



**EUROPA**  
**OCEAN WORLD**

1  
00:00:11,900 --> 00:00:09,620  
the search for life beyond Earth begins

2  
00:00:15,080 --> 00:00:11,910  
with understanding life on our home

3  
00:00:16,010 --> 00:00:15,090  
planet and that story the story of life

4  
00:00:21,320 --> 00:00:16,020  
on Earth

5  
00:00:23,030 --> 00:00:21,330  
may have begun in our oceans and that's

6  
00:00:24,830 --> 00:00:23,040  
because of course if we've learned

7  
00:00:27,019 --> 00:00:24,840  
anything about life on Earth it's at

8  
00:00:32,910 --> 00:00:27,029  
where you find the liquid water you

9  
00:00:42,660 --> 00:00:37,080  
so what if I told you that there is an

10  
00:00:45,000 --> 00:00:42,670  
ocean out there beyond earth an ocean in

11  
00:00:47,850 --> 00:00:45,010  
our solar system that has been in

12  
00:00:50,970 --> 00:00:47,860  
existence for billions of years it's an

13  
00:00:53,939 --> 00:00:50,980

ocean that is perhaps ten times as deep

14

00:00:56,880 --> 00:00:53,949

as Earth's ocean it's an ocean that is

15

00:00:58,740 --> 00:00:56,890

global and may contain two to three

16

00:01:01,649 --> 00:00:58,750

times the volume of all the liquid water

17

00:01:04,740 --> 00:01:01,659

on the earth it's an ocean that exists

18

00:01:18,990 --> 00:01:04,750

beneath the icy shell of Jupiter's moon

19

00:01:21,779 --> 00:01:19,000

Europa so how do we think we know that

20

00:01:23,940 --> 00:01:21,789

Europa's ocean exists well it's a

21

00:01:26,880 --> 00:01:23,950

combination of using telescopes on the

22

00:01:29,999 --> 00:01:26,890

ground and having spacecraft that have

23

00:01:32,730 --> 00:01:30,009

flown by Europa and collected data about

24

00:01:34,859 --> 00:01:32,740

the surface about the interior structure

25

00:01:37,109 --> 00:01:34,869

and about the magnetic field around

26

00:01:38,940 --> 00:01:37,119

Europa and the combination of those data

27

00:01:41,670 --> 00:01:38,950

sets leads us to a high degree of

28

00:01:45,179 --> 00:01:41,680

confidence that this global liquid water

29

00:01:46,560 --> 00:01:45,189

h<sub>2</sub>o ocean is there today and it's been

30

00:01:50,130 --> 00:01:46,570

there for much of the history of the

31

00:01:55,030 --> 00:01:52,720

we used to think that in order for a

32

00:01:56,680 --> 00:01:55,040

world to be habitable you had to be just

33

00:01:58,960 --> 00:01:56,690

the right distance from the Sun or

34

00:02:01,540 --> 00:01:58,970

whatever your star was such that you

35

00:02:04,960 --> 00:02:01,550

could have a liquid water ocean on the

36

00:02:08,380 --> 00:02:04,970

surface now along with liquid water life

37

00:02:11,110 --> 00:02:08,390

as we know it needs two other key stones

38

00:02:13,840 --> 00:02:11,120

the first is the building blocks for

39

00:02:16,300 --> 00:02:13,850

life the stuff you find in rocks and the

40

00:02:20,080 --> 00:02:16,310

second is some form of energy to help

41

00:02:23,830 --> 00:02:20,090

power life and here's where Europa is a

42

00:02:26,650 --> 00:02:23,840

real gamechanger it is far far out from

43

00:02:29,530 --> 00:02:26,660

the Sun and yet it's got this liquid

44

00:02:31,510 --> 00:02:29,540

water ocean and the reason that Europa

45

00:02:34,300 --> 00:02:31,520

has liquid water is because it's

46

00:02:37,510 --> 00:02:34,310

orbiting Jupiter and the tidal tugging

47

00:02:40,360 --> 00:02:37,520

pull causes your OPA to flex up and down

48

00:02:41,949 --> 00:02:40,370

and all that tidal energy turns into

49

00:02:44,260 --> 00:02:41,959

mechanical energy which turns into

50

00:02:47,220 --> 00:02:44,270

friction and heat that helps maintain

51  
00:02:51,220 --> 00:02:47,230  
this liquid water ocean beneath

52  
00:02:53,890 --> 00:02:51,230  
nicshelle along with helping maintain

53  
00:02:57,850 --> 00:02:53,900  
liquid water we think that tidal energy

54  
00:03:00,910 --> 00:02:57,860  
may also allow that ocean to interact

55  
00:03:03,310 --> 00:03:00,920  
with rocks on Europa seafloor and it may

56  
00:03:05,470 --> 00:03:03,320  
even give rise to things like

57  
00:03:07,780 --> 00:03:05,480  
hydrothermal vents which could help

58  
00:03:15,100 --> 00:03:07,790  
provide not just the building blocks for

59  
00:03:20,650 --> 00:03:17,800  
the question of whether or not life

60  
00:03:23,890 --> 00:03:20,660  
exists beyond the question of whether or

61  
00:03:27,630 --> 00:03:23,900  
not biology works beyond our home planet

62  
00:03:31,090 --> 00:03:27,640  
is one of humanity's oldest and yet

63  
00:03:35,020 --> 00:03:31,100

unanswered questions and for the first

64

00:03:38,650 --> 00:03:35,030

time in the history of humanity we have

65

00:03:42,030 --> 00:03:38,660

the tools and technology and capability

66

00:03:46,150 --> 00:03:42,040

to potentially answer this question and