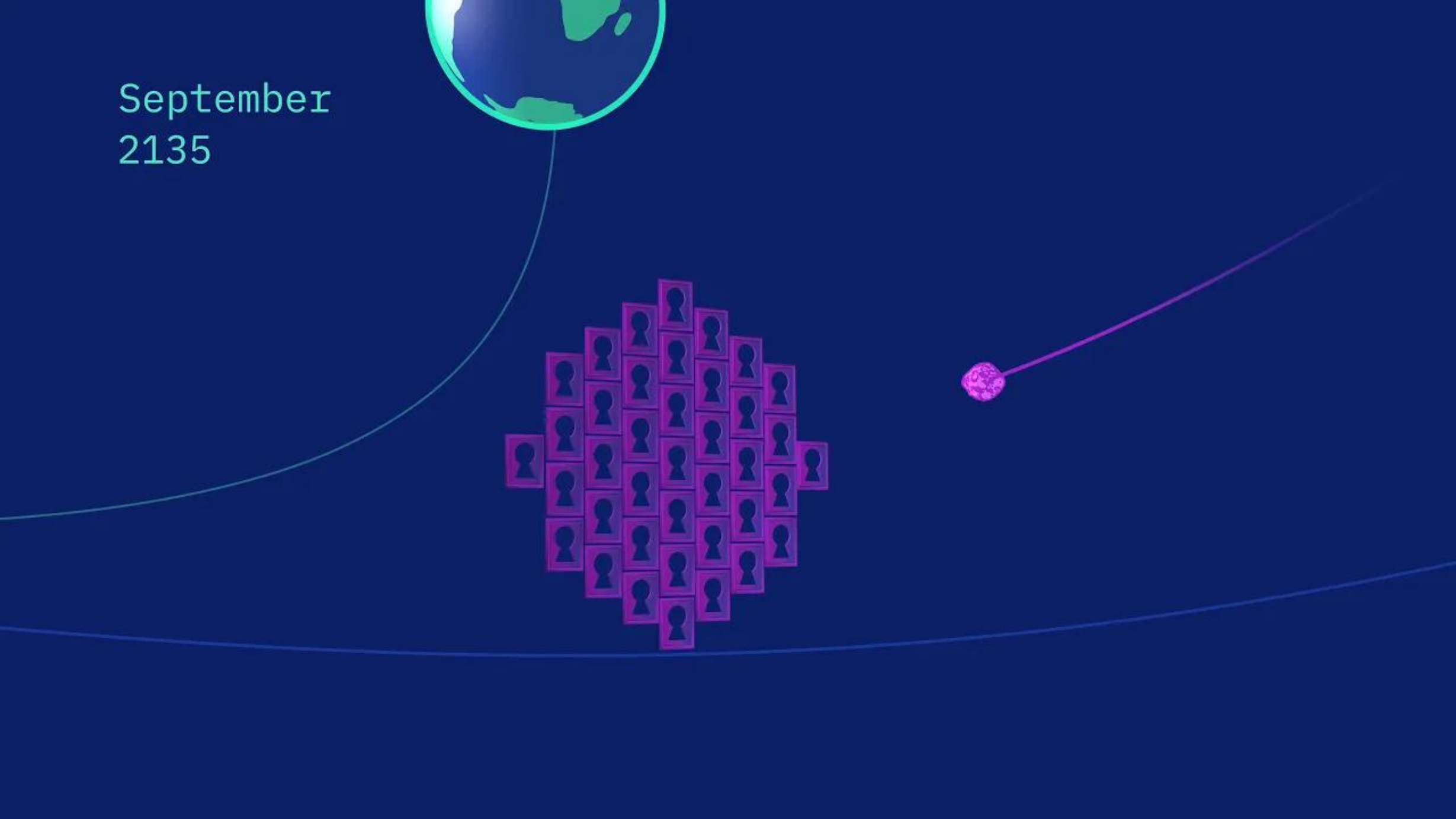
September
2135

1
00:00:00,083 --> 00:00:00,850
■■■

2
00:00:00,850 --> 00:00:04,954
In 2135, a potentially hazardous asteroid called Bennu

3
00:00:04,954 --> 00:00:07,073
will make a close flyby of Earth.

4
00:00:07,073 --> 00:00:10,694
During this encounter, our planet’s gravity will tweak Bennu’s path,

5
00:00:10,694 --> 00:00:13,630
making it a challenge to calculate its future trajectory

6
00:00:13,630 --> 00:00:17,534
and the odds of a potential impact late in the 22nd century.

7
00:00:17,534 --> 00:00:19,369
Why is this hard to determine?

8
00:00:19,369 --> 00:00:21,554
Well, we know how gravity works…

9
00:00:21,554 --> 00:00:24,040
but there are still uncertainties in Bennu’s trajectory

10
00:00:24,040 --> 00:00:26,659
that will be magnified by the close encounter.

11
00:00:26,659 --> 00:00:29,562
In addition to gravity, asteroids can be pushed around

12
00:00:29,562 --> 00:00:33,249
by non-gravitational forces like the Yarkovsky effect.

13
00:00:33,249 --> 00:00:37,303

When sunlight strikes a rotating asteroid, the dayside heats up.

14
00:00:37,303 --> 00:00:40,340
As the asteroid turns, the night side cools down

15
00:00:40,340 --> 00:00:41,875
and releases the heat.

16
00:00:41,875 --> 00:00:44,360
This exerts a small thrust on the asteroid,

17
00:00:44,360 --> 00:00:46,980
which can change its direction over time.

18
00:00:46,980 --> 00:00:49,866
The Yarkovsky effect is challenging to model, but it can make

19
00:00:49,866 --> 00:00:53,236
a big difference in determining where asteroids end up.

20
00:00:53,236 --> 00:00:56,056
Because we don’t know exactly how the Yarkovsky effect

21
00:00:56,056 --> 00:00:58,591
will perturb Bennu’s orbit, we have limited knowledge

22
00:00:58,591 --> 00:01:02,712
of where Bennu will be as it approaches Earth in 2135.

23
00:01:02,712 --> 00:01:06,733
Scientists thus have to consider a range of possible trajectories,

24
00:01:06,733 --> 00:01:10,603
depending on how strongly the Yarkovsky effect is pushing on Bennu.

25
00:01:10,603 --> 00:01:13,823
A few of these trajectories line up with regions of space

26
00:01:13,823 --> 00:01:16,493
called gravitational keyholes.

27
00:01:16,493 --> 00:01:18,711
If Bennu were to pass through a keyhole,

28
00:01:18,711 --> 00:01:21,965
Earth’s gravity would bend its path in just the right way

29
00:01:21,965 --> 00:01:24,284
to cause an impact on a subsequent orbit,

30
00:01:24,284 --> 00:01:26,553
late in the 22nd century.

31
00:01:26,553 --> 00:01:29,572
The odds of this actually happening are quite low,

32
00:01:29,572 --> 00:01:32,392
but scientists want to know as much as possible.

33
00:01:32,392 --> 00:01:35,845
That’s one reason why NASA sent the OSIRIS-REx spacecraft

34
00:01:35,845 --> 00:01:39,365
to study Bennu from 2018 to 2021.

35
00:01:39,365 --> 00:01:42,318
OSIRIS-REx greatly improved our knowledge of Bennu’s

36
00:01:42,318 --> 00:01:45,805
position, density, thermal inertia, and other properties

37
00:01:45,805 --> 00:01:49,209
that can influence how its orbit will evolve over time.

38
00:01:49,209 --> 00:01:51,995

The new data allowed scientists to significantly reduce

39
00:01:51,995 --> 00:01:54,414
uncertainties in Bennu’s predicted orbit,

40
00:01:54,414 --> 00:01:57,784
ruling out a number of keyholes for the 2135 flyby,

41
00:01:57,784 --> 00:02:01,221
and eliminating several future impact scenarios.

42
00:02:01,221 --> 00:02:04,390
While Bennu remains a hazardous asteroid, we can now make

43
00:02:04,390 --> 00:02:08,361
better models of its orbital evolution thanks to OSIRIS-REx.

44
00:02:08,361 --> 00:02:10,797
This will allow us – and our descendants –

45
00:02:10,797 --> 00:02:12,749
to better calculate Bennu’s risk