers Program.

24
00:01:11,805 --> 00:01:15,342
Our objective is to travel out
to a near-Earth asteroid named

25
00:01:15,342 --> 00:01:19,346
Bennu, survey that object in
great detail to understand its

26
00:01:19,346 --> 00:01:23,650
geology, its mineralogy and
composition, ultimately select a

27
00:01:23,650 --> 00:01:26,286
single location on the
asteroid's surface to acquire a

28
00:01:26,286 --> 00:01:29,423
sample, and return that material
back to the Earth for scientific

29
00:01:29,423 --> 00:01:30,857
analysis.

30
00:01:30,857 --> 00:01:33,961
Asteroid Bennu is a fragment
of the early solar system, an

31
00:01:33,961 --> 00:01:37,998

un-melted, unaltered piece of
the origin of the solar system.

32
00:01:37,998 --> 00:01:41,268
It preserves the ingredients,
the raw materials that went into

33
00:01:41,268 --> 00:01:44,237
the formation of
planets, the formation of life.

34
00:01:44,237 --> 00:01:47,441
By bringing a sample back to the
Earth, such as OSIRIS-REx will

35
00:01:47,441 --> 00:01:51,545
do with samples of Bennu in
2023, we'll be able to look at

36
00:01:51,545 --> 00:01:54,948
the samples in laboratories
around the world, to understand

37
00:01:54,948 --> 00:02:00,087
in great detail the nature of
the sample and its place in the

38
00:02:00,087 --> 00:02:01,922
origin of the solar system.

39
00:02:01,922 --> 00:02:04,891
The OSIRIS-REx spacecraft
launched in 2016, and it's

40
00:02:04,891 --> 00:02:08,762
actually taken us two years to
get to the asteroid Bennu, and

41
00:02:08,762 --> 00:02:10,497
in that time we

had an Earth flyby.

42
00:02:10,497 --> 00:02:14,334
So, we used an Earth flyby in
2017 to change the plane of our

43
00:02:14,334 --> 00:02:17,604
orbit to match Bennu's orbit
plane, and it's also provided a

44
00:02:17,604 --> 00:02:21,208
great opportunity from a flight
dynamics perspective to really

45
00:02:21,208 --> 00:02:24,411
calibrate our models and learn
how to fly the spacecraft which

46
00:02:24,411 --> 00:02:26,980
will help us in the really
challenging part of the mission,

47
00:02:26,980 --> 00:02:29,516
which is orbiting in the
low-gravity environment of the

48
00:02:29,516 --> 00:02:30,751
asteroid.

49
00:02:30,751 --> 00:02:32,919
Over the past few months, the
flight dynamics team has been

50
00:02:32,919 --> 00:02:35,689
getting images of the asteroid
Bennu, and it started out as

51
00:02:35,689 --> 00:02:38,892
just a very small point source
in the camera, and it's been

52
00:02:38,892 --> 00:02:41,561
getting bigger and bigger and
bigger in the field of view.

53
00:02:41,561 --> 00:02:45,232
And that's allowed us to perform
optical navigation, to refine

54
00:02:45,232 --> 00:02:49,236
our prediction of the asteroid's
orbit, and allow us to more

55
00:02:49,236 --> 00:02:53,040
precisely navigate and target
our approach to the asteroid.

56
00:02:53,040 --> 00:02:56,043
As OSIRIS-REx approaches the
asteroid, we've done a series of

57
00:02:56,043 --> 00:02:58,412
braking maneuvers called
Asteroid Approach Maneuvers to

58
00:02:58,412 --> 00:03:01,615
slow down the spacecraft, so
that we can get into orbit

59
00:03:01,615 --> 00:03:03,550
around the
asteroid later this year.

60
00:03:03,550 --> 00:03:06,887
We're also taking lots of images
of Bennu to understand its

61
00:03:06,887 --> 00:03:09,856
rotation, look for natural
satellites, and potential dust

62
00:03:09,856 --> 00:03:11,058
plumes.

63
00:03:11,058 --> 00:03:14,127
This is an extremely exciting
time on OSIRIS-REx as we're just

64
00:03:14,127 --> 00:03:16,029
poised at arrival at Bennu.

65
00:03:16,029 --> 00:03:18,799
And one of the most exciting
things to us, and relieving too

66
00:03:18,799 --> 00:03:22,269
to the engineers, is how closely
the asteroid has resembled what

67
00:03:22,269 --> 00:03:23,270
we had predicted.

68
00:03:23,270 --> 00:03:26,273
Early on our science team, prior
to launch, had come up with of a

69
00:03:26,273 --> 00:03:29,142
model of what they thought the
asteroid would look like, based

70
00:03:29,142 --> 00:03:32,712
purely on ground-based radar
observations from Arecibo, and

71
00:03:32,712 --> 00:03:36,349
from that they created a
reference asteroid that we used

72
00:03:36,349 --> 00:03:38,752

as the requirements to
design the mission against.

73
00:03:38,752 --> 00:03:41,054
But no one could be sure that
the asteroid would really look

74
00:03:41,054 --> 00:03:43,256
like the scientists had
predicted, so it's been a

75
00:03:43,256 --> 00:03:47,060
tremendous relief to us to find
that the actual Bennu is very

76
00:03:47,060 --> 00:03:49,563
similar to what the
scientists had predicted.

77
00:03:49,563 --> 00:03:51,264
So, the science
team really nailed it.

78
00:03:51,264 --> 00:03:54,367
Well right now as we're
approaching asteroid Bennu,

79
00:03:54,367 --> 00:03:57,771
we're looking for debris or
other objects that are orbiting

80
00:03:57,771 --> 00:04:00,373
the asteroid just in case
we need to avoid those.

81
00:04:00,373 --> 00:04:03,176
And then once we arrive on
December 3 we'll perform

82
00:04:03,176 --> 00:04:06,046

Preliminary Survey, and in
Preliminary Survey we fly over

83
00:04:06,046 --> 00:04:08,982
the north pole, south pole,
and the middle of the asteroid.

84
00:04:08,982 --> 00:04:11,985
This helps us to map the gravity
of the asteroid and understand

85
00:04:11,985 --> 00:04:14,421
how to operate near
such a small body.

86
00:04:14,421 --> 00:04:16,656
Additionally, this will be the
first time that we get close-up

87
00:04:16,656 --> 00:04:19,292
pictures of the surface, and
we'll know how smooth or rocky

88
00:04:19,292 --> 00:04:21,161
the surface that
we're going to study is.

89
00:04:21,161 --> 00:04:25,098
As we get closer to asteroid
Bennu, we'll begin to map its

90
00:04:25,098 --> 00:04:27,968
surface in higher detail.

91
00:04:27,968 --> 00:04:31,872
What we'll be able to do is
first identify the distribution

92
00:04:31,872 --> 00:04:36,176
of rocks and particles that

might pose a hazard to the

93
00:04:36,176 --> 00:04:39,479
sampling mechanism on the
spacecraft, and we'll also get a

94
00:04:39,479 --> 00:04:42,849
better sense of what the shape
of Bennu is like at smaller

95
00:04:42,849 --> 00:04:43,517
scales.

96
00:04:43,517 --> 00:04:46,820
Looking at Bennu in more and
more detail is going to help us

97
00:04:46,820 --> 00:04:50,524
identify all the areas that we
shouldn't go to grab a sample

98
00:04:50,524 --> 00:04:51,191
from.

99
00:04:51,191 --> 00:04:54,261
Throughout 2019 we'll be doing
global characterization of the

100
00:04:54,261 --> 00:04:57,797
asteroid, basically making
maps of the entire surface.

101
00:04:57,797 --> 00:05:00,100
We're interested
in its topography.

102
00:05:00,100 --> 00:05:01,034
Are there craters?

103

00:05:01,034 --> 00:05:03,703
Where are the boulders, the
valleys, the mountains of the

104
00:05:03,703 --> 00:05:04,371
asteroid?

105
00:05:04,371 --> 00:05:07,240
And then we want to understand
the distribution of geologic

106
00:05:07,240 --> 00:05:10,177
materials: are we finding
different patches of minerals in

107
00:05:10,177 --> 00:05:13,680
one location versus another, and
why are certain areas that have

108
00:05:13,680 --> 00:05:15,682
a composition and
others maybe different?

109
00:05:15,682 --> 00:05:19,085
We're going to be looking most
importantly for areas where we

110
00:05:19,085 --> 00:05:21,021
can collect a sample.

111
00:05:21,021 --> 00:05:24,424
OSIRIS-REx will collect a sample
from Bennu using our TAGSAM,

112
00:05:24,424 --> 00:05:27,594
which is the Touch And Go
Sample Acquisition Mechanism.

113
00:05:27,594 --> 00:05:30,697
What that is, is an arm

connected to this sampler head

114
00:05:30,697 --> 00:05:31,464
that you see here.

115
00:05:31,464 --> 00:05:34,968
This is similar in size to
an air filter from a car.

116
00:05:34,968 --> 00:05:38,238
How this mechanism works is
there's compressed gas that is

117
00:05:38,238 --> 00:05:41,174
released that will stir up the
regolith from Bennu, store it

118
00:05:41,174 --> 00:05:44,611
into this canister, which we
will then put inside of our

119
00:05:44,611 --> 00:05:47,080
sample release capsule
and bring back to Earth.

120
00:05:47,080 --> 00:05:50,617
We will collect the sample of
Bennu in 2020 and return it to

121
00:05:50,617 --> 00:05:51,751
Earth in 2023.

122
00:05:51,751 --> 00:05:55,889
Once we're in the vicinity
of our home world, about

123
00:05:55,889 --> 00:05:59,226
four-and-a-half hours
before impacting the top of the

124
00:05:59,226 --> 00:06:02,162
atmosphere, the spacecraft spins
up and releases that sample

125
00:06:02,162 --> 00:06:02,963
return capsule.

126
00:06:02,963 --> 00:06:06,867
The spacecraft fires its engines
to perform a deflection burn,

127
00:06:06,867 --> 00:06:09,936
going off into orbit around
the sun, and the return capsule

128
00:06:09,936 --> 00:06:13,173
enters the Earth's atmosphere,
targeting a landing in the Utah

129
00:06:13,173 --> 00:06:14,074
desert.

130
00:06:14,074 --> 00:06:17,344
I'll be there on site when we
open that capsule up and we see

131
00:06:17,344 --> 00:06:21,014
those samples for the first
time, and science begins at that

132
00:06:21,014 --> 00:06:23,984
point on the next phase of the
mission, the sample analysis

133
00:06:23,984 --> 00:06:24,985
period.