



THE INSANELY IMPORTANT WORLD OF  
**PHYTOPLANKTON**

1  
00:00:00,166 --> 00:00:01,301  
One phytoplankton cannot

2  
00:00:01,301 --> 00:00:04,904  
do too much, but so many of them  
actually control everything that we have:

3  
00:00:04,904 --> 00:00:07,307  
our food, our air that we breathe and our climate.

4  
00:00:07,307 --> 00:00:08,341  
They're so powerful.

5  
00:00:08,408 --> 00:00:11,578  
Phyto Phytters!  
[rock music throughout]

6  
00:00:11,578 --> 00:00:15,382  
Microscopic warriors  
fighting for the sea.

7  
00:00:15,382 --> 00:00:18,985  
These tiny titans, the Phyto  
Phytters are out to do battle on the seas.

8  
00:00:19,252 --> 00:00:21,721  
The evil Alexandrium  
was up to his old schemes.

9  
00:00:21,721 --> 00:00:26,593  
My saxitoxins will poison  
your precious shellfish.

10  
00:00:26,593 --> 00:00:28,862  
You're no match for Dinophysis!

11  
00:00:28,862 --> 00:00:31,531  
Dinophysis steals pigments from the Phyto Phytters,

12

00:00:31,531 --> 00:00:35,201

but Protoperidinium lights up the battle  
with its bioluminescence.

13

00:00:35,502 --> 00:00:37,337

Who will reign marine supreme?

14

00:00:37,370 --> 00:00:39,773

Go, Emiliania!

15

00:00:39,773 --> 00:00:43,243

Only the Phyto Phytors  
will decide the true fate of the seas.

16

00:00:43,443 --> 00:00:45,111

Each sold separately.

17

00:00:45,111 --> 00:00:47,514

They're just insanely important.

18

00:00:47,514 --> 00:00:49,582

I mean, there's many things  
that are important,

19

00:00:49,582 --> 00:00:51,317

but these are insanely important.

20

00:00:53,686 --> 00:00:56,289

Plankton generally doesn't really

21

00:00:56,289 --> 00:00:59,726

mean like a taxonomic group of things.

22

00:00:59,959 --> 00:01:02,896

We think about mammals and then plants.

23

00:01:03,263 --> 00:01:04,364

Plankton are not that.

24  
00:01:04,364 --> 00:01:07,067  
Plankton are really defined by the way they live.

25  
00:01:07,067 --> 00:01:09,669  
Plankton means the wanderer in Greek.

26  
00:01:09,803 --> 00:01:14,174  
And these are just oceanic organisms  
that really just don't swim that fast.

27  
00:01:14,207 --> 00:01:16,209  
They can't fight the ocean currents.

28  
00:01:16,209 --> 00:01:21,281  
It's a really nontraditional way  
of thinking about biology, in a sense.

29  
00:01:21,848 --> 00:01:24,250  
Plankton, we can define

30  
00:01:24,250 --> 00:01:25,452  
traditionally,

31  
00:01:25,452 --> 00:01:28,788  
in zooplankton, so something that is kind of more animal-like

32  
00:01:28,788 --> 00:01:31,758  
and phytoplankton, something that is more plant-like.

33  
00:01:31,758 --> 00:01:35,028  
All phytoplankton does a process  
we call photosynthesis.

34  
00:01:35,628 --> 00:01:39,466  
They take carbon dioxide and carbon  
in an organic form,

35

00:01:39,466 --> 00:01:42,302

capture some of the sunlight  
and then produce

36

00:01:42,302 --> 00:01:45,138

our carbohydrates  
or just simply said, sugars.

37

00:01:45,138 --> 00:01:48,675

They now are carrying that Sun energy  
and push it into

38

00:01:48,675 --> 00:01:50,343

the food system of the ocean.

39

00:01:50,343 --> 00:01:52,812

And while they're doing all that stuff,  
they also produce the oxygen.

40

00:01:52,812 --> 00:01:56,549

So opposite from us,  
we inhale oxygen, exhale carbon dioxide.

41

00:01:56,549 --> 00:01:59,285

So that's why they're really important.  
That's why we love them so much.

42

00:01:59,285 --> 00:02:03,623

And that's why they're like really crucial  
for the whole life on the Earth.

43

00:02:05,158 --> 00:02:09,162

Phytoplankton itself,  
its diversity is gigantic.

44

00:02:09,162 --> 00:02:13,566

I think there's like 10,000 species,  
and each of them has a specific role.

45

00:02:13,633 --> 00:02:16,936

Why is there so much diversity in something that is so teeny tiny?

46

00:02:16,936 --> 00:02:19,506

It's fantasy, science fiction, and horror comes together.

47

00:02:19,506 --> 00:02:21,875

I mean, it's just so beautiful.

48

00:02:25,945 --> 00:02:28,681

But there are certain type of phytoplankton, called coccolithophores,

49

00:02:28,681 --> 00:02:32,452

and specifically the most famous one is *Emiliana huxleyi*.

50

00:02:33,019 --> 00:02:36,856

But they take this inorganic carbon to make that something like

51

00:02:36,856 --> 00:02:38,825

like a shell, in which they live in.

52

00:02:39,225 --> 00:02:41,294

They're calcium carbonate which they make,

53

00:02:41,294 --> 00:02:42,629

which is pretty much chalk.

54

00:02:43,029 --> 00:02:45,598

They make it in a shape of these hubcaps.

55

00:02:45,632 --> 00:02:48,034

And if you think about how teeny tiny they are,

56

00:02:48,034 --> 00:02:49,068  
they're like, you know, I don't know.

57

00:02:49,068 --> 00:02:52,572  
I can put probably like 30 or 40  
or 50 of them in the width of my hair.

58

00:02:54,974 --> 00:02:57,177  
When they bloom, once they die,

59

00:02:57,177 --> 00:03:00,780  
not only they take that normal  
like sugar carbon that they produce,

60

00:03:00,780 --> 00:03:02,849  
but they also take the calcium carbonate,

61

00:03:02,849 --> 00:03:06,719  
that inorganic, that chalky material  
down to the bottom of the ocean.

62

00:03:06,719 --> 00:03:09,255  
So they're really, really good for exporting carbon,

63

00:03:09,956 --> 00:03:12,792  
removing it from this contact with the atmosphere,

64

00:03:12,792 --> 00:03:17,630  
which is really important when it comes  
to the flow of carbon in the whole Earth

65

00:03:17,630 --> 00:03:21,634  
ecosystem, but also control of  
the carbon in the atmosphere.

66

00:03:23,269 --> 00:03:26,306  
So Alexandrium is a very specific type  
of phytoplankton.

67

00:03:26,339 --> 00:03:27,974

It's called a dinoflagellate.

68

00:03:27,974 --> 00:03:29,042

So it's kind of like

69

00:03:29,042 --> 00:03:33,213

maybe plant, maybe zooplankton,  
maybe this animal, maybe can be both, no?

70

00:03:33,780 --> 00:03:38,117

But one thing that it does, it makes this  
very, very, very, very powerful toxin.

71

00:03:38,451 --> 00:03:41,154

They're causing problems in the Gulf of Maine.

72

00:03:41,955 --> 00:03:44,357

Alexandrium, you don't have to have a lot.

73

00:03:44,357 --> 00:03:48,962

Actually really low numbers of Alexandrium  
can be present and produce

74

00:03:48,962 --> 00:03:52,265

really detrimental effect on humanity

75

00:03:52,265 --> 00:03:54,901

that feeds on this shellfish.

76

00:03:56,803 --> 00:03:59,505

So the changes of the color of the ocean

77

00:03:59,505 --> 00:04:03,409

due to the presence of this phytoplankton  
are just so miniature, no?

78

00:04:03,409 --> 00:04:05,178

We cannot see it with our eyes,

79  
00:04:05,178 --> 00:04:10,516  
but if we have sensitive instruments,  
such as the Ocean Color Instrument on PACE,

80  
00:04:10,516 --> 00:04:13,152  
we're going to be able to differentiate  
not only because it's sensitive

81  
00:04:13,152 --> 00:04:16,089  
to the intensity,  
but it's also sensitive to the colors.

82  
00:04:16,756 --> 00:04:20,693  
Having this hyperspectral view with really high sensitivity

83  
00:04:20,693 --> 00:04:22,495  
is going to allow me to differentiate

84  
00:04:22,495 --> 00:04:24,330  
much, much more of the phytoplankton,

85  
00:04:24,330 --> 00:04:28,735  
because each of them--or at least each group--has its own optical patterns.

86  
00:04:28,968 --> 00:04:30,837  
It's an optical fingerprint.

87  
00:04:31,504 --> 00:04:32,605  
We're hoping that

88  
00:04:32,605 --> 00:04:35,775  
PACE, due to its capabilities, is going to be able

89  
00:04:36,009 --> 00:04:39,078  
to really focus  
on specific species of interest,

90

00:04:39,078 --> 00:04:41,648  
such as the harmful algal bloom species

91  
00:04:41,648 --> 00:04:45,585  
or species that are very beneficial  
for the growth of certain organisms.

92  
00:04:46,052 --> 00:04:48,054  
So the speciation is

93  
00:04:48,054 --> 00:04:52,392  
a function of the technical abilities  
that PACE has, but it's also